Mulga Rock Uranium Project

Conceptual Mine Closure Plan

Vimy Resources Limited

MRUP-EMP-031

November 2015

Document Number:	MRUP-EMP-031	**Mineral Field Number/s:**	39 (Mt Margaret)
Version Number:	A.1	**Tenement Number/s:**	M39/1080, M39/1081, E39/876, E39/877, E39/1148, E39/1149, E39/1150, E39/1551, L39/193, L39/219, P39/4878, P39/4880

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Document Status:

Rev.	Prepared	Reviewed	Approved	Date	Description
0	E Clerk	A Pratt	J Tapp	06.11.2015	Rev0

Prepared for Vimy Resources Limited by Golder Associates Pty Ltd

Mine Closure Plan Checklist (2015)

Please cross reference page numbers from the Mine Closure Plan where appropriate, and provide comments or reasons for No (N) or Not Applicable (NA) answers. For Mine Closure Plan revisions please indicate where updates have been made to the previous revision and a brief summary of the change.

Q No	Mine Closure Plan (MCP) checklist	Y/N/NA	Page No.	Comments	Changes from previous version (Y/N)	Page No.	Summary
1	Has the Checklist been endorsed by a senior representative within the tenement holder/operating company? (See bottom of checklist.)	Y	NA	Signed at the end of this Checklist	Y		
Public Availability							
2	Are you aware that from 2015 all MCPs will be made publicly available?	Y	NA	Indicated on this Checklist			
3	Is there any information in this MCP that should not be publicly available?	N	NA	There is no confidential information contained in this document			
4	If "Yes" to Q3, has confidential information been submitted in a separate document/section?	NA					
Cover Page, Table of Contents							
5	Does the MCP cover page include: • Project Title • Company Name • Contact Details (including telephone numbers and email addresses) • Document ID and version number • Date of submission (needs to match the date of this checklist)	Y	Cover page		Y	Cover page	Contact details updated
Scope and Purpose							
6	State why the MCP is submitted (e.g. as part of a Mining Proposal, a reviewed MCP or to fulfil other legal requirements)	Y	3	Public Environmental Review	N		
Project Overview							
7	Does the project summary include: • Land ownership details (include any land management agency responsible for the land / reserve and the purpose for which the land / reserve [including surrounding land] is being managed) • Location of the project; • Comprehensive site plan(s); • Background information on	Y	5 onwards		Y	13 onwards	Project description updates

Q No	Mine Closure Plan (MCP) checklist	Y/N/NA	Page No.	Comments	Changes from previous version (Y/N)	Page No.	Summary
	the history and status of the project.						
Legal Obligations and Commitments							
8	Does the MCP include a consolidated summary or register of closure obligations and commitments?	Y	16 and post checklist		Y	20	Commitment summary included
Stakeholder Engagement							
9	Have all stakeholders involved in closure been identified?	Y	22 onwards		N		
10	Does the MCP include a summary or register of historic stakeholder engagement with details on who has been consulted and the outcomes?	Y	23		Y	27	Outcomes have been consolidated
11	Does the MCP include a stakeholder consultation strategy to be implemented in the future?	Y	22 onwards		N		
Post-mining land use(s) and Closure Objectives							
12	Does the MCP include agreed post-mining land use(s), closure objectives and conceptual landform design diagram?	Y	24 onwards		Y	33 onwards	Refined closure objectives
13	Does the MCP identify all potential (or pre-existing) environmental legacies, which may restrict the post mining land use (including contaminated sites)?	N	NA	Greenfields site. Baseline investigations have been completed	N	NA	Greenfields site. Baseline investigations have been completed
14	Has any soil or groundwater contamination that occurred, or is suspected to have occurred, during the operation of the mine, been reported to DER as required under the Contaminated Sites Act 2003?	N	NA	Greenfields site. Baseline investigations have been completed	N	NA	Greenfields site. Baseline investigations have been completed
Development of Completion Criteria							
15	Does the MCP include an appropriate set of specific completion criteria and closure performance indicators?	Y	26 onwards		Y	35 onwards	Refined completion criteria
Collection and Analysis of Closure Data							
16	Does the MCP include baseline data (including pre-mining studies and environmental data)?	Y	30 onwards		Y	40 onwards	Baseline data updates
17	Has materials characterisation been carried out consistent with applicable standards and guidelines (e.g. GARD Guide)?	Y	38		Y	45	Baseline data updates
18	Does the MCP identify applicable closure learnings from benchmarking against other comparable mine sites?	N	56 onwards	The Plan is conceptual. Limited comparable sites are available with progressed rehabilitation.	Y	60 onwards	Refined closure issues assessment.

Q No	Mine Closure Plan (MCP) checklist	Y/N/NA	Page No.	Comments	Changes from previous version (Y/N)	Page No.	Summary
				Reference is made to studies and a commitment has been made to review rehabilitation works on nearby mine sites.			
19	Does the MCP identify all key issues impacting mine closure objectives and outcomes (including potential contamination impacts)?	Y	57 onwards		Y	60 onwards	Refined closure issues assessment.
20	Does the MCP include information relevant to mine closure for each domain or feature?	Y	10		Y	16	Refined closure domains
Identification and Management of Closure Issues							
21	Does the MCP include a gap analysis/risk assessment to determine if further information is required in relation to closure of each domain or feature?	Y	64 onwards		Y	60 onwards	Formal risk assessment included and refined issues assessment.
22	Does the MCP include the process, methodology, and has the rationale been provided to justify identification and management of the issues?	Y	56 onwards		Y	60 onwards	Formal risk assessment included and refined issues assessment.
Closure Implementation							
23	Does the MCP include a summary of closure implementation strategies and activities for the proposed operations or for the whole site?	Y	74 onwards		Y	85 onwards	Refined closure implementation strategies
24	Does the MCP include a closure work program for each domain or feature?	Y	74 onwards		Y	85 onwards	Refined closure implementation strategies
25	Does the MCP contain site layout plans to clearly show each type of disturbance as defined in Schedule 1 of the MRF Regulations?	Y	9		Y	15	Refined project layout
26	Does the MCP contain a schedule of research and trial activities?	Y	69		Y	55	Refined studies and trials
27	Does the MCP contain a schedule of progressive rehabilitation activities?	Y	97 onwards		Y	86 onwards	Refined schedule
28	Does the MCP include details of how unexpected closure and care and maintenance will be handled?	Y	101		N	88	
29	Does the MCP contain a schedule of decommissioning activities?	N		Decommissioning is addressed in the Radioactive	N		Decommissioning is addressed in the Radioactive

Q No	Mine Closure Plan (MCP) checklist	Y/N/NA	Page No.	Comments	Changes from previous version (Y/N)	Page No.	Summary
				Waste Management Plan. It will be further developed once the final design of the facility is known. It will be incorporated into this Plan			Waste Management Plan. It will be further developed once the final design of the facility is known. It will be incorporated into this Plan
30	Does the MCP contain a schedule of closure performance monitoring and maintenance activities?	Y	97 onwards		Y	86 onwards	Refined schedule
Closure Monitoring and Maintenance							
31	Does the MCP contain a framework, including methodology, quality control and remedial strategy for closure performance monitoring including post-closure monitoring and maintenance?	Y	108 onwards		Y	92	Refined monitoring and maintenance activities
Financial Provisioning for Closure							
32	Does the MCP include costing methodology, assumptions and financial provision to resource closure implementation and monitoring?	Y	111		Y	94	Refined method
33	Does the MCP include a process for regular review of the financial provision?	Y	111		N		
Management of Information and Data							
34	Does the MCP contain a description of management strategies including systems and processes for the retention of mine records?	Y	112		No	95	

Corporate Endorsement:

I hereby certify that to the best of my knowledge, the information within this Mine Closure Plan and checklist is true and correct and addresses all the requirements of the Guidelines for the Preparation of a Mine Closure Plan approved by the Director General of the Department of Mines and Petroleum.

Name: ________________________ **Signed: _______________________**

Position: ______________________ **Date: _________________________**

(NB: The corporate endorsement must be given by tenement holder(s) or a senior representative authorised by the tenement holder(s), such as a Registered Manager or Company Director)

Summary of Closure Commitments

Vimy Resources Limited commits to undertaking the following closure actions:

- Implement the Mine Closure Plan (MCP) throughout the life of mine (LOM).
- Review and update this conceptual MCP (CMCP) every three years (or at such time as specified in writing) and submit it to the DMP for review. Interim revisions will be undertaken to capture significant changes in mine closure planning.
- Commence the studies and trials presented in this CMCP within three years.
- Consult with and consider the interests of all relevant stakeholders during all stages of closure planning.
- Establish and refine rehabilitation objectives and completion criteria, based on the findings of monitoring and research, and appropriate to the agreed post-mine land use.
- Construct safe, stable, non-polluting landforms that are geomorphologically and functionally consistent with the surrounding landscape, capable of sustaining agreed post-operational land use, and do not impact on surrounding environmental values or uses.
- Develop indicators to demonstrate when rehabilitation activities meet the established objectives and completion criteria.
- Refine provisional completion criteria throughout the LOM. In addition, a measurement approach will be developed in accordance with these criteria, and presented within subsequent MCPs. Criteria will be assessed against regionally equivalent ecosystems.
- Progressive rehabilitation to meet agreed post-operational land use objectives and completion criteria.
- Backfill pits either fully (tailings or overburden) or partially to a level not less than 10m above the water table.
- Meeting the Department of Mines and Petroleum (DMP) DMP Environment Branch within 18 months of submitting this CMCP to discuss mine closure and attain agreement on suitable and achievable closure outcomes.
- Ensure adequate financial provisions will be available for closure, based on realistic estimations of closure costs.

Table of Contents

List of Figures

List of Tables

List of Plates

List of Appendices

List of Acronyms and Abbreviations

Acronym/ Abbreviation	Description
ABA	Acid Base Accounting
AFP	Albany Fraser Province
AHD	Australian Height Datum
ALARA	As Low as Reasonably Achievable
AMD	Acid and metalliferous drainage
ANC	Acid Neutralising Capacity
ANCOLD	Australian National Committee on Large Dams
ANZMEC	Australian and New Zealand Minerals and Energy Council
ARD	Acid Rock Drainage
ASLP	Australian Standard Leach Procedure
BOM	Bureau Of Meteorology
CMCP	Conceptual Mine Closure Plan
DEC	Department of Environment And Conservation (Western Australia)
DFAT	Department of Foreign Affairs and Trade
DFES	Department of Fire and Emergency Services (formerly the Fire and Emergency Services Authority) (Western Australia)
DITR	Department of Industry, Tourism and Resources
DME	Department of Minerals and Energy (Western Australia)
DMP	Department of Mines And Petroleum (Western Australia)
DoW	Department of Water (Western Australia)
DRF	Declared Rare Flora
EC	Electrical Conductivity
EMP	Environmental Management Plan
EP Act	Environmental Protection Act
EPA	Environmental Protection Authority (Western Australia)
EPBC Act	Environment Protection And Biodiversity Protection Act
ESA	Environmentally Sensitive Area
ESD	Environmental Scoping Document
ESP	Exchangeable Sodium Percentage
GDE	Groundwater Dependent Ecosystem
GVD	Great Victorian Desert
HCF	Hydraulic Conductivity Function
IBRA	Interim Biogeographic Regionalisation for Australia
LFA	Landform Function Analysis
LiDAR	Light Detection And Ranging
LOM	Life of Mine
MACA	Mining and Civil Australia
MCA	Minerals Council of Australia
MCP	Mine Closure Plan
MCPL	Mattiske Consulting Pty Ltd
MNES	Matters of National Environmental Significance

Acronym/ Abbreviation	Description
MPA	Maximum Potential Acidity
MRE	Mulga Rock East
MRF	Mining Rehabilitation Fund
MRUP	Mulga Rock Uranium Project
MRW	Mulga Rock West
Mtpa	Million Tonnes Per Annum
MW	Megawatt
NA	Not Applicable
NAF	Non Acid-Forming
NAG	Net Acid Generation
NAPP	Net Acid Producing Potential
OEPA	Office of Environmental Protection Authority
OL	Overburden Landform
PAF	Potentially Acid-Forming
PAW	Plant Available Water
PEC	Priority Ecological Communities
PER	Public Environmental Review
PKEF	Preliminary Key Environmental Factors
PNC	PNC Exploration (Australia) Pty Ltd
PRB	Permeable reactive barrier
RIP	Resin-in-pulp
ROM	Run Of Mine
RWMP	Radioactive Waste Management Plan
SA	South Australia
SandRE	Soil and Rock Engineering
SDU	Sodium diuranate
SLU	Soil-Landscape Units
SMM	Southern Marsupial Mole
SMU	Soil Mapping Units
SRE	Short Range Endemic
TDS	Total Dissolved Solids
TEC	Threatened Ecological Communities
TOC	Total Organic Carbon
TSF	Tailings Storage Facility
UCL	Unallocated Crown Land
UOC	Uranium oxide concentrate
WA	Western Australia

1. Scope and Purpose

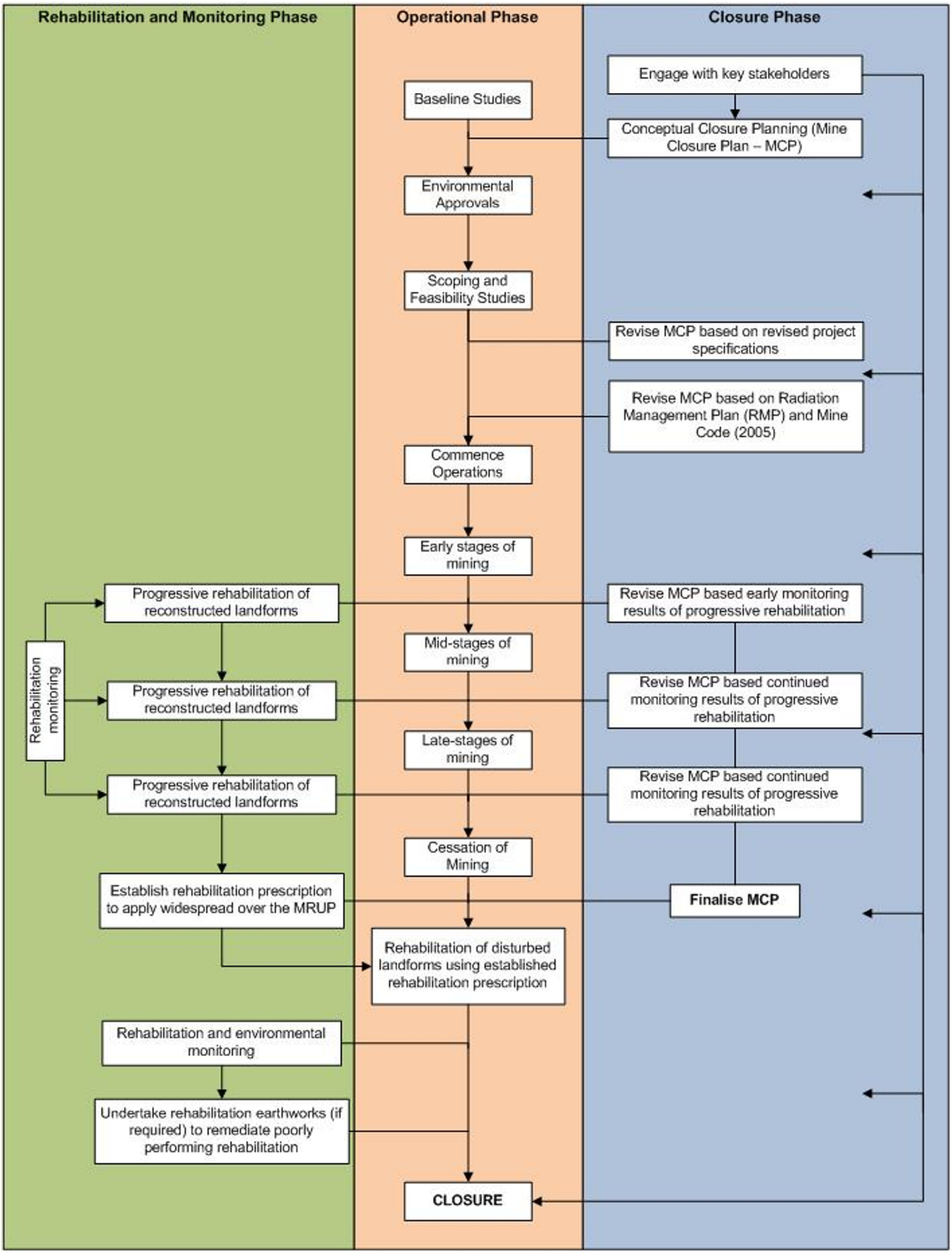
This Conceptual Mine Closure Plan (CMCP) was prepared as part of the Public Environmental Review (PER) for the proposed Mulga Rock Uranium Project (MRUP). As required by the approved Environmental Protection Authority (EPA) Environmental Scoping Document (ESD), this CMCP was prepared in accordance with the EPA/Department of Mines and Petroleum (DMP) Guidelines for Preparing Mine Closure Plans (EPA/DMP, 2015). This CMCP should be read in conjunction with the Radiation Management Plan (RMP) (MRUP-EMP-028) and the Radioactive Waste Management Plan (RWMP) (MRUP-EMP-029) to cover the radiological aspects of this Project and its closure.

Vimy Resources Limited (Vimy) recognises the importance of mine closure to the successful and sustainable operation of the MRUP, and that mine closure together with excellence in managing environmental responsibilities should be an integral part of mine development and operations. The purpose of the CMCP is to provide an initial planning and consultation tool to guide the Project direction in respect to closure outcomes and best practice technology goals during design and construction by:

- identifying those aspects relating to decommissioning and closure which may impact on the environment, health and safety, and may be of concern to regulatory agencies,
- providing a basis for consultation with regulators and identified stakeholders regarding the post-mining land uses of the Project area and the development of agreed completion criteria,
- assisting in the development of management strategies to be implemented as part of the Project's design, construction and operation to minimise impacts and site closure requirements,
- identifying closure costs to establish adequate financial provisions and
- providing details of the management strategies to be implemented by Vimy to the appropriate regulatory agencies to confirm completion criteria are met.

In accordance with Section 84AA of the *Mining Act 1978*, Vimy will implement a management strategy to review and update this CMCP every three years (or at such time as specified in writing) and submit it to the DMP for review. Interim revisions will be undertaken to capture significant changes in mine closure planning.

Figure 1.1 conceptually outlines Vimy's approach to mine closure plan development over the life of the MRUP.



CLIENT VIMY RESOURCES LIMITED			PROJECT MULGA ROCK URANIUM PROJECT
CONSULTANT Golder Associates	YYYY-MM-DD	2015-10-31	TITLE **MINE CLOSURE PLAN DEVELOPMENT**
	DESIGNED	MS	
	PREPARED	MS	
	REVIEWED	EWC	PROJECT NO. 1540340 · CONTROL H1 · REV. 0 · FIGURE 1.1
	APPROVED	EWC	

2. Project Summary

The Mulga Rock Uranium Project (MRUP or Project) is approximately 240km east-north-east of Kalgoorlie-Boulder in the Shire of Menzies (Figure 2.1). The area is remote, located on the western flank of the Great Victoria Desert, comprising series of large, generally parallel sand dunes, with inter-dunal swales and broad flat plains. Access to the Project area is limited and is only possible using four-wheel-drive vehicles.

The nearest residential town to the Project is Laverton which lies approximately 200km to the north-west. Other regional residential communities include Pinjin Station homestead located approximately 100km to the west, Coonana Aboriginal community situated approximately 130km to the south-south-west, Kanandah Station homestead positioned approximately 150km to the south-east and the Tropicana Gold Mine lying approximately 110km to the north-east of the Project. The nearest pastoral stations are:

- Kanandah – 150km southeast
- Pinjin – 100km west
- Coonana – 130km

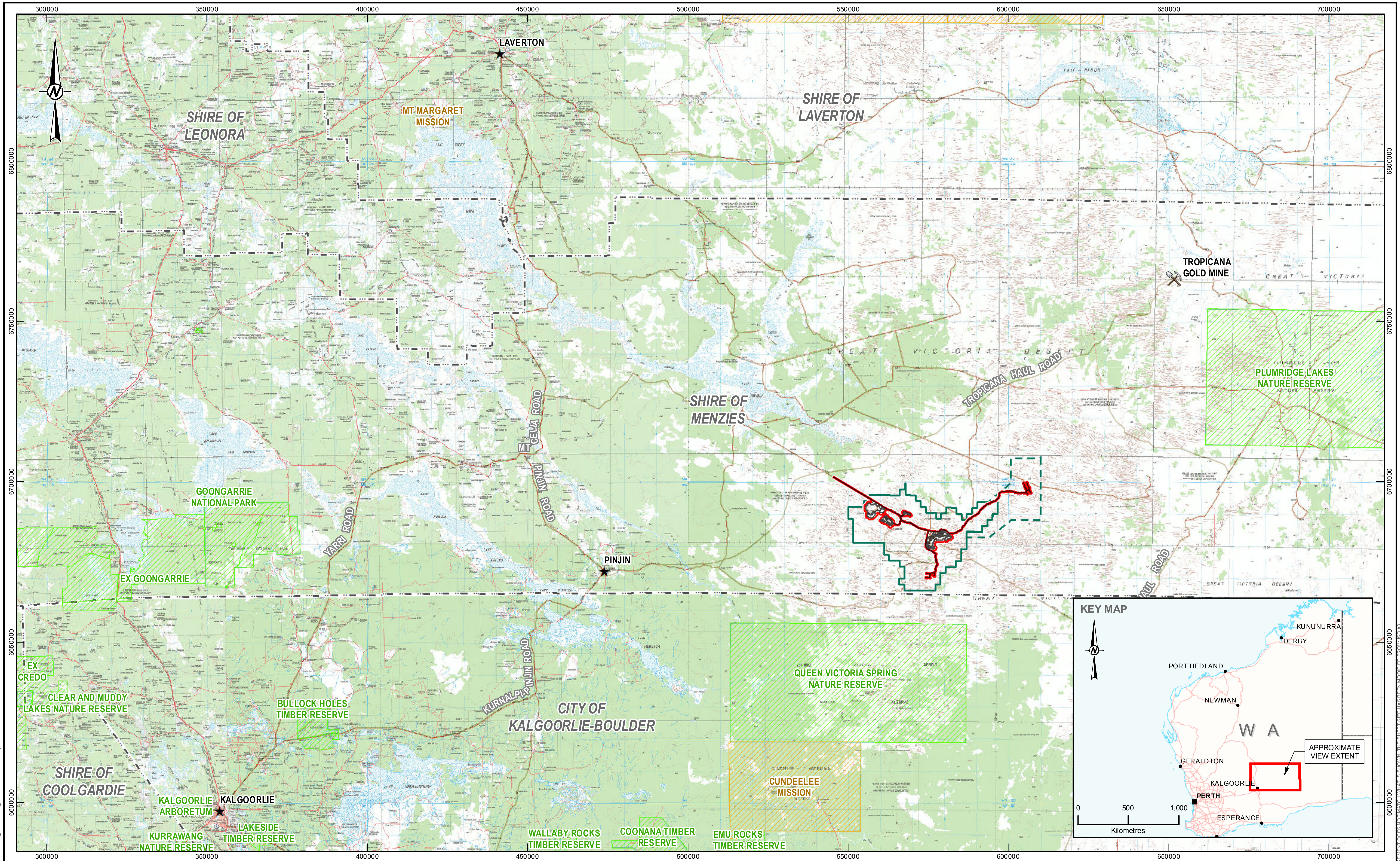
Tropicana Gold Mine is located 110km to the north-east of the MRUP.

The MRUP covers approximately 102,000ha on granted mining tenure (primarily M39/1080 and M39/1081) within Unallocated Crown Land (UCL). It includes two distinct mining centres, Mulga Rock East (MRE) comprising the Princess and Ambassador resources and Mulga Rock West (MRW) comprising the Emperor and Shogun resources (Figure 2.2). MRE contains over 65% of the total recoverable uranium and is of a higher grade than MRW. Mining will commence at MRE which will include the location of the processing plant.

Up to 4.5 million tonnes per annum (Mtpa) of ore will be mined using traditional open cut techniques, crushed, beneficiated and then processed at an acid leach and precipitation treatment plant to produce, on average, 1,360 tonnes of uranium oxide concentrate (UOC) per year over the life of the Project. The anticipated life of mine (LOM) is up to 16 years, based on the currently identified resource. The UOC product will be sealed in drums and transported by road from the mine site in sealed sea-containers to a suitable port (expected to be Port Adelaide) which is approved to receive and ship Class 7 materials for export.

Other metal concentrates will be extracted using sulfide precipitation after the uranium has been removed and sold separately. These metal concentrates will not be classified as radioactive.

The MRUP will require the clearing of vegetation, borefield abstraction, mine dewatering and reinjection, the creation of above ground and in-pit overburden (non-mineralised) and tailings landforms and the construction of onsite processing facilities and associated infrastructure. Key Project infrastructure will include mine administration and workshop facilities, fuel and chemical storage depots, a diesel or gas-fired power plant of up to 20MW capacity and distribution network, a saline abstraction borefield and a saline mine water reinjection borefield with associated pipelines and power supply units, an accommodation village servicing a fly-in / fly-out workforce, an airstrip, laydown areas and other supporting ancillary infrastructure including communications systems, roads, a waste water treatment plant and solid waste landfill facilities. Transport to site for consumables, bulk materials and general supply items will be via existing public road systems linked to dedicated Project site roads, branching off the Tropicana Gold Mine access road.



LEGEND

- TROPICANA GOLD MINE
- TOWN
- ROAD
- INFRASTRUCTURE
- MRUP DEVELOPMENT ENVELOPE
- PROJECT BOUNDARY (MINING TENURE)
- PROJECT BOUNDARY (MISCELLANEOUS TENURE)
- CONSERVATION RESERVE
- ABORIGINAL LAND TRUST ESTATE
- LOCAL GOVERNMENT AUTHORITY (LGA) BOUNDARY

NOTES

1. COORDINATE SYSTEM: GDA 1994 MGA ZONE 51

REFERENCE

INFRASTRUCTURE DATA PROVIDED BY CLIENT
BASE DATA © WESTERN AUSTRALIAN LAND INFORMATION AUTHORITY TRADING AS LANDGATE (2015)
IMAGE SOURCED FROM GEOSCIENCE AUSTRALIA 250K TOPO
INSET BASE DATA/ROADS SOURCED FROM STREET PRO DATA 2009

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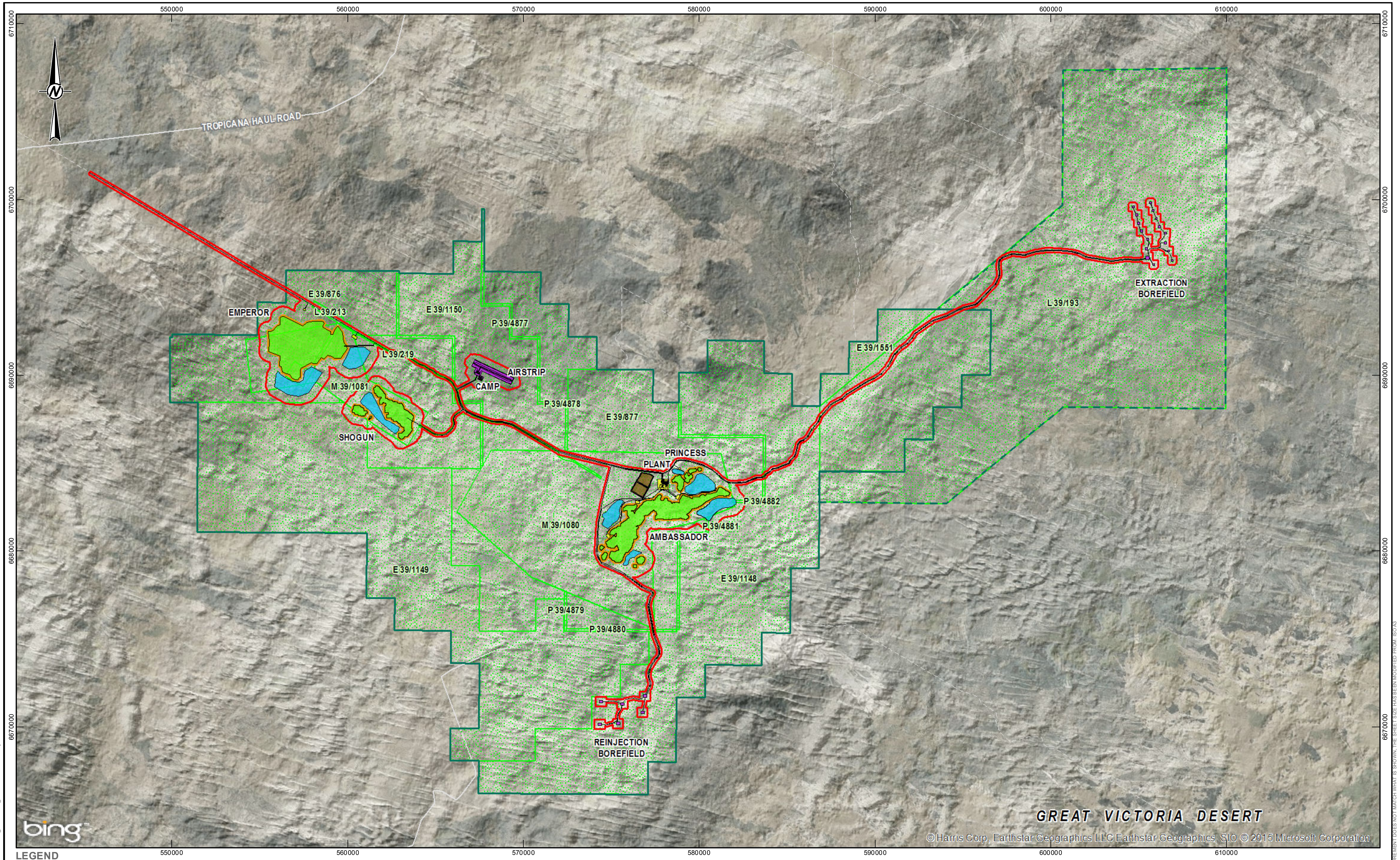
CLIENT	VIMY RESOURCES LIMITED
CONSULTANT	Golder Associates
YYYY-MM-DD	2015-10-29
DESIGNED	MS
PREPARED	MS
REVIEWED	EWC
APPROVED	EWC
PROJECT	MULGA ROCK URANIUM PROJECT
TITLE	REGIONAL LOCATION
PROJECT NO.	1540340
CONTROL	H1
REV.	0
FIGURE	2.1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A3

25mm



LEGEND

- MINOR ROAD/TRACK
- ROAD
- MRUP DEVELOPMENT ENVELOPE
- PROJECT BOUNDARY (MINING TENURE)
- PROJECT BOUNDARY (MISCELLANEOUS TENURE)
- PROJECT TENEMENT
- PIT
- OVERBURDEN LANDFORM
- PROCESSING INFRASTRUCTURE
- ABOVE GROUND TSF
- SUPPORTING INFRASTRUCTURE
- PIT CLEARING (50 m BUFFER)

NOTES

1. COORDINATE SYSTEM: GDA 1994 MGA ZONE 51

REFERENCE

INFRASTRUCTURE DATA PROVIDED BY CLIENT
TENEMENTS BOUNDARY © DEPARTMENT OF MINES AND PETROLEUM
AERIAL IMAGERY SOURCED FROM ESRI ONLINE
TOPOGRAPHY BASED ON NATIONAL DEM 1 S SOURCED FROM GEOSCIENCE AUSTRALIA

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CLIENT
VIMY RESOURCES LIMITED

VIMY RESOURCES

CONSULTANT
Golder Associates

YYYY-MM-DD	2015-10-29
DESIGNED	MS
PREPARED	MS
REVIEWED	EWC
APPROVED	EWC

PROJECT
MULGA ROCK URANIUM PROJECT

TITLE
PROJECT TENURE AND DEVELOPMENT ENVELOPE

PROJECT NO.	CONTROL	REV.	FIGURE
1540340	H1	0	2.2

2.1 Mining

The Project comprises two distinct mining centres, Mulga Rock East (MRE) and Mulga Rock West (MRW), which are approximately 20km apart. Mining will commence at MRE which will include the location of the plant.

The MRUP will be mined using open cut mining techniques, and their locations are shown in Figure 2.3. Due to the large lateral extent and horizontal geometry, the deposit lends itself to strip mining techniques using truck and excavator, and dozer trap mining techniques.

2.2 Processing

2.2.1 Beneficiation Plant

Run of mine (ROM) ore feed is initially crushed and then conveyed from the pit to a modularised beneficiation plant which is comprised of a series of cyclones (similar to that used in mineral sands) to separate the materials according to grain size. The heavy coarse grained sands and gravels are generally non mineralised and the removal of this material results in a concentration of the plant feed (light carbonaceous material). The beneficiated slurry is then pumped to the mill at the main process plant. The waste sand fraction from the cyclones is pumped to the pit void, where it is dewatered and stacked as back fill in the base of the pit (AMEC Foster Wheeler 2015).

2.2.2 Main Process Plant

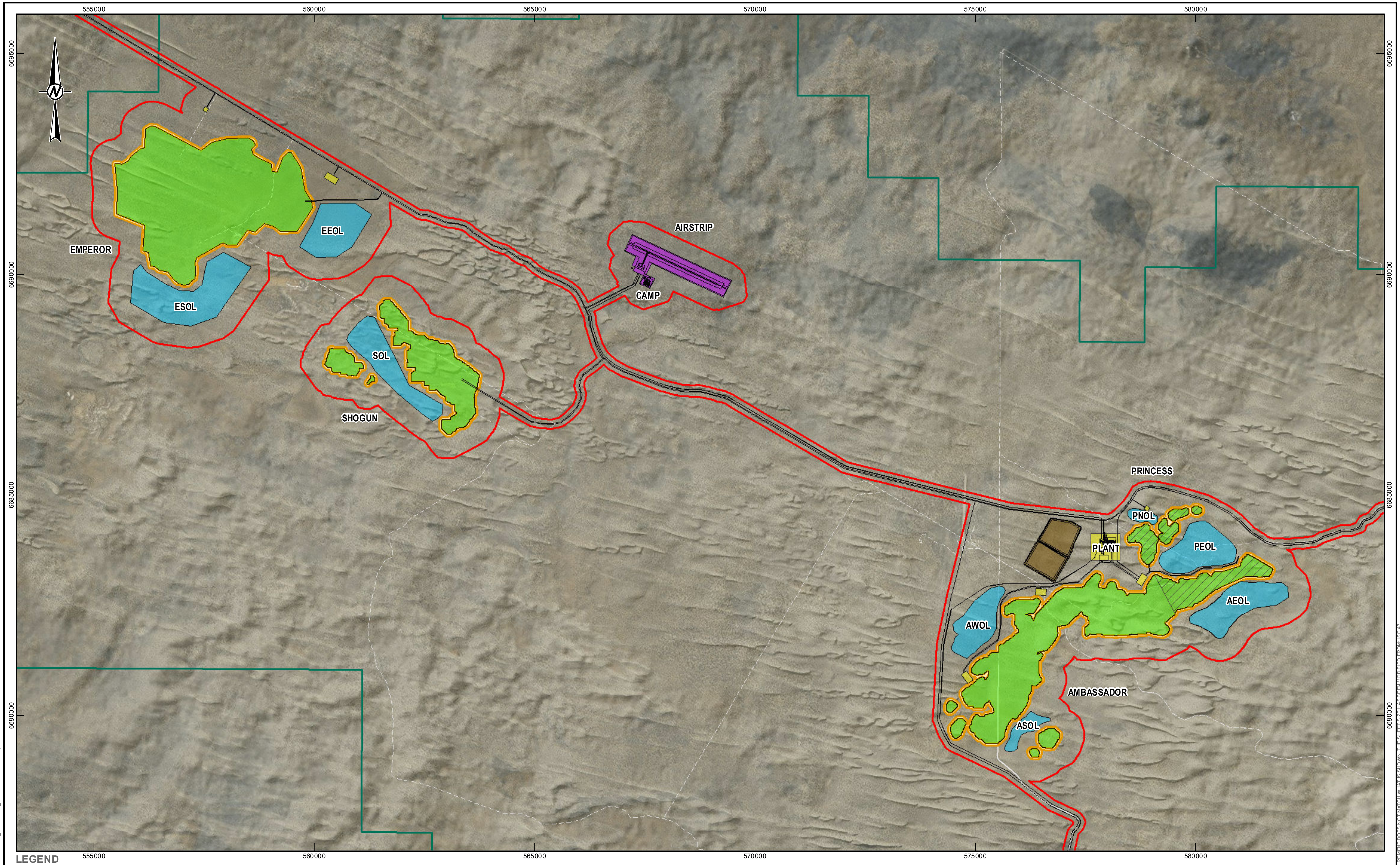
MRUP uranium mineralisation is unique in that it is either present as adsorbed uranium onto the surface of the carbonaceous material in its oxidised form, or as ultra-fine (nanometre scale) uraninite grains (UO_2). This means acid can be used to simply desorb the uranium from the carbonaceous ore before resin beads are used to selectively extract uranium from solution.

The main process plant will receive beneficiated ore from the mine and then grind this feed to 80% passing a size of 150µm using a mill circuit. The milled ore is then leached for 4 hours at 40ºC using sulfuric acid at an addition of 30kg acid per tonne of leach feed. Uranium is typically leached within 1-2 hours and shows very fast kinetics.

The leach discharge is then pumped to a resin-in-pulp (RIP) circuit where the slurry is contacted with an ion-exchange resin to recover the uranium present in solution. The RIP circuit has eight contact stages and is analogous to a gold carbon-in-pulp circuit except resin is used instead of activated carbon.

Uranium-loaded resin is then recovered and uranium stripped from the resin using a sodium chloride solution. The strip solution, which now contains the uranium, is further concentrated and then precipitated using concentrated caustic to generate a sodium diuranate (SDU) precipitate. The SDU precipitate is then re-dissolved using sulfuric acid and precipitated from solution using hydrogen peroxide to generate a final uranyl peroxide or "yellowcake" product. The final uranium product is washed, filtered, dried and packaged in steel drums ready for transport.

The slurry from the uranium RIP circuit has no recoverable uranium remaining but is further processed to recover the base metals still in solution. The uranium-barren leach solution is recovered using a counter current decantation circuit. The solution is neutralised to pH ~4.0 using lime. A gypsum precipitate containing iron, aluminium and other impurities is removed and sent to tails. The purified base metal solution is then contacted with sodium sulfide to produce separate copper-zinc and nickel-cobalt mixed sulphide precipitates. These products are thickened, filtered, washed and packaged in to 2 tonne bulk bags for final sale (AMEC Foster Wheeler 2015).



LEGEND

	MINOR ROAD/TRACK		IN-PIT TSF
	ROAD		PIT
	MRUP DEVELOPMENT ENVELOPE		OVERBURDEN LANDFORM
	PROJECT BOUNDARY (MINING TENURE)		PROCESSING INFRASTRUCTURE
	PROJECT BOUNDARY (MISCELLANEOUS TENURE)		ABOVE GROUND TSF
	PIT CLEARING (50 m BUFFER)		SUPPORTING INFRASTRUCTURE

NOTES

1. COORDINATE SYSTEM: GDA 1994 MGA ZONE 51

REFERENCE

INFRASTRUCTURE DATA PROVIDED BY CLIENT
AERIAL IMAGERY SOURCED FROM ESRI ONLINE
TOPOGRAPHY BASED ON NATIONAL DEM 1 S SOURCED FROM GEOSCIENCE AUSTRALIA

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1:80,000 KILOMETRES

CLIENT
VIMY RESOURCES LIMITED

VIMY RESOURCES

CONSULTANT

Golder Associates

YYYY-MM-DD	2015-10-29
DESIGNED	MS
PREPARED	MS
REVIEWED	EWC
APPROVED	EWC

PROJECT
MULGA ROCK URANIUM PROJECT

TITLE
CONCEPTUAL PROJECT LAYOUT PLAN

PROJECT NO.	CONTROL	REV.	FIGURE
1540340	H1	0	**2.3**

25mm

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A3

2.3 Closure Domains

The MRUP will consist of the following closure domains:

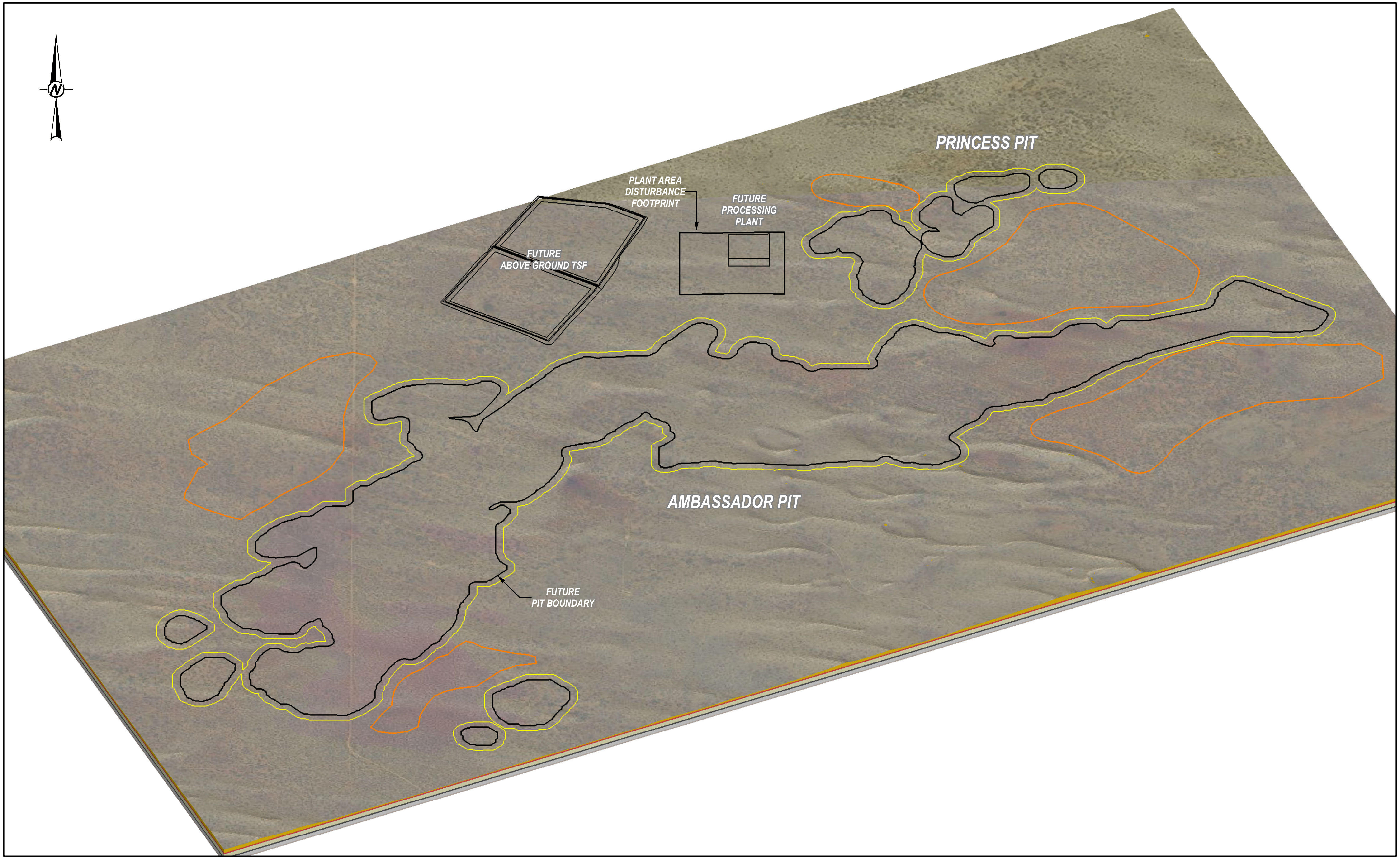
- pits,
- overburden landforms,
- above ground tailings storage facility (TSF),
- in-pit TSFs
- infrastructure.

2.3.1 Pits

Four open pit areas are proposed to be mined consecutively at the MRUP. Pre-mine, operational phase 3D images for Mulga Rock East Deposit and Mulga Rock West Deposits are presented in Figure 2.4 to Figure 2.6 and summarised in Table 2.1.

Table 2.1 Proposed Mine Pits

Mine Pit	Surface Area (ha)	Maximum Depth (m)	Maximum Volume (m^3)
Princess Four interconnected pits	65	62	22,905,844
Ambassador One main pit with four satellite pits at the southern end	761	76	260,625,000
Shogun One main pit and two satellite pits to the west	268	42	33,125,000
Emperor Single pit	942	46	270,000,000
Total	**2,036**	**42-76**	**586,655,844**



LEGEND

FUTURE OVERBURDEN LOCATION	OREBODY
PIT CLEARING (50 m BUFFER)	REDUCED EOCENE SEDIMENTS
QUATERNARY SEDIMENTS	HIGH PERMEABILITY BASAL SAND
MIOCENE SEDIMENTS	PERMIAN SEDIMENTS (BASEMENT)
OXIDISED EOCENE SEDIMENTS	

NOTES

SURFACE TOPOGRAPHY SHOWN WITH NO VERTICAL EXAGGERATION.
MODEL FOR DISPLAY ONLY (NOT TO BE SCALED OFF).

CLIENT
VIMY RESOURCES LIMITED

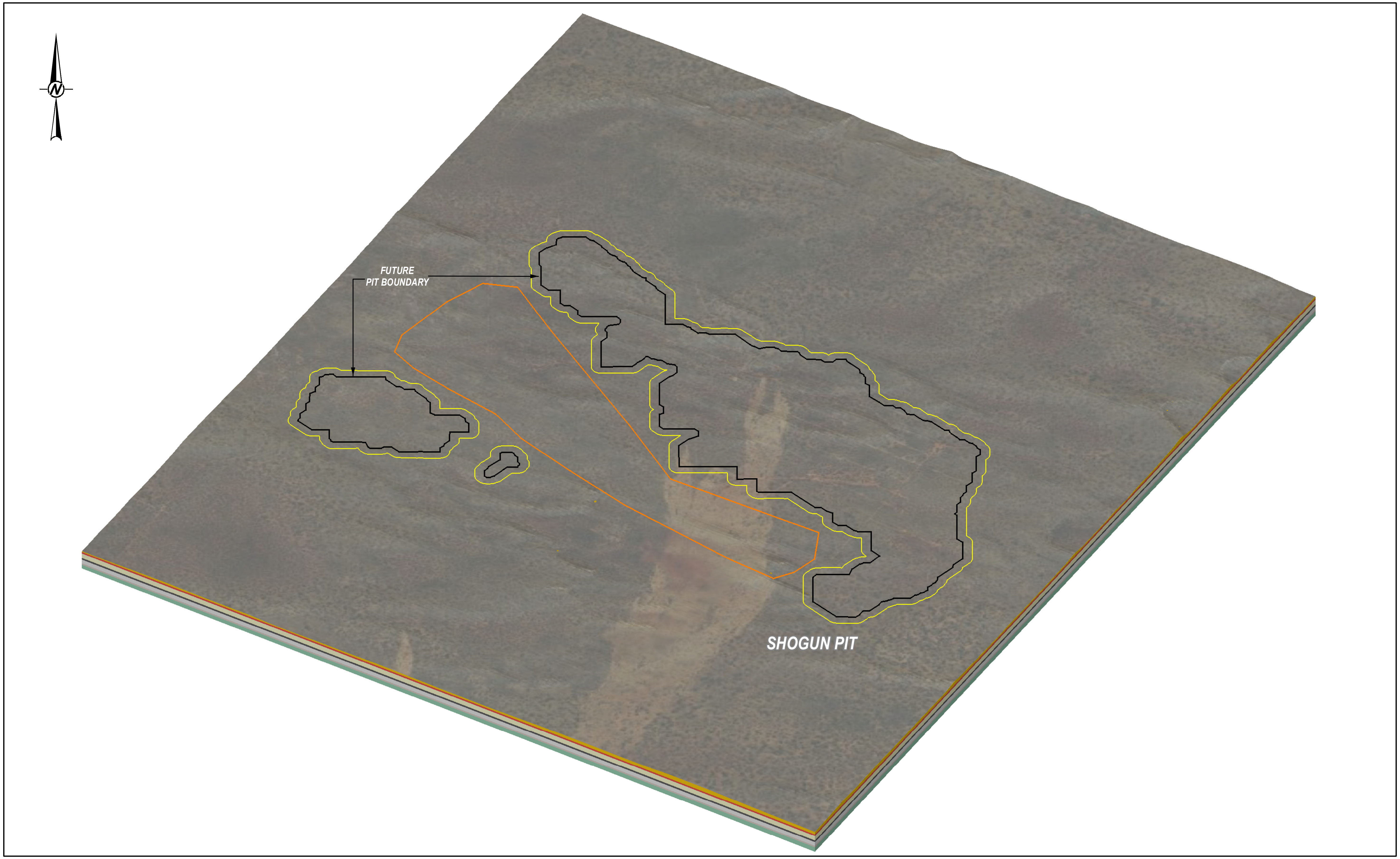
CONSULTANT
Golder Associates

YYYY-MM-DD	2015-10-29
DESIGNED	SAR
PREPARED	SAR
REVIEWED	EWC
APPROVED	EWC

PROJECT
MULGA ROCK URANIUM PROJECT

TITLE
3D IMAGE OF THE MULGA ROCK EAST – PRE OPERATION

PROJECT NO.	CONTROL	REV.	FIGURE
1540340	H1	0	2.4



LEGEND

- FUTURE OVERBURDEN LOCATION
- PIT CLEARING (50 m BUFFER)
- QUATERNARY SEDIMENTS
- MIOCENE SEDIMENTS
- OXIDISED EOCENE SEDIMENTS
- OREBODY
- REDUCED EOCENE SEDIMENTS
- HIGH PERMEABILITY BASAL SAND
- PERMIAN SEDIMENTS (BASEMENT)

NOTES

SURFACE TOPOGRAPHY SHOWN WITH NO VERTICAL EXAGGERATION.
MODEL FOR DISPLAY ONLY (NOT TO BE SCALED OFF).

CLIENT
VIMY RESOURCES LIMITED

PROJECT
MULGA ROCK URANIUM PROJECT

CONSULTANT
Golder Associates

YYYY-MM-DD	2015-10-29
DESIGNED	SAR
PREPARED	SAR
REVIEWED	EWC
APPROVED	EWC

TITLE
3D IMAGE OF THE MULGA ROCK WEST – SHOGUN PRE OPERATION

PROJECT NO.	CONTROL	REV.	FIGURE
1540340	H1	0	2.5

Path: G:\Spatial_Information_Group\GIS_WORKSPACE_AUSTRALIA\01_WA\SH5107_MINGWAL\1540340\Projects\APPENDIX\Rev0\1540340-H1-F002.5-Rev0.mxd

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A3

25mm

LEGEND

	FUTURE OVERBURDEN LOCATION		OREBODY
	PIT CLEARING (50 m BUFFER)		REDUCED EOCENE SEDIMENTS
	QUATERNARY SEDIMENTS		HIGH PERMEABILITY BASAL SAND
	MIOCENE SEDIMENTS		PERMIAN SEDIMENTS (BASEMENT)
	OXIDISED EOCENE SEDIMENTS		

NOTES

SURFACE TOPOGRAPHY SHOWN WITH NO VERTICAL EXAGGERATION.
MODEL FOR DISPLAY ONLY (NOT TO BE SCALED OFF).

CLIENT
VIMY RESOURCES LIMITED

CONSULTANT
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YYYY-MM-DD	2015-10-29
DESIGNED	SAR
PREPARED	SAR
REVIEWED	EWC
APPROVED	EWC

PROJECT
MULGA ROCK URANIUM PROJECT

TITLE
3D IMAGE OF THE MULGA ROCK WEST – EMPEROR PRE OPERATION

PROJECT NO.	CONTROL	REV.	FIGURE
1540340	H1	0	2.6

2.3.2 Overburden Landforms

Eight OLs are proposed for the MRUP. Pre-mine, operational phase 3D images for Mulga Rock East Deposit and Mulga Rock West Deposits are presented in Figure 2.4 to Figure 2.6 and summarised in Table 2.2.

Table 2.2 Proposed OL to be Developed at the MRUP

OL	Surface Area (ha)	Maximum Height (m)	Maximum Volume (m^3)
PNOL (Princess North OL)	16.3	30	2,266,800
PEOL (Princess East OL)	130.7	30	25,214,000
AEOL (Ambassador East OL)	136	30	23,715,000
ASOL (Ambassador South OL)	32.9	30	4,675,600
AWOL (Ambassador West OL)	106.5	30	19,947,000
SOL (Shogun OL)	141.9	30	34,800,000
EEOL (Emperor East OL)	135.2	30	35,577,000
ESOL (Emperor South OL)	237	30	68,329,000
Total	**936.5**	**30**	**214,524,400**

2.3.3 Tailings Storage Facilities (TSF)

Three TSFs are proposed for the MRUP, one above ground TSF and two in-pit TSFs. These are presented in Figure 2.3 and summarised in Table 2.3.

Table 2.3 Proposed TSFs to be Developed at the MRUP

Mine Pit	Surface Area (ha)	Maximum height / depth (m)	Maximum Volume (m^3)	Comment
TSF	106 (Two cells 53ha each)	10 (above surface)	4,543,643	Operating life - 3 years. Planned deposition for 18 months and 18 months contingency.
Princess In-pit TSF	65	62 (below surface)	18,187,000	Four interconnected pits. Operating life – 7 years.
Ambassador In-pit TSF	172	52(below surface)	25,734,879	Eastern section of Ambassador Pit. Operating life – 8 years.
Total	**343**		**48,465,522**	

2.3.4 Infrastructure

The following areas are associated with the Infrastructure domain:

- Process Infrastructure
  - Processing plant
  - Workshop and maintenance areas
  - Warehouse and logistics facilities
  - ROM pad
  - Beneficiation plant
  - Fuel storage and bulk chemical
  - Wastewater treatment plant
  - Laydown areas
- Supporting Infrastructure
  - Accommodation village
  - Administration offices
  - Landfill
  - Truck park-up bays and go-lines
  - Roads (haul and light vehicle) and access tracks
  - Water storage facilities (including turkey's nests, evaporation and solution/process water ponds)
  - Exploration drill holes and tracks
  - Drainage structures
  - Extraction and reinjection borefield
  - Pit dewatering facilities
  - Pipelines
  - Above and below ground utilities
  - Airstrip

3. Identification of Closure Obligations

Closure obligations occur at two levels:

- generic obligations, which are typically set by legislation and best practice guidelines, and are developed to promote environment stewardship within industry and
- site or activity-specific obligations, which are generally set by individual regulatory agencies to ensure environmental compliance and that all activities are undertaken in an environmentally sound manner.

Closure obligations pertinent to the MRUP are provided below.

3.1 Generic Closure Obligations

3.1.1 Generic legislation

Generic legislation that is applicable to the MRUP is provided in are summarised in Table 3.1.

Table 3.1 Generic Legislation Applicable to MRUP

Legislation	Reference	Obligations relevant to closure
Mining Act 1978	Part IV, Division 2 s.63(b)	Make safe all holes, pits, trenches and other disturbances on the surface of the land which are likely to endanger the safety of any person or animal.
	Part IV, Division 2 s.63(c)	Take all necessary steps to prevent fire and damage to trees or other property.
	Part IV, Division 3 s.84AA	A Mine Closure Plan is required to be approved by the Department and reviewed every 3 years, or as specified by the Department.
Mining Regulations 1981	Part V, Division 6 r.97	Avoid activity that obstructs any public thoroughfare or undermines any road, railway, dam or building in such manner as to endanger the public safety.
	Part V, Division 6 r.98	The proponent shall not allow detritus, dirt, sludge, refuse, garbage, mine water or pollutant from the tenement to become an inconvenience to the holder of any other mining tenement or to the public, or in any way injure or obstruct any road or thoroughfare or any land used for agricultural purposes. Specifies provisions for issuance of Closure Notices.
Environmental Protection Act 1986	Part V, Division 1 s.49(2)-(5)	Prevent conducting activities that may emit unreasonable emission or transmission of noise, odour or electromagnetic radiation which unreasonably interferes with the health, welfare, convenience, comfort or amenity of any person.
	Part V, Division 1 s.50(1)-(4)	Prevent discharging waste in circumstances likely to cause pollution.
	Part V, Division 1 s.50A(1)-(3)	Prevent causing serious environmental harm.
	Part V, Division 1 s.50B(1)-(3)	Prevent causing material environmental harm.
	Part V, Division 2 s.51C	Prevent the unauthorised clearing of native vegetation.

Legislation	Reference	Obligations relevant to closure
Environmental Protection Regulations 1987.	Part 6 r.14	Disposal of tyres are to be disposed in accordance with Regulation 14: Tyres may be disposed of by burial under a final soil cover of not less than 500mm — (a) in batches separated from each other by at least 100mm of soil and each consisting of not more than 40 cubic metres of tyres reduced to pieces; (b) in batches separated from each other by at least 100mm of soil and each consisting of not more than 1,000 whole tyres.
Contaminated Sites Act 2003.	Part II, Division 1 s. 11	The proponent or individuals are to report known or suspected areas of contaminated sites.
Contaminated Sites Regulations 2006	Part 2, r.6	
Contaminated Sites Act 2003	Part III, Division 1 s.23	Sites classified as Contaminated - Remediation Required as described under the Contaminated Sites Act 2003 are to be remediated.
Mines Safety and Inspection Regulations 1995	Part 3, Division 2 r.3.12 and 3.14	Notification of suspension of mining operations must be in writing and include: • the name and location of the mine; • the number of the lease, tenement or other interest; • the name and address of the principal employer at the mine; • what mining operations are to be affected, and whether they are to be commenced, recommenced, abandoned or suspended; and • the date on which the mining operations are to be commenced, recommenced, abandoned or suspended (as the case may be). • the reason for the suspension and the planned duration of the suspension; • whether the closure is total or whether access to underground and/or open pit workings is to be maintained; • if underground and/or open pit access is to be maintained, details of the arrangements that have been made for the provision of regular services and emergency services to ensure the safety of employees engaged in maintaining the mine; • the measures that have been taken to prevent unauthorised access or entry to the mine; • the precautions that have been taken to protect underground equipment and service installations; and • any plans required to be prepared under section 88 of the Act.
	Part 3, Division 2 r.3.16	Notification of the abandonment of mining operations at a mine must include the following details: • precautions taken to ensure that access to underground workings has been secured against unauthorised entry; • precautions taken to prevent inadvertent access to open pit workings; • precautions taken to prevent post mining subsidence into underground workings, by back-filling stope voids and by other appropriate measures; • precautions taken to ensure that all plant and equipment have been removed or secured and left in a safe condition; • precautions taken to remove or properly dispose of all hazardous substances at the mine; • any plans required to be prepared under section 88 of the Act.
	Part 16, Division	The proponent shall submit a plan with the notification which shows: (a) the specific locations in which radioactive waste has been buried; and

Legislation	Reference	Obligations relevant to closure
	2 r.16.35	(b) the absorbed dose rates in air one metre above the final surface.
		After the mine is abandoned, rehabilitation sites are to be inspected and monitored at such intervals and in such a way as is approved by the State mining engineer.
Aboriginal Heritage Act 1972	Part IV, s.16 and s.18	Heritage sites are not to be altered, excavated, damaged, concealed or any portion of the site removed in anyway, unless granted via Section 16 or 18 under the Aboriginal Heritage Act 1978.
Soil and Land Conservation Act 1945	Part V, (32)	The proponent shall take adequate precautions to prevent or control soil erosion, salinity or flooding; or the destruction, cutting down or injuring of any tree, shrub, grass or any other plant on land where land degradation is occurring or likely to occur.
Rights in Water and Irrigation Act 1914	Part III, Division 2 s.21a and s. 25)	In the case that the obstruction, destruction, diversion or impediment to a water course during the closure period is required, details are to be provided to the Minister for assessment.
Dangerous Goods Safety Act 2004	Part 2, (8)	The proponent has a duty to minimise risk during the handling or transporting of dangerous goods.
	Schedule 1 (cl 6 and 7)	When removing dangerous goods from the site, it must be done so in accordance with schedule 1.
Wildlife Conservation Act 1950	s.16 and s.23F	A person may not take for any purpose, including mine closure activities, protected fauna or flora without a licence, or rare and endangered flora without the written consent of the Minister.
Health Act 1911	Part IV, Division 2 s.87	The proponent shall ensure (stagnant) pools, ponds, open ditches, and drains do not become offensive to the public or allow these areas to become prejudicial to human health.
Environmental Protection (Controlled Waste) Regulations 2004	Part III, Division 6 s44	Disposal of asbestos is to be separated, wrapped and labelled and disposed in accordance with Part III,(6)(44) The proponent is to treat all products listed in schedule 1 of the Environmental Protection (Controlled Waste) Regulations 2004 as a controlled waste.

3.1.2 Leading Practice Closure Standards and Guidelines

Vimy has based their approach on the following leading practice closure standards and guidelines to ensure environmentally sound development of the MRUP:

- ANZECC/ARMCANZ (2000). *Australian and New Zealand guidelines for fresh and marine water quality. National Water Quality Management Strategy Paper No 4*. Australian and New Zealand Environment and Conservation Council & Agriculture and Resource Management Council of Australia and New Zealand, Canberra. 1,500pp.
- ARPANSA (2005). *Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing.* This is a Code of Practice and Safety Guide intended to foster uniform high standards of radiation protection and radioactive waste management in mining and mineral processing throughout Australia. Also known as the Mining Code (2005).
- DITR (2015). Leading Practice Sustainable Development Program for the Mining Industry - Risk Assessment and Management. Department of Industry, Tourism and Resources, Canberra, Australia.
- Guidelines for Preparing Mine Closure Plans. The purpose of these guidelines is to provide guidance on the preparation of Mine Closure Plans to meet Western Australian regulatory requirements. The guidelines were jointly developed by the DMP and the EPA (DMP / EPA 2015).
- Environmental Protection Agency (EPA) Guidance Statement No. 6 for the rehabilitation of terrestrial ecosystems (EPA 2006).

- IAEA (2010). *Best Practice in Environmental Management of Uranium Mining:* Nuclear Energy Series No NF-T-1.2. This is an overall guide to what is best practice in modern uranium mining and provides operators with guidelines and examples of the implementation of the principles of best practice operating in the uranium mining and processing industry with respect to the extraction and processing of uranium ores.
- Managing Acid and Metalliferous Drainage. This handbook is one within the Leading Practice Sustainable Development in Mining Series, and was prepared by the DITR in February 2007. It encompasses social, economic and environmental aspects of the various mining phases, addressing the decision making, regulatory framework, identification and prediction, risk, minimisation, control and treatment, monitoring and performance evaluation and management processes of acid and metalliferous drainage (AMD). Case studies are also included.
- Mine Closure and Completion. This document was prepared by the Department of Industry, Tourism and Resources (DITR) in October 2006 as part of an Australian Government initiative Leading Practice Sustainable Development Program for the Mining Industry. The publication addresses sustainable development and closure, mine life phases, planning during the operational phase and mine completion and relinquishment, including case studies.
- Mine Rehabilitation. This handbook was published in October 2006 within the Leading Practice Sustainable Development in Mining Series by the DITR. It outlines sustainable development and mine rehabilitation, planning, operations, and closure, and includes case studies addressing these aspects of mine rehabilitation. The revised Guidelines in press will also be followed.
- Strategic Framework for Mine Closure. This handbook was prepared by the Minerals Council of Australia (MCA), and the Australian and New Zealand Minerals and Energy Council (ANZMEC) in 2000. It outlines strategic framework concepts associated with stakeholder involvement, planning, financial provision, implementation, standards, and relinquishment. Examples of best practice are also included.

3.2 Site Specific Closure Obligations

The site specific tenement conditions relevant to closure are summarised in Table 3.2.

Table 3.2 Specific Requirements Applicable to MRUP

Tenement	#	Pertinent Endorsement/Conditions	Closure Relevance
ENDORSEMENTS			
M39/1080, M39/1081, L39/193 and L39/219	4	The rights of ingress to and egress from the mining tenement being at all reasonable times preserved to officers of DoW for inspection and investigation purposes.	If bores are retained on the Mining tenement, then sign over and access needs to be determined
	5	The storage and disposal of petroleum hydrocarbons, chemicals and potentially hazardous substances being in accordance with the current published version of the DoW's relevant Water Quality Protection Notes and Guidelines for mining and mineral processing.	Correct disposal of petroleum hydrocarbons, chemicals and potentially hazardous substances
M39/1080 and M39/1081	8	Measures such as effective drainage controls, sediment traps and stormwater retention facilities being implemented to minimise erosion and sedimentation of receiving catchments and adjacent areas	Such controls in place, especially on overburden landform

Tenement	#	Pertinent Endorsement/Conditions	Closure Relevance
CONDITIONS			
M39/1080, M39/1081, E39/876, E39/877, E39/1148, E39/1149, E39/1150, E39/1551	2	All surface holes drilled for the purpose of exploration are to be capped, filled or otherwise made safe immediately after completion.	Inventory of exploration areas required.
	3	All disturbances to the surface of the land made as a result of exploration, including costeans, drill pads, grid lines and access tracks, being backfilled and rehabilitated to the satisfaction of the Environmental Officer, Department of Mines and Petroleum (DMP). Backfilling and rehabilitation being required no later than 6 months after excavation unless otherwise approved in writing by the Environmental Officer, DMP	As above
	4	All waste materials, rubbish, plastic sample bags, abandoned equipment and temporary buildings being removed from the mining tenement prior to or at the termination of exploration program.	As above
M39/1080 and E39/877	7	No interference with the use of the Aerial Landing Ground and mining thereon being confined to below a depth of 15m from the natural surface.	Airstrip to be unaffected.
M39/1081	7	The rights of ingress to and egress from Miscellaneous Licence 39/213 being at all times preserved to the licensee and no interference with the purpose or installations connected to the licence.	Access required to be maintained if L39/213 still live
E39/877, E39/1550 and L39/193	7/5	The development and operation of the Project being carried out in such a manner so as to create the minimum practicable disturbance to the existing vegetation and natural landform.	Aesthetic considerations for overburden landform and above ground TSF designs
E39/877, E39/1550	8/6	All topsoil being removed ahead of all mining operations from sites such as pit areas, waste disposal areas, ore stockpile areas, pipeline, haul roads and new access roads and being stockpiled for later respreading or immediately respread as rehabilitation progresses.	Topsoil Management Plan
E39/1550	7	At the completion of operations, all buildings and structures being removed from site or demolished and buried to the satisfaction of the Director, Environment Division, DMP.	Removal of all infrastructure
	8	All rubbish and scrap is to be progressively disposed of in a suitable manner	Rubbish removal
	9	At the completion of operations, or progressively where possible, all access roads and other disturbed areas being covered with topsoil, deep ripped and revegetated with local native grasses, shrubs and trees to the satisfaction of the Director, Environment Division, DMP.	Rehabilitation Plan
E39/1551	5	The rights of ingress to and egress from Miscellaneous Licence 39/193 being at all times preserved to the licensee and no interference with the purpose or installations connected to the licence.	Access required to be maintained if L39/193 still live
L39/193 and L39/219	2/8 and16 (repeated)	On the completion of the life of mining operations in relation to this licence the holder shall: remove all installations constructed pursuant to this licence; cover over all wells and holes in the ground to such degree of safety as shall be determined by the Environmental Officer, DMP; and on such areas cleared of natural growth by the holder or any of its agents, the holder shall plant trees and/or shrubs and/or any other plant as shall conform to the general pattern and type of growth in	Remove all infrastructure and rehabilitate – but note that no seedlings will be planted, but seeding will occur during the progressive rehabilitation

Tenement	#	Pertinent Endorsement/Conditions	Closure Relevance
		the area and as directed by the Environmental Officer, DMP and properly maintain same until the Environmental Officer advises regrowth is self-supporting; unless the Mining Registrar or Minister responsible for the *Mining Act 1978* orders or consents otherwise.	
L39/193	12	All topsoil and vegetation being removed ahead of all mining operations and being stockpiled appropriately for later respreading or immediately respread as rehabilitation progresses.	Topsoil Management Plan
L39/219	4	Where surface disturbance activities are proposed on the licence which are not associated with development or construction proposals, the prior written approval of the Environmental Officer, DMP must be obtained before the use of drilling rigs, scrapers, graders, bulldozers, backhoes or other mechanised equipment for the proposed surface disturbance activities. Following approval, all topsoil being removed ahead of operations and separately stockpiled for replacement after backfilling and/or completion of operations	Topsoil Management Plan
	6	All topsoil that may be removed ahead of pipe laying operations to be stockpiled for replacement in accordance with the directions of the Environmental Officer, Department of Mines and Petroleum.	Topsoil Management Plan
	10	Wherever any part of a road intersects an existing fence, the holder shall where necessary construct a gate or livestock grid having such dimensions and be constructed of such materials and be of such standard as agreed with the pastoralist or as determined by the Environmental Officer, DMP.	No fences evident

3.3 Vimy Standards and Guidelines

Vimy governs rehabilitation and closure planning on a corporate level through:

- the introduction of progressive mine rehabilitation into Project development and mine planning enabling the reduction of LOM closure costs and overall environmental liabilities and
- improving the estimated accuracy of Vimy's closure liabilities and provisioning estimates.

These objectives are achieved by requiring that:

- legal obligations at both State and Commonwealth levels for closure are recognised,
- the collection of baseline information required for successful mine closure and rehabilitation is obtained as early as possible in the Project lifecycle,
- environmental risks are acknowledged during Project design and appropriate management strategies implemented prior to and during operations,
- mine closure liabilities and provisioning are recognised during Project design and feasibility and updated regularly to reflect the long term mine plan and
- mine closure and rehabilitation plans are in alignment with relevant current guidelines and are regularly reviewed through an integrated, multi-disciplinary approach and these are recognised in the all mine plans and relevant approval documents.

4. Stakeholder Engagement

Vimy notes stakeholder consultation is an integral component of mine closure planning. Vimy will consult with its key stakeholders on all aspects of mine development and closure. As a key component of Vimy's stakeholder consultation strategy, open consultation meetings with key stakeholders have been and will continue to be held frequently to discuss mine operations and mine closure planning. The stakeholder consultation process is facilitated by:

- identifying key stakeholders,
- establishing a robust consultation approach to ensure effective consultation is undertaken,
- developing individual stakeholder consultation plans and
- engaging with key stakeholders to identify and discuss areas of concern.

4.1 Stakeholder Identification

A preliminary register of key stakeholders relevant to the mine development and closure of the MRUP is provided in Table 4.1.

Table 4.1 Preliminary Stakeholder Register for the MRUP

Category	Stakeholder	Key considerations
Federal Government	• Department of the Environment (DoE) • Department of Resources, Energy and Tourism (DRET) • Department of Foreign Affairs and Trade (DFAT) • Australian Safeguards and Non-Proliferation Office – (ASNO)	• Project setting and key characteristics • Nature of the dual State/Commonwealth assessment process • Legislative overview and agency knowledge • Environmental factors, baseline studies, key threats to be mitigated, knowledge gaps • Closure, demonstrating achieved completion criteria, end landuse and landforms
State Government	• Department of Mines and Petroleum (DMP, Perth) • Office of Environmental Protection Authority (OEPA Service Unit) • Department of Environment and Regulation (DER) • Department of Parks and Wildlife (DPAW) • Department of Water (DoW) • Department of Aboriginal Affairs (DAA) • Radiological Council of Western Australia	• Project setting and key characteristics, • Nature of the dual State/Commonwealth assessment process, • Legislative overview and agency knowledge • Stakeholder consultation process • Environmental factors, baseline studies, key threats to be mitigated, knowledge gaps • Development of EMPs • Waste management • Aboriginal heritage, native title claim boundaries • Flora/fauna (including Priority species, etc.) • Borefields, dewatering, groundwater, surface water • Uranium and other radionuclides • Handling of fibrous or radioactive material, studies • Involvement of radiation and groundwater specialists • Closure, demonstrating achieved completion criteria, end landuse and landforms • Progressive rehabilitation

Category	Stakeholder	Key considerations
Local Government	• Shires of Menzies and Kalgoorlie-Boulder	• Access to site and infrastructure • Transport routes • Future work opportunities
Neighbouring Projects	• Zeus Resources • Tropicana Gold Mine	• Access to site and infrastructure • Transport routes • Cumulative effects • Rehabilitation success to date • Closure landform design
Indigenous Stakeholders	• Wongatha People	• Tribal rights asserted over the land. • Future work opportunities for Wongatha People

4.2 Stakeholder Consultation

A Stakeholder Consultation Record has been established by Vimy and will continue to be updated throughout the LOM to ensure that there is identification of closure issues from key stakeholders on closure planning.

Given the MRUP is in its early stage, specific closure outcomes and commitments have not been discussed with stakeholders. As the Project progresses, the closure planning will become more definitive to ensure that planned closure works consider stakeholder views.

5. Post-Mining Land Use/s and Closure Objectives

5.1 Pre-Mine Land Use

The MRUP is located on UCL. The existing land use is unprotected natural habitat.

5.2 Closure Objectives and Guiding Principles

As specified in the Guidelines for Preparing Mine Closure Plans (EPA/DMP, 2015), the overall objectives of closure are to construct a safe, stable, non-polluting landforms that demonstrate sustainable closure land uses. Although these holistic goals may seem unassuming and straightforward at first glance, their achievement, particularly for operations covering large areas and having long LOM (such as for the MRUP), is a complex process and requires a 'whole of company' approach. To successfully achieve these closure goals, buy-in at a corporate, legal, social, planning, operations and environmental level must occur, and failure to consult with any one of these groups within a company, will likely result in closure and relinquishment of tenements not being realised.

To ensure the broad closure objectives are achieved, Vimy commits to:

- ensuring the interests of relevant stakeholders are considered during all stages of closure planning
- establishing and refining rehabilitation objectives and completion criteria, based on the findings of monitoring and research, that are appropriate to the agreed post-mine land use
- construct safe, stable, non-polluting landforms that are geomorphologically and functionally consistent with the surrounding landscape and capable of sustaining agreed post-operational land use, and do not impact on surrounding environmental values or uses
- rehabilitate disturbed areas to meet agreed post-operational land use objectives and completion criteria, and
- develop indicators to demonstrate when rehabilitation activities meet the established objectives and completion criteria.

Through the implementation of the above closure objectives:

- no significant long term physical offsite impacts will occur as a result of operations
- no significant long term impact on baseline surface or groundwater flow patterns and quality will occur as a result of operations
- no unsafe areas will remain after closure whereby members of the general public and animals could be harmed, and
- rehabilitated and closed operational areas will be aesthetically consistent with the surrounding landform and consider stakeholder expectations.

5.3 Final Land Use

Following cessation of mining, and subsequent rehabilitation and closure of post-mine landforms, the land use of the area will be self-sustaining native ecosystems of regional relevance.

In order to achieve this final land use, the following preliminary closure objectives have been identified:

- landforms will be safe,
- landforms will be physically stable,
- disturbed and rehabilitated areas will be non-polluting,
- landforms will be commensurate with the surrounding landscape, and
- vegetation and fauna habitat will not be significantly different to analogue reference sites.

6. Completion Criteria

Completion criteria are measurable targets against which closure implementation, and subsequent performance, can be assessed. Vimy applies an adaptive management approach to the development of completion criteria, with identification of provisional criteria commencing during early Project approval stages, following stakeholder consultation and collection of baseline data. These provisional completion criteria are continually reviewed and updated throughout the entire LOM (i.e. iterative feedback loop) as expectations of relevant stakeholders change over time and in response to ongoing monitoring, research and trial rehabilitation information.

Vimy believes that completion criteria should be achievable, realistic and consider stakeholder expectations. They should not be developed in isolation (otherwise they will have no meaning), and should be intricately linked to:

- closure objectives
- post-mine land use, and
- monitoring approach (i.e. to guide what parameters are monitored and ensure no redundancy in monitoring approach).

This relationship is shown in Figure 6.1.

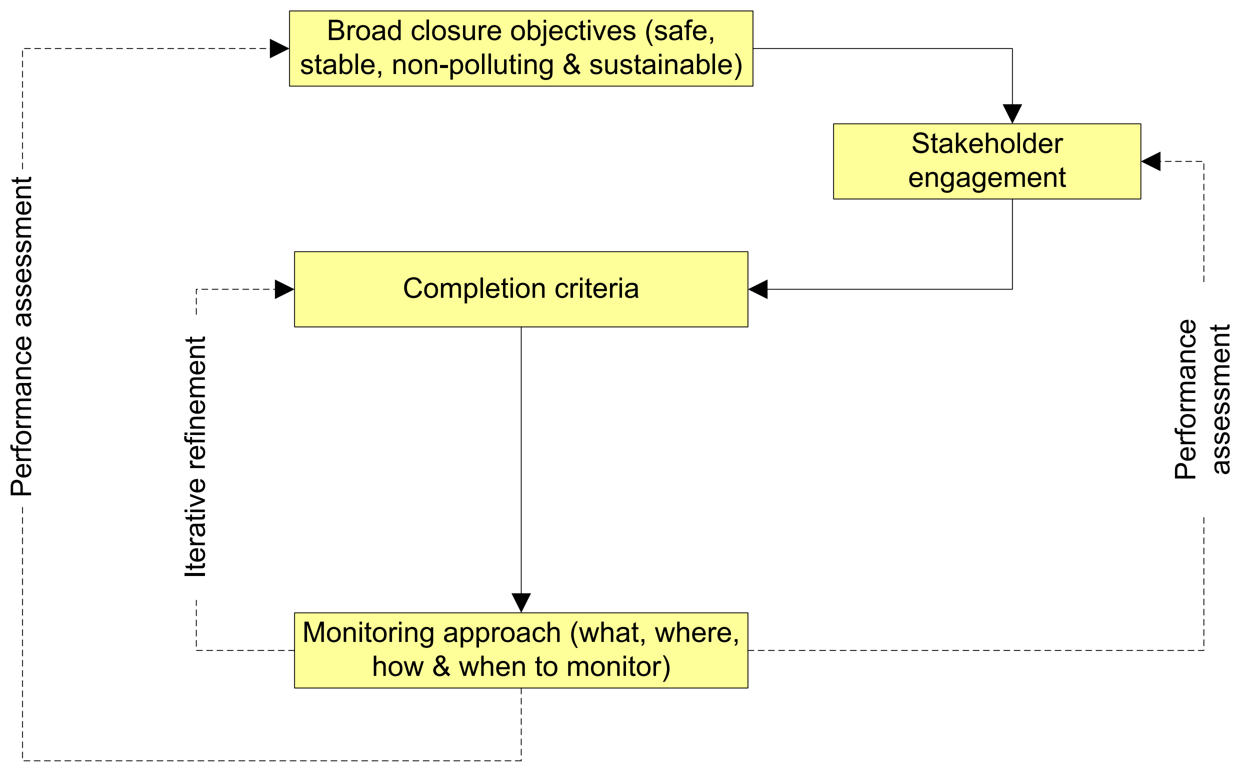


Figure 6.1 Relationship between Completion Criteria and Other Aspects of the Closure Process

6.1 Development of Completion Criteria

The purpose of completion criteria is to allow demonstration that a given area or landform has achieved the rehabilitation objectives and provide confidence to regulators and post-operational land users that these areas or landforms are capable of sustaining over the long term the agreed post-mine land use, utilising normal management practices.

The development of completion criteria will continue throughout the operational period of the mine to allow integration of data from ongoing rehabilitation trials, research and monitoring. The goals of this development are to progressively refine monitoring activities and rehabilitation to develop measurable metrics based onsite specific data, providing confidence that completion criteria can fulfil the intended role within the mine closure planning framework.

Provisional qualitative completion criteria have been developed for the MRUP and are presented in Table 6.1. These will be refined throughout the LOM. In addition, a measurement approach will be developed in accordance with these criteria, and presented within subsequent CMCPs. Criteria will be assessed against regional analogue ecosystems.

6.2 Basis for Development

As specified in the Guidelines for Preparing Mine Closure Plans (EPA/DMP, 2015), the development of completion criteria will follow the SMART Principle (ANZMEC/MCA, 2000) and be:

- Specific enough to reflect a unique set of environmental, social and economic circumstances,
- Measurable to demonstrate that rehabilitation is trending towards analogue indices,
- Achievable or realistic so that the criteria being measured is attainable,
- Relevant to the objectives that are being measured and flexible enough to adapt to changing circumstances without compromising objectives,
- Time-bound so that the criteria can be monitored over an appropriate time frame to ensure the results are robust for ultimate relinquishment.

Given the early stages of development of MRUP, completion criteria should be viewed as provisional and will be updated over life-of-mine as the Project evolves as per ICMM (2008).

Table 6.1 MRUP Closure Domain Completion Criteria

Subject	Objective	Domain	Criteria	Verification Tools	CMCP Section
1. Safety					
1.1 Safety	Site is safe for use under the agreed post-mine land use.	All	• Hazards which may endanger safety of humans are identified and managed to reduce risk to acceptable residual level.	• Relevant regulatory guidelines have been met. • Mine safety inspection audit.	Section 10
1.2 Landform safety	Final landforms are safe.	All	• Landforms constructed as per closure designs outlined in Section 9 of this CMCP.	• Monitoring confirms landforms constructed to final agreed designs.	Sections 9 and 10
2. Stability					
2.1 Landform Stability	Rehabilitated surfaces are stable to wind and water erosion.	All	• Landforms constructed as per closure designs outlined in Section 9 of this CMCP. • Erosion rates do not show significantly different rates from analogue regional landforms.	• Landforms constructed to agreed designs. • Analogue sites will be chosen and to define key completion criteria for all landforms. Analogue sites have been studied and monitoring will occur throughout mine life. • Erosion will be monitored quantitatively.	Sections 9 and 10
3. Pollution					
3.1 Acid and Metalliferous Drainage	AMD is prevented.	Pits OLs TSF Infrastructure	• Overburden material used in landform construction is characterised and handled appropriately. • Management strategies are in place to manage PAF in post-mine landforms so that AMD is prevented.	• Waste characterisation assessments confirm volumes, geochemistry and PAF risk. • Operational documentation confirms PAF materials have been appropriately placed. • Closure monitoring indicates AMD prevented.	Sections 7 and 10
3.2 Contamination	Contaminated soils are appropriately managed to comply with the Contaminated Sites Act 2003.	All domains	• Contaminated soils are identified and notified. Where necessary they are appropriately managed.	• Relevant regulatory guidelines and Acts have been met.	Sections 7 and 10

Subject	Objective	Domain	Criteria	Verification Tools	CMCP Section
4. Sustainability					
4.1 Sustainability	Rehabilitation is sustainable and suitable for the agreed post-mine land use.	All	• Rehabilitation activities are carried out in accordance with the management strategies agreed to in the CMCP. • Revegetation assemblages seeded are appropriate for region and landforms.	• Rehabilitation monitoring confirms revegetation assemblage is appropriate to agreed land use. • Analogue sites will be chosen and identified vegetation units from these sites will be used to define completion criteria for all landforms. • Analogue sites have been studied and monitoring will occur throughout mine life.	Sections 7 and 10
4.2 Growth medium	Suitable growth medium, where available, is in place to facilitate rehabilitation and re-establish the agreed post-mine land use.	All where relevant	• Surface of landforms have been constructed in accordance with specifications outlined in this CMCP for each domain.	• Landforms constructed to agreed designs.	Sections 7 and 10
4.3 Provenance	Vegetation assemblage is of local provenance.	All	• Vegetation assemblage seed source is of local provenance.	• Seed collection records and vegetation monitoring confirms revegetation is of provenance.	Sections 7 and 10
4.4 Weeds	Presence of weeds does not limit the sustainability of rehabilitation or its potential to sustain agreed post-mine land use.	All	• No new species of weeds are established. • Weeds not impacting revegetation sustainability.	• No new species of weeds are established with reference to analogue sites. • Vegetation seed source is of local provenance	Sections 7 and 10
5. Miscellaneous					
5.1 Visual Amenity	Visual amenity of constructed landforms is sympathetic to regional landforms.	All	• Landforms shape as per agreed designs. • Revegetation sympathetic to regional commensurate landforms.	• Rehabilitation monitoring confirms landforms constructed to design. • Photographs taken during rehabilitation monitoring demonstrates congruence with surrounding landforms.	Sections 9 and 10

7. Collection and Analysis of Closure Data

This section provides a summary of details on the baseline physical and biological aspects pertinent to the closure of the MRUP including:

- biogeographic region
- local physical environment
  - climate
  - geology
  - geochemistry and AMD
  - growth medium and landform characteristic
  - surface water
  - groundwater
- local biological environment
  - flora and vegetation
  - terrestrial fauna, subterranean fauna and SRE.

This information provides a basis for the development of completion criteria and performance indicators for closure monitoring. The closure management of the mining operations is based on understanding the surrounding environment and its functioning, and the outcomes of monitoring and research programs. A summary of the key baseline environmental data relevant to the CMCP is provided in Table 7.1.

Table 7.1 Summary of Existing Environmental Data for the MRUP

Aspect	Description
Biogeographic region	Great Victorian Desert Shield Subregion (GVD01).
Climate	The climate of the MRUP is classified as semi-arid to arid, with pan evaporations rates greatly exceeding rainfall throughout most of the year, and therefore the MRUP exists in a water deficit condition.
Geology and geochemistry	The MRUP occurs within the Narnoo Paleodrainage channel that has been filled with a diverse mix of Eocene sediments under lacustrine and palustrine conditions. These sediments have been extensively weathered and oxidised to around 40m depth, and all sulfides and mobile metals and metalloid have been stripped from the profile leaving a geochemically inert material. Below the redox boundary the remaining carbonaceous sediments (representing the ore) are enriched in uranium and base metals, and are classified as PAF. The potential for metalliferous drainage is limited due to the strong affinity of metals and metalloids for the organic matter.
Regolith characterisation	The landsurface within the MRUP is dominated by large Quaternary dunes that have been deposited directly onto the pre-existing Miocene/Eocene sediments. This material is structurally stable, however it has a very low water holding and nutrient retention capacity and thus has limited capacity to support native vegetation, with the depth of this sand cover governing the distribution of the vegetation types.

Aspect	Description
Flora	A total of 335 vascular plant taxa, representative of approximately 140 genera and 43 families, have been recorded in numerous surveys by MCPL in the MRUP area since 2007 (MCPL 2015a). The majority of taxa recorded were representative of the Fabaceae (52 taxa), Myrtaceae (40 taxa), Goodeniaceae (25 taxa) and Proteaceae (23 taxa) families, and typical of the wider GVD flora. A total of nine annual and/or biennial species, equating to approximately 2.7% of the total number of taxa, were recorded (MCPL 2015a). Of the 89 dunes surveyed, only five dunes with *Hibbertia crispula* occur within the Project Development Envelope representing approximately 225 plants (MCPL 2015c). The 2014 fire affected 78% of the Project Disturbance Footprint and 74% of the Project Development Envelope. It is estimated that 76% (approximately 10,823 plants) were potentially impacted by this fire and that many of these individual plants will no longer exist. A total of 13 other Priority Flora species have been recorded in the MRUP area from the 2007-2015 surveys (MCPL 2015c).
Fauna	Eighteen mammal species, 38 bird species, zero amphibians and 42 species of reptile have been recorded at or near to the Project site. Four conservation significant animals may occur in the area. Sandhill dunnarts, despite concentrated trapping, were only recorded in 1985. Evidence of Southern Marsupial Moles indicated that they may have been present at very low levels at some time in the past and are restricted to yellow aeolian sands. The Woma Python has been seen onsite on a limited number of occasions. The Malleefowl is not likely to occur in the Project habitat. No locally conservation significant SREs or stygofauna were sampled.
Conservation areas	There are no PECs or TECs or other conservation significant zones in the region of the Project.
Groundwater	Groundwater within the mining areas of the MRUP is confined within the paleodrainage channel with a level of approximately 40m below the land surface (290mAHD). Hydraulic gradient are very small (<0.002) and thus water movement in the aquifer is sluggish. This groundwater is moderately acidic and hypersaline, and enriched in Cd, Co, Cu, Ni, Pb and Zn. Groundwater in the Kakrook abstraction borefield is constrained within a graben-horst structure and is of good quality, being circum-neutral in pH, relatively non-saline and containing low solutes.
Surface water	No surface water occurs within the MRUP due to the nature of the topography and surficial sandy soils.
Land allotment	MRUP is located within the Shire of Menzies on granted Mining Tenement M39/1080 and 39/1081
Aboriginal heritage	There are no significant heritage sites located in the Disturbance Footprint, but there is one Registered Site located at the edge of the proposed Development Envelope.
European heritage	No evidence of any historic settlement in the region.

The sections below provide a brief description of the environmental factors pertinent to closure. More detailed descriptions are provided in the relevant Preliminary Key Environmental Factors (PKEF) in the PER document.

7.1 Interim Biogeographic Regionalisation of Australia

The MRUP occurs within the Great Victorian Desert (GVD) Bioregion of Australia. This Region covers a total area of 42.2Mha, across Western Australia (WA) and South Australia (SA) and consists of the following subregions:

- Shield (GVD01; 4.7Mha),
- Central (GVD02; 12.6Mha),
- Maralinga (GVD03; 11.5Mha),
- Kintore (GVD04; 5Mha),
- Tallaringa (GVD05; 3.7Mha) and
- Yellabinna (GVD06; 4.8Mha)

The MRUP occurs solely within the Shield subregion (GVD01), which is characterised by Quaternary dunefields overlying Paleocene to Permian strata of the Narnoo, Gunbarrel and Officer Basins on the eastern margin of the Yilgarn Craton. It has a Continental Stress Class of 6, implying that the landscape is healthy and stable.

7.2 Climate

The climate of the MRUP area is classified as desert with hot summers and cool – mild winters. Rainfall throughout the year does not vary considerably with 20–40mm/month falling in the summer months (November – March), often associated with cyclonic events, and 10–30mm/month in winter (April – October), with a total annual average rainfall of approximately 280mm. Pan evaporation (around 2,650mm/yr) greatly exceeds rainfall throughout the year and thus the environment exists in a water deficit condition. Daily pan evaporation rates vary from 11–12mm/day (330-360mm/month) in summer to 2-3mm/day (75–100mm/month) in winter.

Long term monthly rainfall data for the three closest Bureau of Meteorology (BOM 2015a) weather stations (Balgair, Laverton and Kalgoorlie) are provided in Figure 7.1; whilst pan evaporation data are presented in Figure 7.2.

9 am wind speeds vary from around 5km/hr during winter to around 11km/h. Summer wind direction is predominately (50–80%) from the south-east (i.e. blowing to the northwest) and in winter the prevailing wind direction is easterly.

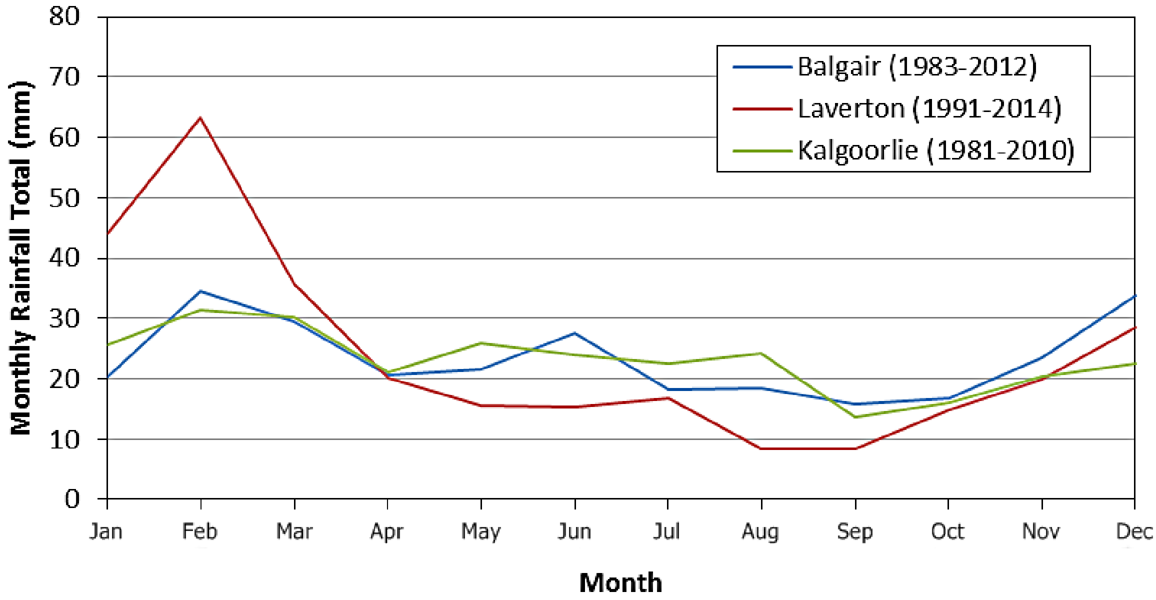


Figure 7.1 Long Term Monthly Average Rainfall Data

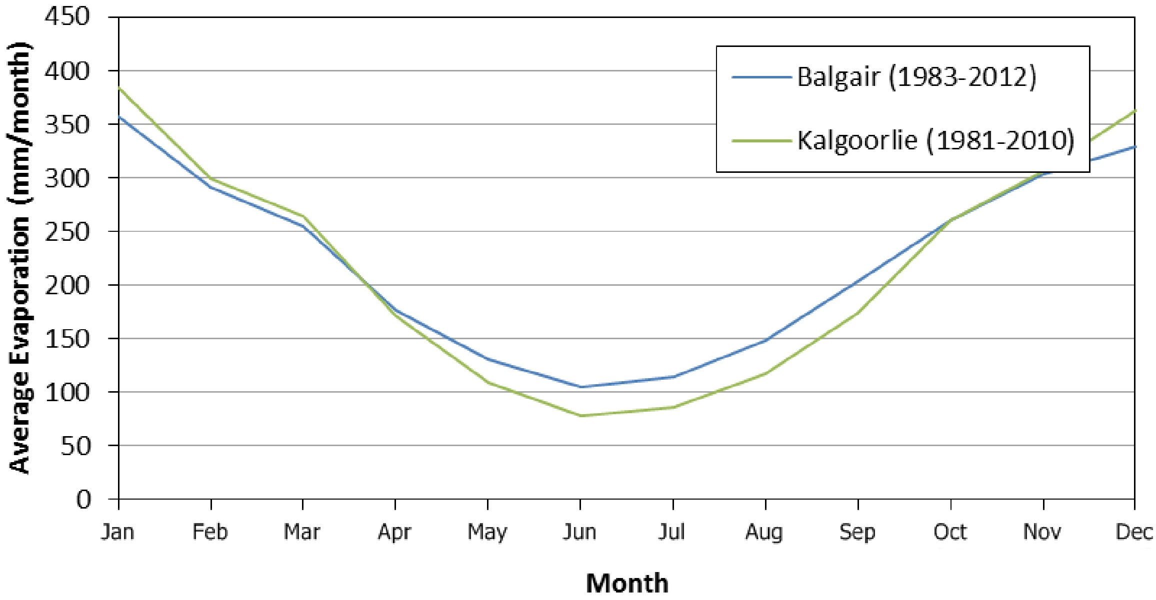


Figure 7.2 Long Term Monthly Average Pan Evaporation

7.2.1 Implications for Mine Closure

The climate within the MRUP results in a water deficit environment throughout the majority of the year, with pan evaporation greatly exceeding total annual rainfall. This has important implications for the functioning of the native ecosystem and MRUP's plans to re-establish a self-sustaining native ecosystem post-mine. Under water deficit conditions, native vegetation must either be deep-rooted, in order to obtain sufficient soil moisture to meet their transpiration requirements, and/or have physiological adaptations to minimise water loss or transpiration (i.e. hidden stomata, ability to close stomata) particularly during the hot, dry summer period. Given this requirement for deep roots on some species, rehabilitation must therefore ensure that the thickness of the reconstructed soil profile is appropriate for the species selected, and that there are no physical or chemical limitations within the required rooting depth; otherwise the revegetation will likely be water-stressed (i.e. they cannot extract sufficient plant available water to meet their transpiration requirements) and not be considered sustainable, which is a key tenet of closure.

In addition to influencing the rooting depth of the native vegetation, arid water deficit climatic conditions influence capillary water movement within the unsaturated zone. In an arid climate the surface soils typically exist in a very dry condition, which is significantly drier than the soils at depth, and consequently strong upward hydraulic gradients prevail throughout the year. Any stored moisture deeper in the profile will overtime slowly move towards the surface. This has important implications for any above or below ground TSF, whereby the tailings at decommissioning likely exist at field capacity. If a capillary break is not included in a rehabilitation design, then upward capillary movement of saline (potentially metal-laden) water will occur resulting in a degradation of the growth medium and likely impact on rehabilitation performance. Consequently, a capillary break is required for closure.

The dry condition experienced at the soil surface also strongly influences water infiltration into the soil profile. Water movement or permeability through unsaturated soils is dependent on the Hydraulic Conductivity Function (HCF) of the soil. For all soils there is a rapid decrease in permeability as a soil dries, such that when in a dry condition (as occurs throughout summer) their permeability is typically several orders of magnitude less than the rainfall rate. Consequently, infiltration-excess overland flow occurs resulting in either sheet flow or convergent flow that causes erosion and sediment loss. All post-mine landforms will therefore need to account for significant infiltration-excess overland flows and be designed to control and minimise these surface water flows to prevent erosion and sediment loss.

The MRUP is located in a wind-dominated rather than a hydrologically dominated environment and landform design needs to consider these erosion forces.

7.3 Overburden and Ore Characterisation

7.3.1 Geological Setting

The MRUP occurs within an Eocene paleodrainage channel that was incised into the Cretaceous – Eocene Narnoo Basin. Given the geomorphic nature of the paleovalley during deposition (i.e. slow meandering oxbow shaped stream; Figure 7.3) the Eocene sediments experienced extensive lacustrine and palustrine conditions, and consequently they became enriched in organic matter (up to 40%; ANSTO, 2015), with Total Organic Carbon (TOC) contents varying from 2 to 25% (Soilwater Consultants (SWC), 2015a). Widespread peneplanation of the Archean and Proterozoic granitic rocks of the adjacent Yilgarn Craton and Albany Fraser Province (AFP) resulted in the release and mobilisation of uranium from the parent minerals, and subsequent deposition within the Narnoo paleodrainage channel. Given the carbonaceous nature of the Eocene sediments and the prevailing geochemical conditions, the released uranium was strongly absorbed onto the surface of the organic matter, either through ion exchange or functional-group complexation (Douglas *et al*., 1996), and effectively immobilised it from the aquifer, forming the MRUP orebody. In addition, base metals were also strongly complexed with the organic matter and associated sulphides.

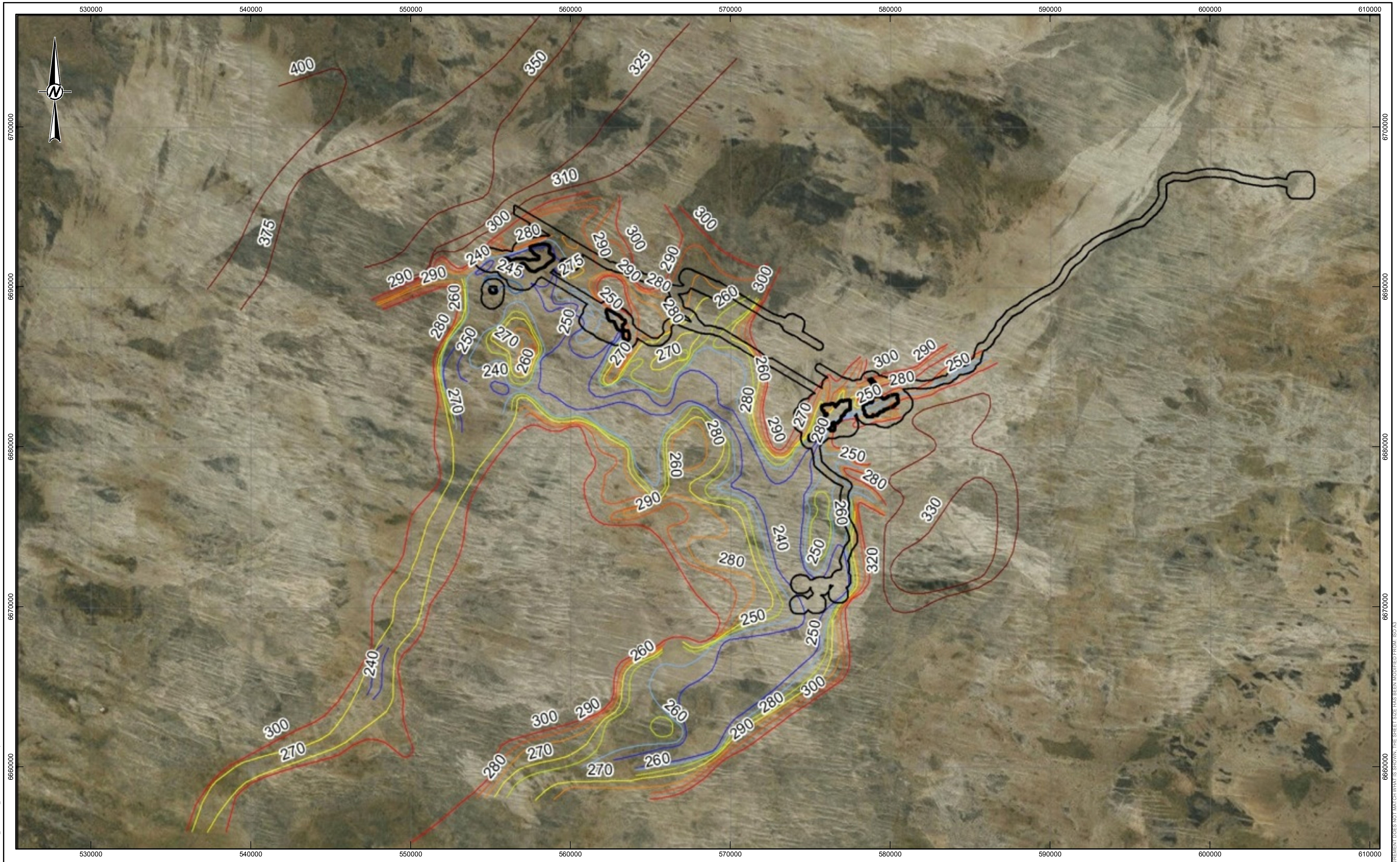
Following the Paleocene-Eocene Thermal Maximum, drying of the global climate resulted in a lowering of groundwater levels to their current level of approximately 40m (around 290mAHD) below the land surface (Figure 7.3). This drop in watertable, resulted in the oxidation of the overlying Eocene sediments, and subsequent oxidation of sulfides contained within the organic matter. The associated release of acidity caused the pH of the sediments to drop (most likely to pH < 3) resulting in a destruction of the clay mineral lattice and organic matter and stripping and remobilisation of the uranium and the majority of the base metals. This accelerated and intense weathering of the overlying unsaturated Eocene sediments has resulted in them becoming geochemically benign.

Uranium (U) precipitation is strongly controlled by redox conditions, such that it effectively becomes immobile under reducing conditions. Consequently, the uranium which is to be mined at the MRUP is confined to and immediately below the current redox boundary (watertable). The uranium orebody is therefore constrained to 2–5m below the current groundwater level, and thus the base of the pit will be at most 5m below the water level.

A schematic diagram showing the geology of the MRUP is provided in Figure 7.4, whilst the morphological characteristic of the sedimentary sequence is shown in Figure 7.5. During the Miocene the entire region was blanketed in a transported cover (Miocene sediments), which has subsequently been covered by a Quaternary Aeolian Sand.

Based on the geology of the MRUP, and following characterisation by SWC (2015b), the lithostratigraphic units shown in Figure 7.4 and Figure 7.5 are simplified into the following management units:

- growth medium: layer for rehabilitation from mixed Miocene/Oxidised Eocene material with a large water storage capacity for revegetation species,
- overburden: Miocene and oxidised Eocene sediments,
- ore: reduced Eocene sediments.



NOTES

1. COORDINATE SYSTEM: GDA 1994 MGA ZONE 51

0 2 4 6 8 10

1:220,000 KILOMETRES

CLIENT
VIMY RESOURCES LIMITED

PROJECT
MULGA ROCK URANIUM PROJECT

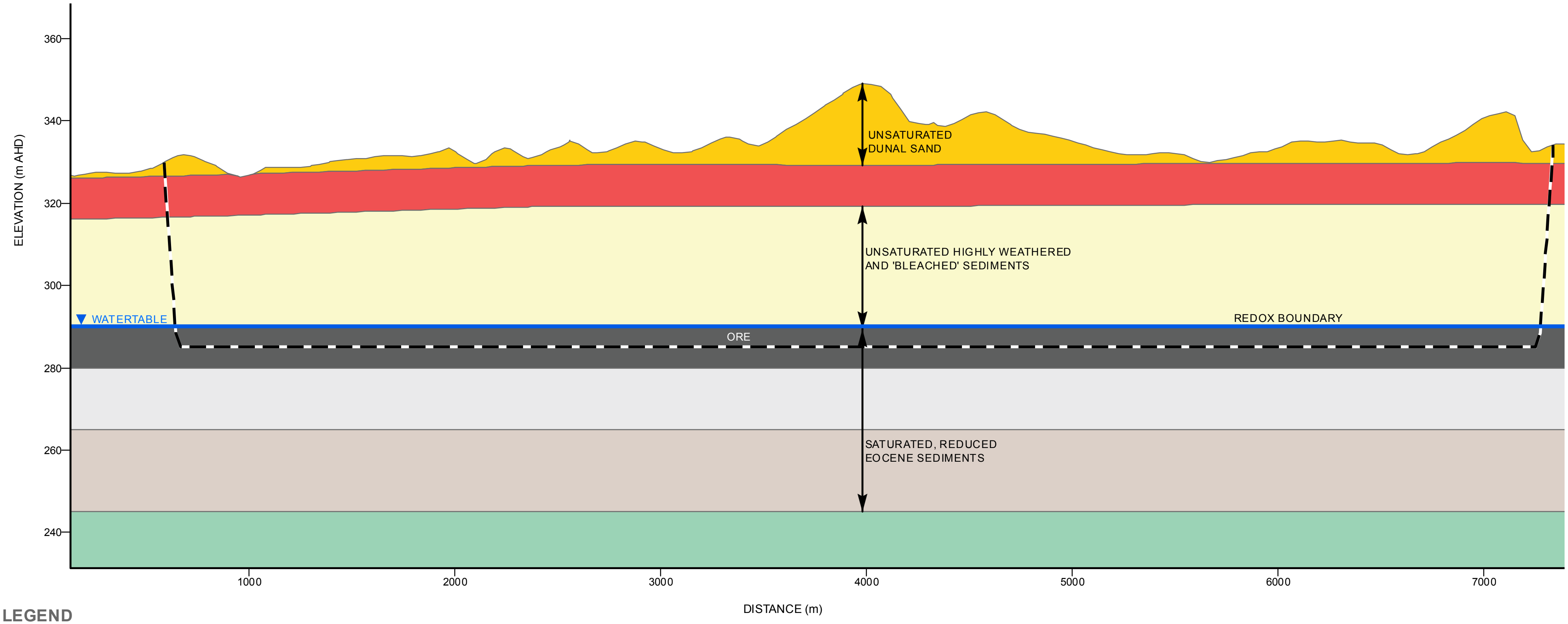
CONSULTANT
Golder Associates

YYYY-MM-DD	2015-10-31
DESIGNED	MS
PREPARED	MS
REVIEWED	EWC
APPROVED	EWC

TITLE
MAP SHOWING THE BASEMENT DEPTHS OF THE PALEODRAINAGE CHANNEL

PROJECT NO.	CONTROL	REV.	FIGURE
1540340	H1	0	7.3

Path: G:\Spatial_Information_Group\GIS_WORKSPACE_AUSTRALIA\01_WA\SH5107_MINIGWAL\1540340\Projects\APPENDIX\Rev0\1540340-H1-F007.4-Rev0.mxd



LEGEND

- PROPOSED MINE PIT
- QUATERNARY SEDIMENTS
- MIOCENE SEDIMENTS
- OXIDISED EOCENE SEDIMENTS
- U-ENRICHED LIGNITE, CLAY, SILT
- REDUCED EOCENE SEDIMENTS
- HIGH PERMEABILITY BASAL SAND
- PERMIAN SEDIMENTS (BASEMENT)

0 10 20 30 40 50
V 1:1,400 METRES

0 200 400 600 800 1,000
H 1:28,000 METRES

CLIENT
VIMY RESOURCES LIMITED

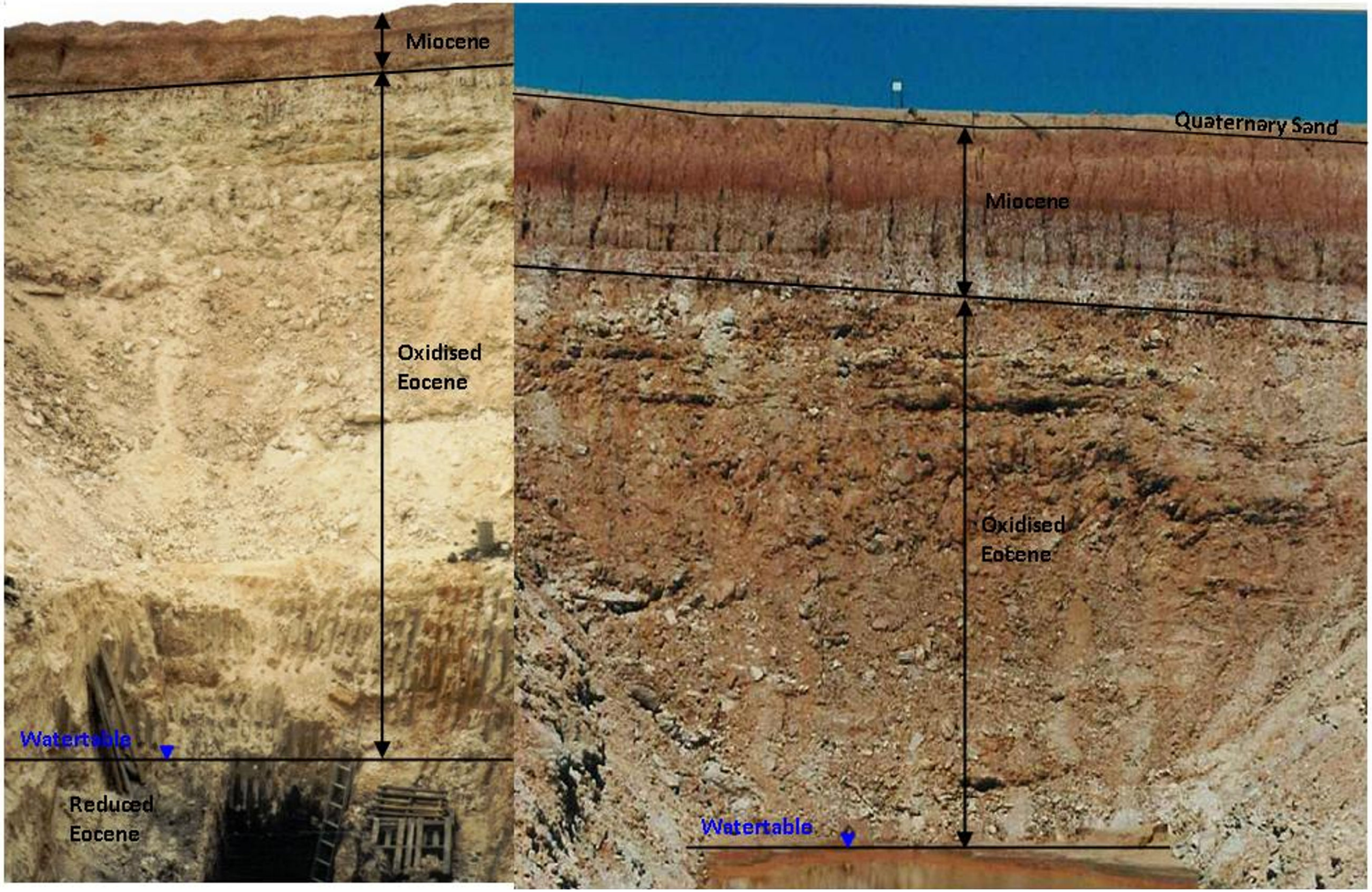
CONSULTANT

YYYY-MM-DD	2015-10-29
DESIGNED	MS
PREPARED	MS
REVIEWED	EWC
APPROVED	EWC

PROJECT
MULGA ROCK URANIUM PROJECT

TITLE
SCHEMATIC DIAGRAM OF THE GEOLOGY WITHIN MRUP

PROJECT NO.	CONTROL	REV.	FIGURE
1540340	H1	0	7.4



CLIENT
VIMY RESOURCES LIMITED

PROJECT
MULGA ROCK URANIUM PROJECT

CONSULTANT
Golder Associates

YYYY-MM-DD	2015-10-31
DESIGNED	MS
PREPARED	MS
REVIEWED	EWC
APPROVED	EWC

TITLE
MORPHOLOGICAL CHARACTERISTIC OF THE SEDIMENTARY SEQUENCE OVERLYING THE OREBODY

PROJECT NO.	CONTROL	REV.	FIGURE
1540340	H1	0	7.5

7.3.2 Geochemical Studies and AMD potential

Geochemical characterisation of the overburden and ore materials has been undertaken by ANSTO (2015), SWC (2015a, b), and extensively assayed during geological drilling. In this work, the multi-elemental composition of the solid-phase has been quantified, either using ICP-OES/MS or XRF and standard acid rock drainage (ARD) techniques (i.e. AMIRA, 2002), whilst the potential for mobilisation of metals and metalloids were determined using the Australian Standard Leach Procedure (ASLP) with site water as the extractant. The results of this geochemical characterisation are summarised below:

All overburden materials to within 2–5m of the water table (i.e. associated with the capillary fringe) is considered geochemically benign, and classified as Non-Acid Forming (NAF), with negligible AMD potential.

The basal 2–5m of the oxidised Eocene sediments (overburden) is likely contain residual sulfides and elevated mobile metals, and thus should be preferentially placed at the base of the mine void and preferably below the recovered groundwater level.

The overburden materials are inherently moderately acidic (pH 4–6) and have low salinities (EC < 100mS/m) in response to the extensive weathering and leaching discussed above.

The ore material is classified as Potential Acid Forming (PAF), with average Total S contents of 1.64% across the orebody and an associated sulphide-S content (80–90% of the Total S) of 1.3–1.5%. This equates to a Maximum Potential Acidity (MPA) of around 43kg H_2SO_4/t. Given the ore material also exists in an acid condition, due to previous (and possibly contemporaneous) sulphide oxidation, it contains no effective or readily available Acid Neutralising Capacity (ANC), and thus the MPA is equivalent to the Net Acid Producing Potential (NAPP). The corresponding Net Acid Generation (NAG) of the orebody varies from 15 to 57 H_2SO_4/t.

ASLP testing of the Ore material shows that only Cd, Co, Fe, Se and Zn are expected to leach from the ore (lignite) materials, with all other elements strongly retained in the solid phase (i.e. through strong organic-metal complexes); hence not mobile to leaching solutions

7.3.3 Physical Studies

Field observations of the overburden materials indicate high sand and silt and are expected to be permeable. They have low salinities and often high to very high sodicities (ESP > 20).

All Quaternary sandy soils assessed were determined to be stable and will likely yield limited sediment loss, given their sandy nature (i.e. >95% sand) and very high infiltration rates.

7.3.4 Implications for Mine Closure

Physical and geochemical characterisation identified that whilst the overburden materials are considered geochemically benign and unlikely to impact on revegetation growth, their less than optimal physical characteristics and high propensity to disperse and hard-set nature means that they should not be used near the surface of the OL. The OL comprised of this material is required to be covered by a minimum of a 1m thick layer of Quaternary sand to prevent them from impacting on the structural integrity and sustainability of the post-mine landforms and the surrounding environment through sediment loss.

7.4 Soil and Landform Characteristics

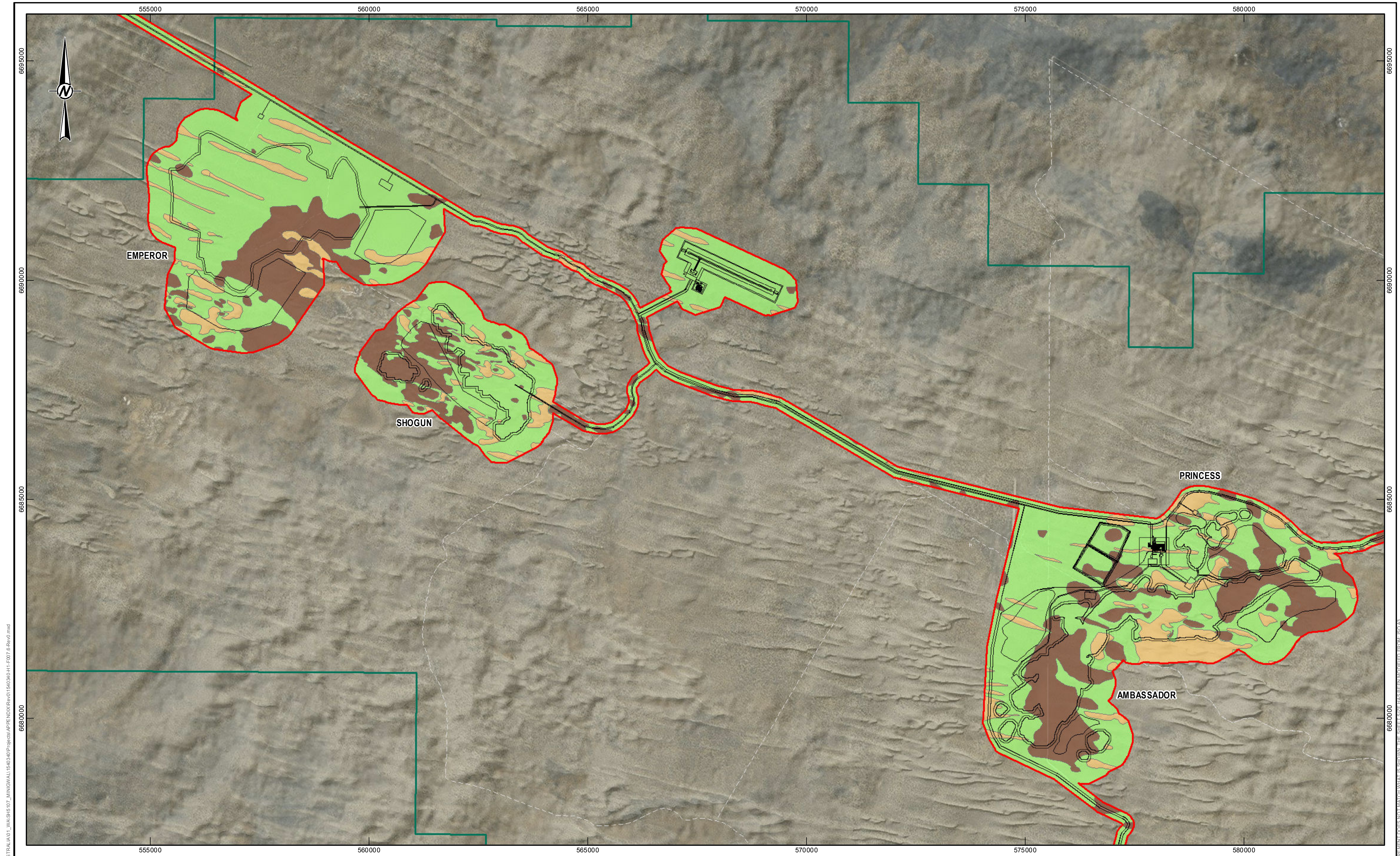
All dunal sands are physically stable, due to their sandy nature, but they have negligible water holding or nutrient retention capacity. Consequently, the thickness of the sand cover, and the distribution of the SMU, governs the distribution of the vegetation across the MRUP. A map showing the distribution of the soils across the MRUP is provided in Figure 7.6.

The Soil-Landscape Units (SLU) across the MRUP have been mapped and characterised by SWC (2015b). The distributions of the SLU or Soil Mapping Units (SMU; as defined in SWC, 2015b) are governed by thickness of the Quaternary sand overlying the underlying Miocene sediments. The MRUP landscape is effectively composed of just three SMU:

- SMU 1: Deep Dunal Sands – forms the dominant dunes of the region, with > 5m thick deep yellow sands,
- SMU 2: Deep Sandy Duplex – represents the transition between SMU 1 and 3, and consists of 3–5m of yellow sand, and
- SMU 3: Calcareous loam – effectively represents the top of the Miocene surface and composed of calcareous (often consolidated) loam.

7.4.1 Implications for Mine Closure

Manipulation of the thickness of the Quaternary sand cover over the post-mine landforms will control the nature or type of revegetation that will be sustainably supported by the reconstructed profile. A sand cover is required over all post-mine landforms to protect the underlying clayey overburden materials from developing adverse physical properties (i.e. to act as both an evaporative and rainfall buffer). Consideration needs to be given to the highly duplex nature of the reconstructed profile, where erodible sands are placed directly over low permeable clays. This is particularly important on the batter slopes of these landforms, as subsurface perching and lateral flows may results if not managed appropriately.



LEGEND

- MINOR ROAD/TRACK
- ROAD
- INFRASTRUCTURE
- MRUP DEVELOPMENT ENVELOPE
- PROJECT BOUNDARY (MINING TENURE)
- SMU 1: DEEP DUNAL SANDS
- SMU 2: SANDY DUPLEX SOILS
- SMU 3: CALCAREOUS LOAMY SOILS

NOTES

1. COORDINATE SYSTEM: GDA 1994 MGA ZONE 51

REFERENCE

SMU AND INFRASTRUCTURE DATA PROVIDED BY CLIENT
AERIAL IMAGERY SOURCED FROM ESRI ONLINE
TOPOGRAPHY BASED ON NATIONAL DEM 1 S SOURCED FROM GEOSCIENCE AUSTRALIA

0 1 2 3 4 5
1:80,000 KILOMETRES

CLIENT	VIMY RESOURCES LIMITED
PROJECT	MULGA ROCK URANIUM PROJECT
CONSULTANT	Golder Associates
YYYY-MM-DD	2015-10-29
DESIGNED	MS
PREPARED	MS
REVIEWED	EWC
APPROVED	EWC
TITLE	SOIL DISTRIBUTION ACROSS THE MRUP
PROJECT NO.	1540340
CONTROL	H1
REV.	0
FIGURE	7.6

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A3
25mm

7.5 Surface Water

No surface water occurs within the MRUP, or the immediately surrounds, and the geomorphic controls and sandy nature of the surface soils, will limit the generation of any surface water flows. Accumulation of surface water is confined to the localised topographic depressions (i.e. inter-dunal swales) and these have sufficient storage capacity and infiltration properties to retain a 1:100 year 72 hour event (approximately 158mm of rainfall) without overtopping. Consequently, the potential for these depressions to form a connected system that allows for defined stream flow is considered small and unlikely.

7.5.1 Implications for Mine Closure

Mine closure design should not need to accommodate surface runoff except considering the shapes of features such as overburden landforms. The placement of OL within inter-dunal swales is not anticipated to impair the ability for these topographic features to retain a 1:100 year, 72 hour event.

7.6 Groundwater

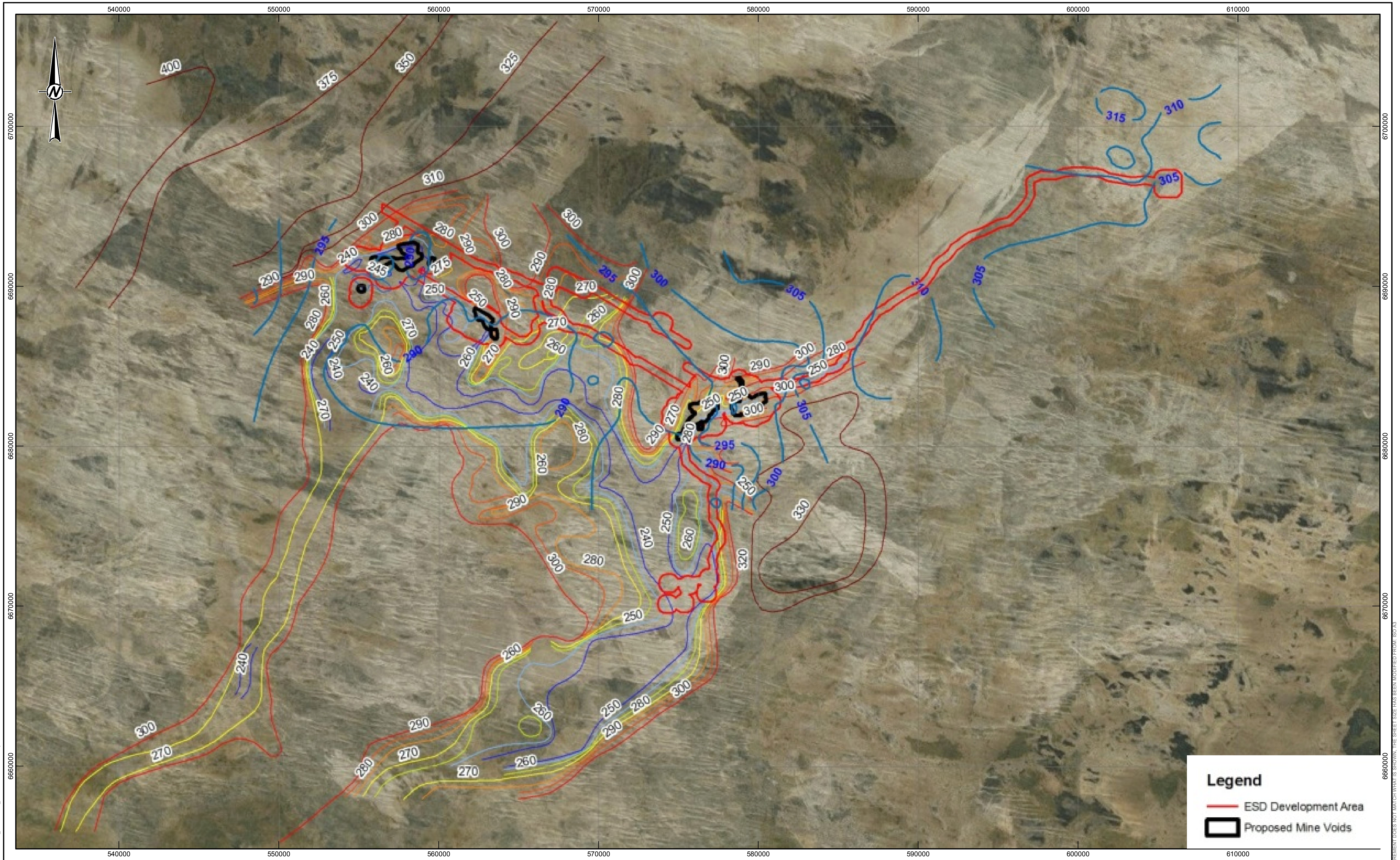
Groundwater investigations (to H3 standard) of the MRUP, including the mining area, and extraction and re-injection borefields, have been undertaken by Rockwater (2015a, b).

Groundwater within the paleodrainage channel, that encompasses the mining areas and re-injection borefield, is typically confined to the Eocene sediments and does not extend into the surrounding Cretaceous to Permian sediments. It has an elevation of around 290mAHD, and given the basement depth of the paleodrainage channel is approximately 240mAHD, the thickness of the aquifer is around 50m (Figure 7.7). Hydraulic gradients within the oxbow paleodrainage channel are very low (i.e. < 0.002; Rockwater, 2015a) and subsequently groundwater flow is sluggish through this system, and replenished only by infiltrating rainfall. The groundwater in the palaeochannel is typically acidic (pH 4–6), hypersaline (TDS > 30,000mg/L) and contains elevated levels of elevated levels of Cd, Co, Cu, Ni, Pb and Zn.

Groundwater within the extraction borefield (Kakarook) is hosted in a graben-horst structure in the AFP. This basin has subsequently been filled with coarse sediment and scree, creating a large unconfined aquifer that extends for over 20km in length and hold over 90 times the total water requirements of the MRUP (Rockwater, 2015b). This borefield is separate from the palaeochannel aquifer and no connectivity likely occurs in the MRUP. The water within the borefield aquifer is of good quality, and is relatively non-saline with TDS values < 10,000mg/L and circum-neutral pH.

7.6.1 Implications for Mine Closure

The mine pits to be developed as part of the MRUP only intersect the upper 2–5m of the at least 50m thick palaeochannel aquifer; hence impacts or impediments on groundwater flows caused by mining are likely to be negligible. Strong density stratification exists within this aquifer and thus any seepage from the mine pits or proposed above- and below-ground TSFs will be partitioned in the upper portion of the aquifer and ‘forced’ through the carbonaceous rich aquifer sediments that act effectively as a permeable reactive barrier (PRB) likely to strip-out elevated metals or metalloids. This process has been modelled by GHD (2015b), and it has shown that no long-term changes in groundwater quality, above existing background concentrations, are expected to occur in response to mining. A conceptual hydrogeochemical model for the MRUP is presented in Figure 7.8.



NOTES

1. COORDINATE SYSTEM: GDA 1994 MGA ZONE 51

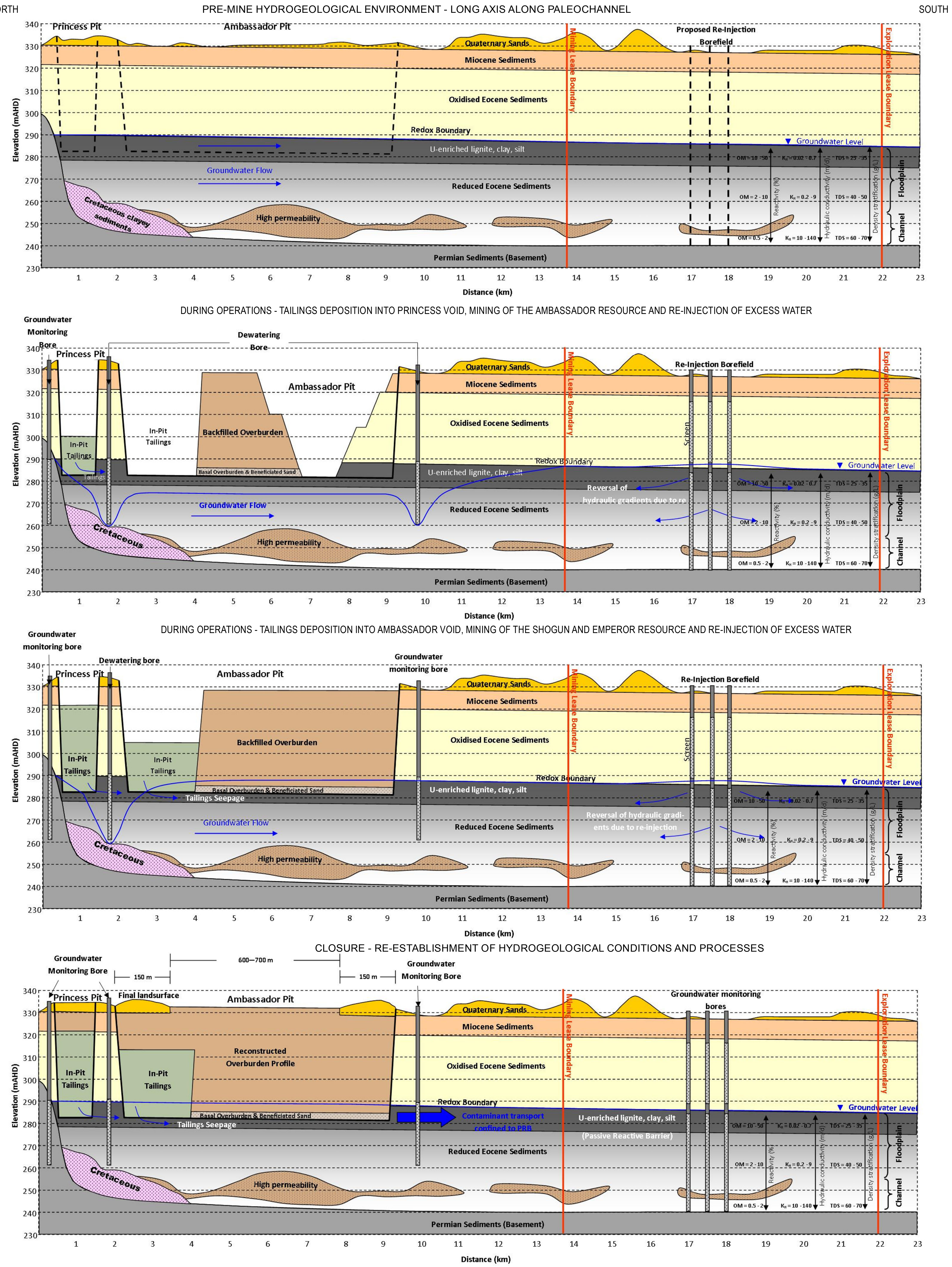
0 2 4 6 8 10

1:220,000 KILOMETRES

CLIENT VIMY RESOURCES LIMITED			PROJECT MULGA ROCK URANIUM PROJECT
CONSULTANT Golder Associates	YYYY-MM-DD	2015-10-31	TITLE **GROUNDWATER LEVELS (BLUE LINES) WITHIN THE PALEODRAINAGE CHANNEL**
	DESIGNED	MS	
	PREPARED	MS	
	REVIEWED	EWC	PROJECT NO. 1540340 · CONTROL H1 · REV. 0 · FIGURE 7.7
	APPROVED	EWC	

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A3

Path: G:\Spatial_Information_Group\GIS_WORKSPACE_AUSTRALIA\01_WA\SH5107_MINIGWAL\1540340\Projects\APPENDIX\Rev0\1540340-H1-F007.8-Rev0.mxd



CLIENT VIMY RESOURCES LIMITED	PROJECT MULGA ROCK URANIUM PROJECT

VIMY RESOURCES

CONSULTANT: Golder Associates

YYYY-MM-DD	2015-10-29
DESIGNED	MS
PREPARED	MS
REVIEWED	EWC
APPROVED	EWC

TITLE
CONCEPTUAL HYDROGEOCHEMICAL MODEL

PROJECT NO.	CONTROL	REV.	FIGURE
1540340	H1	0	7.8

25mm

7.7 Flora

7.7.1 Flora

The MRUP lies entirely within the Vegetation Association 84 in the GVD01 Shield Interim Biogeographic Regionalisation for Australia (IBRA) subregion.

Mapping of the Project area, and vicinity, defined 26 vegetation community types (Figure 7.9 and Figure 7.10) (MCPL 2015c). The majority of the vegetation within and surrounding the Project has not been affected by human activities and prior to the fire was regarded as being Excellent-Pristine based on criteria developed by Keighery (1994) (MCPL 2015).

A total of 335 vascular plant taxa, representing approximately 140 genera and 43 families, have been recorded in numerous surveys by MCPL in the MRUP area since 2007 (MCPL 2015a). The majority of taxa recorded were from Fabaceae (52 taxa), Myrtaceae (40 taxa), Goodeniaceae (25 taxa) and Proteaceae (23 taxa) families, and typical of the wider GVD flora. Nine annual and/or biennial species, equating to approximately 2.7% of the total number of taxa, were recorded (MCPL 2015a).

7.7.1.1 Threatened and Priority Flora

No threatened flora pursuant to Subsection (2) of Section 23F of the *Wildlife Conservation Act* and as listed by the DPaW (2014b) have been recorded in the MRUP area. One State listed Priority 1 (P1) species, *Hibbertia crispula*, is pursuant to Section 179 of the *EPBC Act*, being listed as Vulnerable by the DoE (2015a) and was recorded within the MRUP area (MCPL 2015c). The *Hibbertia crispula* targeted surveys resulted in an estimated 14,269 plants recorded on dunes in and surrounding the Project (MCPL 2015c). The preferred *Hibbertia crispula* habitat is associated with the S6 vegetation community, consistently recorded on the crests of yellow sand dunes (both longitudinal and interconnected) (MCPL 2013). Of the 89 dunes surveyed, only five dunes with *Hibbertia crispula* occur within the Project Development Envelope representing approximately 225 plants (MCPL 2015c). The 2014 fire affected 78% of the Project Disturbance Footprint and 74% of the Project Development Envelope. It is estimated that 76% (approximately 10,823 plants) were potentially impacted by this fire and that many of these individual plants will no longer exist.

A total of 13 other Priority Flora species have been recorded in the MRUP area from the 2007-2015 surveys (MCPL 2015c).

7.7.1.2 Weeds and Declared Plants

No introduced (weed) species or declared plants were recorded in any plant surveys for the MRUP.

Vegetation community E9 is highly restricted to the MRUP area, with 88.58% of its mapped distribution within the Development Envelope entirely. However, only 13.53% of the mapped distribution of E9 is within the Disturbance Footprint. Vegetation community C1 is restricted to areas between the Emperor and Shogun pits and has a high proportion (18.28%) of the mapped community within the Disturbance Footprint.

Vegetation communities E5, E6, E7, E14 and S1have between 60-75% of their mapped distributions within the Development Envelope. Of these, E5, E6 and E7 also have a relatively high proportion of their mapped distributions (25-38%) within the Disturbance Footprint. Vegetation communities S1 and E14 cover less than 19ha of the Development Envelope area, are highly restricted to MRUP area and have a high proportion of their mapped distribution within the Development Envelope entirely. Vegetation communities E3, E4, E5, E6, E8, S8 and S10 occupy the largest mapped areas (between 500ha to 3,316ha). Vegetation community S6 (of the yellow sand dunes) has 7.36% of the mapped distribution within the Disturbance Footprint and is largely restricted by topography and landform type (MCPL 2015).

Vegetation communities A1 and S2 do not fall within the MRUP Development Envelope and therefore are unlikely to be directly impacted by the MRUP.

Priority Flora species were recorded in 17 of the 26 vegetation communities. The S6 vegetation community contained the majority of the Priority species, including *Hibbertia crispula*, *Dampiera eriantha* and *Malleostemon* sp. Officer Basin (D. Pearson 350) and often *Conospermum toddii*. *Comesperma viscidulum*, *Conospermum toddii*, *Grevillea secunda* and *Olearia arida* were recorded across numerous vegetation communities. *Hakea* sp. was recorded in the 2014 proposed extraction borefield survey in vegetation communities E3 and S9.

Vegetation community E3 was most common across the MRUP (comprising 34.7% of the total mapped area by MCPL) and 11 Priority species have been recorded within this community entirely.

Within the proposed mining and OL Disturbance Footprint vegetation is largely characterised by the vegetation units detailed in Figure 7.11.

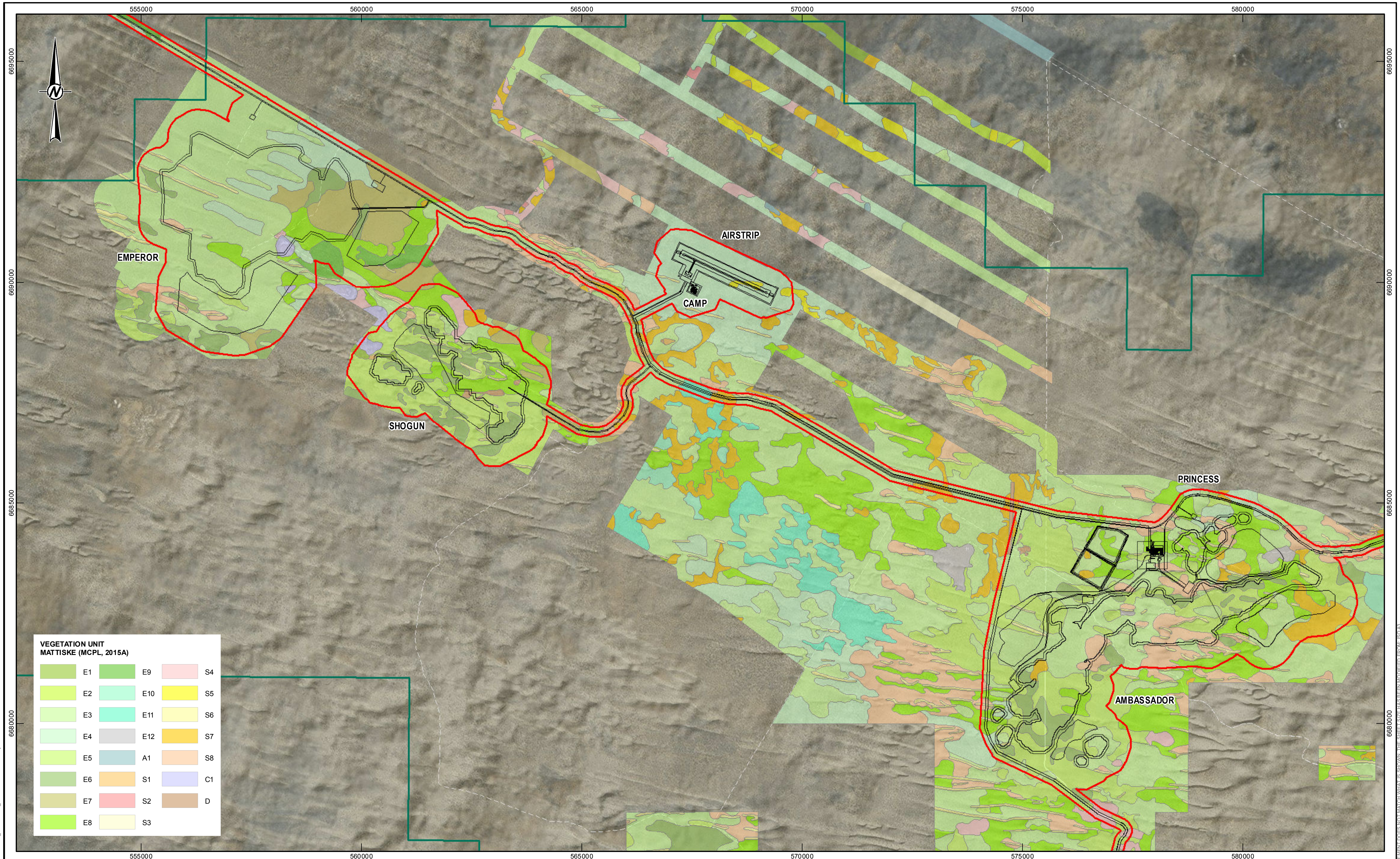
There are no terrestrial GDEs in the Project area. Groundwater within the MRUP is typically around 40m depth, and there is sufficient plant available water (PAW) within the thick overlying unsaturated zone to meet the transpiration requirements of the vegetation. This has been confirmed by geological drilling, whereby roots of the vegetation are restricted to the Quaternary sands and Miocene sediments, with no penetration into the underlying oxidised Eocene sediments.

The proposed mine will not impact on any known Threatened Ecological Communities (TEC), Priority Ecological Communities (PEC) or Environmentally Sensitive Areas (ESA), and none of the vegetation at MRUP was considered regionally significant (MCPL 2015a).

7.7.2 Implications for Mine Closure

The vegetation within the MRUP is representative of the wider GVD and does not contain any known TEC, PEC or ESA. There are no DRF. Few Priority Flora occur within the Disturbance Footprint.

The distribution of vegetation across the MRUP is controlled by the depth of Quaternary sand above the Miocene sediments. This is due primarily to water availability and accessing sufficient plant available water to meet their transpiration requirements. Given the understanding of the distinct vegetation units and their associations with soils and topography, it will be possible to match species from specific vegetation units with construct soil profiles to facilitate the establishment of self-sustaining communities on the constructed landforms. The types of units that will be targeted are outlined in Figure 7.9. The actual resultant species composition will be determined through investigation, trials and monitoring.



LEGEND

- MINOR ROAD/TRACK
- ROAD
- INFRASTRUCTURE
- MRUP DEVELOPMENT ENVELOPE
- PROJECT BOUNDARY (MINING TENURE)

NOTES

1. COORDINATE SYSTEM: GDA 1994 MGA ZONE 51

REFERENCE

INFRASTRUCTURE DATA PROVIDED BY CLIENT
AERIAL IMAGERY SOURCED FROM ESRI ONLINE
TOPOGRAPHY BASED ON NATIONAL DEM 1 S SOURCED FROM GEOSCIENCE AUSTRALIA

0 1 2 3 4 5
1:80,000 KILOMETRES

CLIENT	VIMY RESOURCES LIMITED
CONSULTANT	Golder Associates
YYYY-MM-DD	2015-10-29
DESIGNED	MS
PREPARED	MS
REVIEWED	EWC
APPROVED	EWC

PROJECT
MULGA ROCK URANIUM PROJECT

TITLE
VEGETATION UNIT DISTRIBUTION OVER MINING INFRASTRUCTURE

PROJECT NO.	CONTROL	REV.	FIGURE
1540340	H1	0	7.9

Eucalypt Woodlands

E1 Low Woodland to Low Open Woodland *of Eucalyptus concinna* with *Callitris preissii* over *Westringia cephalantha*, *Melaleuca hamata*, *Acacia colletioides*, *Acacia hemiteles* and *Scaevola spinescens* over *Triodia desertorum*. This community occurs on red-orange sandy loams on flats.

E2 Low Woodland to Open Scrub Mallee of *Eucalyptus trivalva* and *Eucalyptus platycorys* with *Callitris preissii* and *Hakea francisiana* over *Acacia colletioides*, *Acacia hemiteles*, *Melaleuca hamata*, *Westringia cephalantha*, *Bertya dimerostigma* and mixed shrubs over *Triodia desertorum* with occasional emergent *Eucalyptus gongylocarpa*. This community occurs on red-orange sandy loams on flats.

E3 Low Open Woodland of *Eucalyptus gongylocarpa* over *Eucalyptus youngiana*, *Eucalyptus ceratocorys*, *Grevillea juncifolia*, *Hakea francisiana* and *Callitris preissii* over *Acacia helmsiana*, *Cryptandra distigma* and mixed low shrubs over *Triodia desertorum*, *Chrysitrix distigmatosa* and *Lepidobolus deserti*. This community occurs on yellow and yellow-orange sands on flats, slopes and between dunes.

E4 Low Open Woodland of *Eucalyptus gongylocarpa* over *Callitris preissii* with *Hakea francisiana* and *Grevillea juncifolia* over *Bertya dimerostigma*, *Westringia cephalantha* and mixed shrubs over *Triodia rigidissima* and *Triodia desertorum*. This community occurs on orange sands on flats and slopes.

E5 Low Open Woodland of *Eucalyptus rigidula* and *Eucalyptus* sp. Mulga Rock with *Hakea francisiana* and *Grevillea juncifolia* over *Westringia cephalantha*, *Acacia helmsiana*, *Acacia rigens*, *Eremophila platythamnos* subsp. *platythamnos*, *Cryptandra distigma* and mixed low shrubs over *Triodia desertorum*, *Triodia rigidissima* and *Chrysitrix distigmatosa*. This community occurs on yellow and orange sands on flats and slopes.

E6 Open Scrub Mallee to Very Open Scrub Mallee of *Eucalyptus rigidula* and/or *Eucalyptus* sp. Mulga Rock over *Acacia hemiteles*, *Hakea francisiana*, *Westringia rigida*, *Cryptandra distigma*, *Grevillea acuaria* and mixed low shrubs over *Triodia rigidissima* with *Halgania cyanea*. This community occurs on red-orange sandy loams on flats and low lying swales.

E7 Open Scrub Mallee to Very Open Scrub Mallee of varying *Eucalyptus* spp. over *Grevillea acuaria*, *Acacia hemiteles*, *Cryptandra distigma*, *Westringia cephalantha* and mixed shrubs over *Triodia desertorum*. This community occurs on red-orange sandy loams in low lying swales.

E8 Open Scrub Mallee to Very Open Scrub Mallee of *Eucalyptus ceratocorys* and *Eucalyptus mannensis* subsp. *mannensis* with *Eucalyptus youngiana*, *Hakea francisiana* and *Grevillea juncifolia* over *Acacia fragilis*, *Acacia helmsiana* and mixed low shrubs over *Triodia desertorum*, *Chrysitrix distigmatosa* and *Lepidobolus deserti* with emergent *Eucalyptus gongylocarpa*. This community occurs on yellow sands on flats and slopes.

E9 Very Open Scrub Mallee of *Eucalyptus mannensis* subsp. *mannensis* with *Grevillea juncifolia* and *Hakea francisiana* over *Cryptandra distigma*, *Acacia ligulata* and mixed low shrubs over *Triodia desertorum* with emergent *Eucalyptus gongylocarpa*. This community occurs on yellow sand on slopes and flats.

E10 Open Scrub Mallee to Very Open Scrub Mallee of *Eucalyptus concinna* with *Eucalyptus platycorys* over *Hakea francisiana*, *Cryptandra distigma*, *Acacia rigens* and mixed shrubs over *Triodia rigidissima* and *Chrysitrix distigmatosa* with *Leptosema chambersii*. This community occurs on orange-red sandy loams on slopes and flats.

E11 Open Scrub Mallee to Very Open Scrub Mallee of *Eucalyptus platycorys* with *Eucalyptus concinna* over *Acacia helmsiana*, *Grevillea juncifolia*, *Hakea francisiana* and mixed shrubs over *Triodia desertorum* and *Chrysitrix distigmatosa*. This community occurs on orange-yellow sandy loams on slopes and flats.

E12 Open Scrub Mallee to Very Open Scrub Mallee of *Eucalyptus trivalva* with *Eucalyptus rigidula* over *Hakea francisiana*, *Bertya dimerostigma*, *Acacia helmsiana*, *Cryptandra distigma* and *Grevillea juncifolia* over *Triodia rigidissima*, *Triodia desertorum*, *Chrysitrix distigmatosa* and *Halgania cyanea*. This community occurs on orange and red-orange sandy loams on flats and swales.

E13: Low open mallee woodland of *Eucalyptus youngiana* over low shrubland of *Grevillea didymobotrya* subsp. *didymobotrya*, *Cryptandra distigma*, *Banksia elderiana*, *Calothamnus gilesii*, *Acacia desertorum* var. *desertorum* and other *Acacia* spp. over open *Triodia* spp. hummock grassland with *Chrysitrix distigmatosa* and some low myrtaceous shrubs (and occasional emergent *Eucalyptus gongylocarpa*). This community occurs on orange-yellow sandy loams on lower slopes and flats.

E14: Low open mallee woodland of *Eucalyptus leptophylla* or *Eucalyptus horistes* over open low shrubland of *Daviesia ulicifolia* subsp. *aridicola*, *Callitris verrucosa* and mixed *Acacia* spp., over *Triodia* spp., *Androcalva melanopetala*, *Dysphania kalpari* and other short-lived perennial or annual herbs. This community occurs on highly leached red-brown-white sandy-clayey soils in swales and drainage areas.

Acacia Woodland

A1 Low Woodland to Tall Shrubland of *Acacia aneura* over *Aluta maisonneuvei* subsp. *auriculata*, *Eremophila latrobei*, *Phebalium canaliculatum*, *Prostanthera* spp. and mixed shrubs. This community occurs on orange sandy loams or clay loams with some laterite pebbles on flats.

Mixed Shrublands

S1 Shrubland of *Melaleuca hamata* with *Hakea francisiana* and mixed shrubs over *Triodia desertorum* with emergent *Eucalyptus* spp. This community occurs on yellow and orange sand on slopes and flats.

S2 Shrubland of *Acacia sibina* with *Grevillea juncifolia* and *Eucalyptus youngiana* over *Phebalium canaliculatum*, *Grevillea acuaria* and mixed shrubs over *Triodia desertorum*. This community occurs on red clay loams in seasonally wet areas.

S3 Shrubland of *Allocasuarina spinosissima* and *Allocasuarina acutivalvis* subsp. *acutivalvis* with *Grevillea juncifolia* and *Hakea francisiana* over *Triodia desertorum* with emergent *Eucalyptus youngiana* and *Eucalyptus gongylocarpa*. This community occurs on yellow sand on slopes.

S4 Shrubland to Open Shrubland of *Acacia desertorum* var. *desertorum* and mixed low shrubs over *Triodia desertorum* with occasional emergent mallee *Eucalyptus* species. This community occurs on yellow or orange sands on mid-slopes.

S5 Shrubland to Open Shrubland of *Acacia sibina* with *Phebalium tuberculosum* over *Enekbatus eremaeus*, *Bertya dimerostigma*, *Homalocalyx thryptomenoides*, *Baeckea* sp. Great Victoria Desert (A.S. Weston 14813), *Melaleuca hamata* and mixed low shrubs over *Triodia desertorum* and *Chrysitrix distigmatosa* with occasional emergent *Eucalyptus gongylocarpa* and *Eucalyptus youngiana*. This community occurs on yellow-orange sands on flats and lower slopes.

S6 Low Shrubland of *Thryptomene biseriata*, *Allocasuarina spinosissima*, *Allocasuarina acutivalvis* subsp. *acutivalvis*, *Jacksonia arida*, *Calothamnus gilesii*, *Acacia fragilis*, *Conospermum toddii* (P4), *Pityrodia lepidota*, *Lomandra leucocephala*, *Anthotroche pannosa* and mixed low shrubs over *Triodia desertorum* with *Lepidobolus deserti* with emergent *Eucalyptus gongylocarpa*, *Eucalyptus youngiana*, *Eucalyptus ceratocorys* and *Eucalyptus mannensis* subsp. *mannensis*. This community occurs on yellow sand dunes.

S7 Low Shrubland to Low Open Shrubland of *Enekbatus eremaeus*, *Acacia desertorum* var. *desertorum*, *Verticordia helmsii*, *Homalocalyx thryptomenoides*, *Leptospermum fastigiatum*, *Allocasuarina spinosissima*, *Baeckea* sp. Great Victoria Desert (A.S. Weston 14813), *Leptosema chambersii* and mixed low shrubs over *Triodia desertorum* and *Chrysitrix distigmatosa* with occasional emergent mallee *Eucalyptus* species, *Grevillea juncifolia* and *Hakea francisiana*. This community occurs on yellow and orange sands on lower slopes, undulating plains and swales.

S8 Low Open Shrubland of *Calothamnus gilesii*, *Persoonia pertinax*, *Thryptomene biseriata*, and *Leptospermum fastigiatum* with *Anthotroche pannosa*, *Acacia helmsiana*, *Microcorys macredieana*, *Micromyrtus stenocalyx* and mixed low shrubs over *Triodia desertorum* with *Lepidobolus deserti*, *Chrysitrix distigmatosa* and *Caustis dioica* with emergent *Eucalyptus youngiana*, *Eucalyptus gongylocarpa* and *Eucalyptus ceratocorys*. This community occurs on yellow sands flats adjacent to yellow sand dunes and undulating sandplains.

S9: Low open shrubland of *Melaleuca hamata* and mixed *Acacia* species (including *Acacia fragilis*, *Acacia ligulata* and *Acacia sibina*) with *Hannafordia bissillii* subsp. *bissillii*, *Grevillea didymobotrya* subsp. *didymobotrya*, *Mirbelia seorsifolia* over *Triodia* spp. hummock grassland with *Leptosema chambersii*, *Chrysitrix distigmatosa*, *Aristida contorta* and *Goodenia xanthosperma*, with emergent eucalypt mallees. This community occurs on orange-red sandy-clay loam, in swales and on flats.

S10: Low open shrubland of *Banksia elderiana*, *Calothamnus gilesii*, *Grevillea didymobotrya* subsp. *didymobotrya*, *Acacia desertorum* var. *desertorum* and *Grevillea secunda* (P4) with *Leptospermum fastigiatum* and emergent *Eucalyptus youngiana* (and *Eucalyptus rosacea*) over *Triodia* spp. hummock grassland with *Chrysitrix distigmatosa*. This community occurs on orange-yellow undulating sandplains and flats.

Chenopod Shrublands

C1 Low Chenopod Shrubland of *Atriplex ?vesicaria* with *Eremophila decipiens* subsp. *decipiens* and *Acacia colletioides*. This community occurs on red-brown clay loams on clay pans. *Callitris preissii* with *Eucalyptus* spp. over mixed shrubs are found in adjacent pockets.

D Disturbed

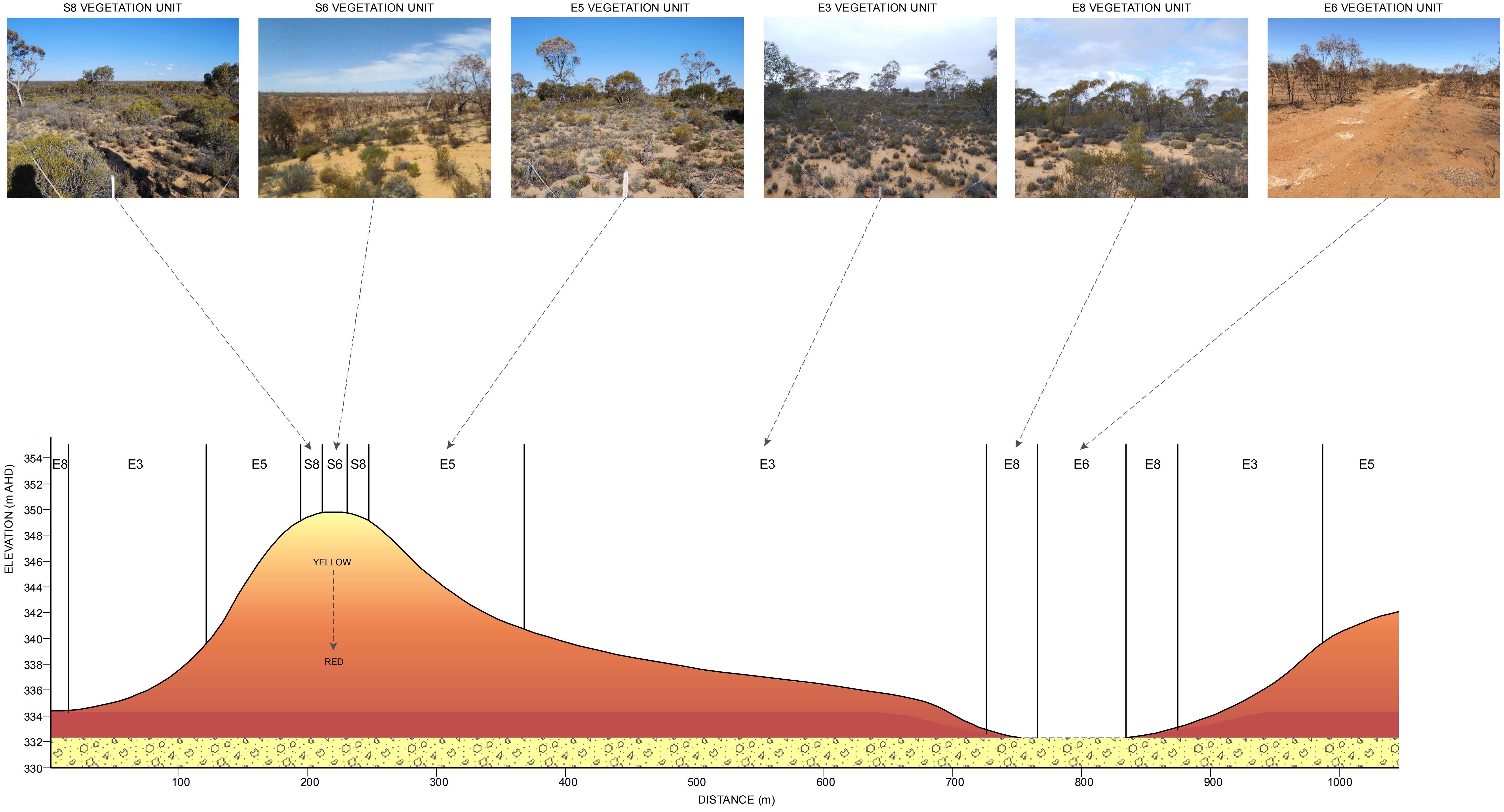
Priority Species

Code	Species	Status
Aen	Acacia eremophila numerous-nerved variant (A.S. George 11924)	P3
Aev	Acacia eremophila var. variabilis	P3
As	Acacia aff. sorophylla	Other
Bs	Baeckea ?sp. Sandstone (C.A. Gardner s.n. 26 Oct. 1963)	P3
Ct	Conospermum toddii	P4
Cta	Caesia talingka ms	P2
Cv	Comesperma viscidulum	P4
Dc	Dicrastylis cundeeleensis	P4
De	Dampiera eriantha	P1
E?u	Eremophila ?undulata	P2
Gs	Grevillea secunda	P4
Hc	Hibbertia crispula	P1 & Vulnerable
Hs139	Hakea sp. (LAC 139 13/04/14)	Other
Hs140	Hakea sp. (LAC 140 13/04/14)	Other
Ic	Isotropis canescens	P2
Le	Labichea eremaea	P3
Lp	Leucopogon aff. planifolius	Other
Mo	Malleostemon sp. Officer Basin (D. Pearson 350)	P2
Nl	Neurachne lanigera	P1
Oa	Olearia arida	P4
Pb	Ptilotus ?blackii	P3
Pc	Physopsis chrysotricha	P2
Sb	Schoenus sp. A1 Boorabbin (K.L. Wilson 2581)	Other
Sg	Styphelia sp. Great Victoria Desert (N. Murdock 44)	P2

REFERENCE

VEGETATION MAPPING - MATTISKE (MCPL, 2015A)

CLIENT: VIMY RESOURCES LIMITED	VIMY RESOURCES		PROJECT: MULGA ROCK URANIUM PROJECT
CONSULTANT: Golder Associates	YYYY-MM-DD	2015-10-29	TITLE: VEGETATION UNIT DISTRIBUTION – LEGEND
	DESIGNED	MS	
	PREPARED	MS	
	REVIEWED	EWC	
	APPROVED	EWC	PROJECT NO. 1540340 · CONTROL H1 · REV. 0 · FIGURE 7.10



LEGEND

- DUNAL SAND
- REDDISH BROWN SANDY LOAM
- CALCRETE

0 5 10 15 20
V 1:300 METRES

0 50 100 150 200
H 1:3,000 METRES

CLIENT VIMY RESOURCES LIMITED	VIMY RESOURCES	PROJECT MULGA ROCK URANIUM PROJECT	
CONSULTANT Golder Associates	YYYY-MM-DD 2015-10-29 DESIGNED MS PREPARED MS REVIEWED EWC APPROVED EWC	TITLE **SOIL AND TOPOGRAPHIC VEGETATION UNIT ASSOCIATION**	
		PROJECT NO. 1540340 CONTROL H1	REV. 0 FIGURE **7.11**

7.8 Fauna

Numerous Level 1 and 2 surveys have been conducted for the MRUP Project area and its surrounds, along with a number of targeted surveys for conservation significant species detailed in Table 7.2.

Table 7.2 List of Fauna Surveys Undertaken in the Project Area

Survey	PER Appendix	Timing of Survey	Comment
Mulga Rock: Flora, fauna and radioecology survey	Appendix B1: W.G. Martinick & Associates Pty Ltd (1986)	June/July 1985	Level 2 Ecological Survey of MRUP was completed for PNC Exploration (Australia) Pty Ltd (PNC). Included collection and preparation of animal and plants samples for radionuclide testing, though no reporting of such tests was sourced.
A fauna survey of the proposed Mulga Rock Project area, Great Victoria Desert, Western Australia	Appendix B2: Ninox Wildlife Consulting (Ninox 2010)	October 2009	Level 2 survey completed for Energy and Minerals Australia Ltd. This survey focused upon the Mulga Rock East area but included a site in the Mulga Rock West area.
Camera Trapping Protocol – Sandhill Dunnart	Appendix B3: Vimy Resources (2015a)	August-November 2014; ongoing	Targeted survey for Sandhill Dunnart (Sminthopsis psammophila) utilising camera traps, with detailed discussion on camera trapping protocol.
A report of the Southern Marsupial Mole, Mulga Rock Uranium Project, Great Victoria Desert, Western Australia	Appendix B5: Ninox Wildlife Consulting (Ninox 2015a)	January 2013 – March 2014	Targeted survey for Southern Marsupial Mole (Notoryctes typhlops) involving trenches surveyed for mole holes.
Fauna assessment for the Malleefowl (Leipoa ocellata)	Appendix B6: Vimy Resources (2015b)	2009–2014 (Helicopter 2009-2010)	Targeted surveys for Malleefowl (Leipoda ocellata) involving helicopter surveys and track surveys.
An updated report on the herpetofauna of the proposed Mulga Rock Project Area, Great Victoria Desert, Western Australia.	Appendix B7: Ninox Wildlife Consulting (Ninox 2015b)	October 2014	Level 1 Desktop Study to updated and complement previous survey completed by Ninox (2010).
Short range endemic fauna at the Mulga Rock Uranium Project	Appendix B8: Bennelongia (2015)	October 2014	Level 1 – desktop study and reconnaissance SRE survey.

Surveys sampled various habitat types using previous vegetation mapping of the Project (MCPL 2008). There was considerable variation in species type and numbers between the two years of survey revealing natural population fluctuations and the probable influence of season of sampling, and preceding rainfall.

7.8.1 Native Mammals

Two level 2 surveys (EPA ref) have been made of the Project area and vicinity (Matinick 1986 and Ninox 2010), with targeted fauna surveys on the Southern Marsupial Mole (Ninox 2015a), herpetofauna (Ninox 2015b), Sandhill Dunnart (Vimy 2015a) and Malleefowl (Vimy 2015b).

During the 1985 survey, 113 specimens of 10 species of small native mammals were recorded. These included eight small dasyurid species and two native rodents Table 7.3.

Table 7.3 Species of Small Mammals Trapped by Martinick (1986)

Scientific Name	Common Name	Numbers Captured
Dasycercus cristicauda	Crest-tailed Mulgara	1
Ningaui ridei	Wongai Ningaui	15
Ningaui yvonneae	Sminthopsis Ningaui	14
Notomys alexis	Spinifex Hopping Mouse	11
Pseudomys hermannburgensis	Sandy Inland Mouse	32
Sminthopsis crassicaudata	Fat-tailed Dunnart	2
Sminthopsis dolichura	Little Long-tailed Dunnart	6
Smithopsis hirtipes	Hairy-footed Dunnart	15
Sminthopsis ooldea	Ooldea Dunnart	5
Sminthopsis psammophila	Sandhill Dunnart	5

Sminthopsis psammophila (Sandhill Dunnart) had not been recorded in Western Australia before this survey. All other species had wide distributions over various parts of arid Australia, although may not be common within their ranges. *Dasycercus blythi* (Brush-tailed mulgara) had been incorrectly identified as *Dasycercus cristicauda* (Crest-tailed Mulgara), in the original report.

Two single specimens of two species of bats were recorded: *Chalinolobus gouldii* (the Little Chocolate Bat) and *Nyctophilus major* (the Greater Long-eared Bat). Bats appeared to only congregate near to the camp lights and above some brackish water tanks.

Macropus fuliginosus (the Grey Kangaroo) was common in the area whilst *Megaleia rufus* (the Red Kangaroo) was observed to the west of the survey area where grasses were more prevalent.

During the 2009 survey, thirteen species of native mammal were recorded. The presence of *Tachyglosus aculetus* (Echidna) was noted due to the presence of scats. *Macropus fuliginosus* (Western Grey Kangaroos) were infrequently observed. Five species of bat were recorded, with *Chalinolobus gouldii* (Gould's Wattled Bat) being the most common and was detected at eight of the ten sites. Dingoes were noted by the presence of footprints.

The highest number of small marsupials recorded was of *Ningaui yvonneae* (Southern Ningaui) and *Sminthopsis hirtipes* (Hairy-footed Dunnart) located at eight of the ten sampling sites. No *Dasycercus blythi* or *Dasycercus cristicauda* (Mulgaras) were recorded during this survey. *Sminthopsis psammophila* (Sandhill Dunnart) were not recorded during this survey despite resampling the Martinick sites of previous captures (Martinick 1985). The number of species and abundance of individual small marsupials varied from 1985 indicating population fluctuations over time (Ninox 2010).

Table 7.4: Species of Small Native Marsupials and Rodents Recorded by Ninox (2010)

Scientific Name	Common Name	Numbers Captured
Ningaui ridei	Wongai Ningaui	4
Ningaui yvonneae	Southern Ningaui	22
Pseudomys hermannsburgensis	Sandy Inland Mouse	2
Sminthopsis dolichura	Little Long-tailed Dunnart	8
Sminthopsis hirtipes	Hairy-footed Dunnart	20

7.8.2 Birds

A total of 38 species of birds have been recorded during sampling at the area of the Project and vicinity with 25 species recorded in 1985 and 28 recorded in 2009 with only 16 species being common between the two sampling periods (Ninox 2010). No bird species of conservation significance have been surveyed at the Project area.

7.8.3 Herpefauna

No amphibians have been recorded within the Development Envelope. A total of 42 species of reptile were recorded during the October 2009 survey with 15 reptile species represented by single individuals, mainly legless lizards and snakes. The most common reptile was the small skink, *Ctenotus schomburkii*, which was the only species to be represented in all ten sampling sites. Two of the 14 reptile species recorded by the trail cameras, had not been previously recorded. These were Woma Python (*Aspidites ramsayi*) and the Gwardar (*Pseudonaja mengdeni*). The total number of reptile species known from the Project from all studies to date is 53. One reptile listed as Vulnerable under both Federal and State legislation which could occur within the MRPA - the Great Desert Skink (*Liopholis kintorei*) - has not been recorded despite targeted searches. One reptile of conservation significance, the Woma (*Aspidites ramsayi*), which is listed under State legislation as Schedule 4, has been recorded within the Development Envelope by both trail cameras and Vimy staff (Ninox 2015b).

7.8.4 Feral Species

Evidence and/or sightings of the house mouse (*Mus musculus*), rabbit (*Oryctolagus cuninulus*), feral cat (*Felis catus*) and one-humped camel (*Camelus dromedarius*) have been recorded during previous Project area and vicinity fauna searches. The camels were particularly common and widespread (Ninox 2005). Wild dogs (*Canis lupus familiaris*), dingoes (*Canis lupus dingo*) and donkeys (*Equus asinus*) have also been surveyed in the Project area (Martinick 1985 and Ninox 2005). Despite this, the condition of the vegetation was still ranked as Excellent-Pristine (MCPL 2015a).

7.8.5 Conservation Significant Fauna

Desktop surveys indicated that a number of conservation significant species may occur in the Project area (Table 7.5).

Table 7.5 List of Conservation Significant Fauna Recorded as Potentially Occurring at the MRUP Area and Immediate Vicinity

Species		Conservation Listing			Observations
Scientific name	Common name	EPBC Act	Wildlife Conservation Act	DPaW	Comments
Notoryctes typhlops	Southern Marsupial Mole	Endangered	Schedule 1	Endangered	Very low density of 'moleholes' observed at MRUP by trenching.
Sminthopsis psammophila	Sandhill Dunnart	Endangered	Schedule 1	Endangered	Observed in MRUP area in 1985 and more recently recorded by camera trapping
Leipoa ocellata	Malleefowl	Vulnerable	Schedule 1	Vulnerable	No individuals or mounds observed at MRUP, and no suitable habitat located within Disturbance Footprint.
Aspidites ramsayi	Woma Python	-	Schedule 4	P1 (only southwest population)	Opportunistic sightings by Vimy staff
Dasycercus cristicauda	Crest-tailed Mulgara	Vulnerable	Schedule 1	Vulnerable	'D. blythi' incorrectly classified as 'D. cristicauda' in 1985; no recordings during surveys.
Dasycercus blythi	Brush-tailed Mulgara	-	-	Priority 4	1 specimen captured in 1985; no captures since, except for observations by cameras looking for Sandhill Dunnarts.
Lerista puncticauda	Dotty tailed Robust Slider	-	-	Priority 2	Surveyed in Queen Victoria Spring Reserve but no records within MRUP area.
Liopholis kintorei	Great Desert Skink	Vulnerable	Schedule 1	Vulnerable	No records at MRUP.
Merops ornatus	Rainbow Bee-eater	Migratory	Schedule 3	-	Recorded at MRUP in 2009. Observed in 2009
Ardeotis australis	Bustard	-	-	Priority 4	Opportunistic sighting in 1985

The Southern Marsupial Mole (SMM) is most often recorded in the crest and slope of sandy dunes which are vegetated with *Acacia* spp. and other shrubs which is a widespread habitat typical of the sandy deserts. It may also occur in some sandy plains or sandy river flats, especially in areas where aeolian dunes occur nearby. Deep, loose sand appears to be a requirement for the species, and evidence of the animal is more often found on yellower sands than on redder sands. Rocky and hard substrates such as calcrete are likely to represent an impenetrable barrier as animals mostly travel underground and are slow and vulnerable on the surface (DoE 2015). No evidence of the presence of SMM was detected in the costeans inspected by in 2009 (Ninox 2010). During subsequent targeted sampling between January 2013 and March 2014 only five of the 122 trenches surveyed were noted as having soil disturbance present that was identified as mole holes of indeterminate age. The MRUP area was found to have a density of 0.01 mole hole/m^2 within surveyed areas compared to Tropicana with approximately 1.99 molehole/m^2. However, the density of mole holes within the MRUP area is very low when compared to the more central deserts of Finke, West Simpson and East Great Sandy which had a density of 3.8 molehole/m^2 (Ninox 2015a).

The Sandhill Dunnart occurs in semi-arid habitats of sand dunes, often 30–50m high, with an understorey of spinifex (*Triodia* spp.) hummock grass, and an overstorey that varies widely. It has a relatively large distribution across the south-western part of the Great Victoria Desert in both Western Australia and South Australia including the nearby Queen Victoria Spring Nature Reserve in Western Australia. All sites have diverse but open shrub layers and spinifex ranging from 10–70% of the ground cover. Spinifex is a critical habitat component for the species, with hummocks of a particular age and structure necessary for the species to build a nest within the dead centre of larger plants for protection and insulation from the extremes of temperature found in their arid environment (DoE 2015). Fire has been identified as an important element for the continuation of the spinifex habitat required by the Sandhill Dunnart. A lack of fire in older areas of spinifex leads to a break down in its habit from hummocks to large broken rings providing little cover for Sandhill Dunnarts. Fire that is too frequent reduces the size of hummocks providing unsuitable cover. Therefore, frequent burning or absence of burning may render a location unsuitable for the species for many years. A suitable fire interval of 8 to 20 years may be beneficial to the species (DoE 2015). Sandhill Dunnarts were captured at four locations within the Project area in 1985 when the Project was being explored by the Pacific Nuclear Corporation. In spite of subsequent surveys to date only two further specimens were recorded in 2008. Long term occupancy is not assured at sites where it has previously been detected (Ninox 2015a). As the Project area has been extensively burnt, there will be few, if any, individuals currently at the Project site. There is extensive suitable habitat in Western Australia, South Australia and the Northern Territory and it is highly likely that the species will occur at more than the presently known locations (DoE 2015).

Malleefowl occur in semi-arid and arid zones of temperate Australia, occupying shrublands and low woodlands that are dominated by mallee vegetation. It also occurs in other habitat types including eucalypt or native pine *Callitris* woodlands, *Acacia* shrublands, Broombush (*Melaleuca uncinata*) vegetation or coastal heathlands (DoE 2015). Surveys for Malleefowl over the past five years within the Development Envelope and using a range of survey techniques did not identify the presence of Malleefowl or suitable woodland habitat. Targeted searches of suitable remnant Mulga thickets habitat within the MRUP but outside the Development Envelope have also not reported the presence of Malleefowl. Therefore, based on assessment of recent survey data, and the absence of any signs of Malleefowl, it is considered unlikely that a Malleefowl population is present in the Project area (Vimy 2015b).

The Woma Python occurs in the arid zones of Western Australia, favouring open myrtaceous heath on sand plains, and dune fields dominated by spinifex (*Triodia* spp.). Populations also extend from central Australia into the south-western edge of Queensland, and into northern South Australia. The Woma Python was not recorded in the 1985 survey of the MRUP but a road kill specimen was identified in 2008 (Martinick 1986). Although specific searches were made by Ninox, no observations of the species were made (Ninox 2015b). More recently, a camera trapping regime undertaken by Vimy recorded a specimen in the area and it has also been opportunistically observed by Vimy staff on several occasions.

Other species listed in a Matters of National Environmental Significance (MNES) search of the Project, with a 20km buffer (PER Appendix I1), were migratory birds or a wetland species that are not likely to occur in the habitat of the Project.

7.8.6 Short Range Endemic (SRE) Invertebrate Species

Following a desktop study on potential SREs in the area, a reconnaissance survey was undertaken and at least 32 species belonging to seven SRE groups were collected (Bennelongia 2015). Mygalomorph spiders were the most diverse group (15 species), followed by pseudoscorpions (5), scorpions (4), slaters (3), centipedes (2), millipedes (2) and snails (1). Based on available knowledge, 20 (62%) of the 32 species were not considered to be SREs. Of the remaining species, ten had a moderate or high probability of being SREs and have a conservation status: eight mygalomorph spiders, one centipede, and one slater. However, these species occurred in habitats that are common, both within and outside the proposed Project area, and other closely-related species collected were generally more widespread in the Great Victoria Dessert (Bennelongia 2015).

Eleven species were considered a Rank 2 SRE with a moderate probability of being a SRE based on belonging to a group with a high proportion of SRE species, and having either has been collected from single microhabitat or have an ecology or morphology suggesting habitat specialisation and range restriction. Nine potential SRE species were recorded at sample sites only within the proposed Disturbance Footprint. Despite this, it was determined that all of the Rank 2 SREs identified, including those only sampled within the proposed Disturbance Footprint, were likely to be more widespread than the vicinity of the Project area due to the wider occurrence of the habitats in which they occurred, and are therefore unlikely to be threatened by the MRUP Project (Bennelongia 2015).

7.8.7 Subterranean Fauna

A pilot survey for stygofauna was undertaken in February 2013 in groundwater within the proposed Development Envelope. Eleven bores were sampled and the groundwater was found to be mostly acidic and saline. No subterranean fauna were identified from the samples retrieved (Woolard 2015). Stygofauna sampling was also undertaken at the location of the proposed extraction borefield (Kakarook North) and in the eastern most part of the proposed mining area (Emperor) in October 2014 (Rockwater 2015c). No stygofauna were detected in samples from Emperor.

Two species of stygofauna were sampled at Kakarook North during the pilot survey. The aquatic worm (*Enchytraeus sp. 1*) has been recorded in other parts of WA. The aquatic worm *Tubificidae sp. MR1* has not been recorded elsewhere, but it is likely that there is suitable habitat for this species extending well beyond the proposed borefield. The high salinity and low pH of groundwater at the proposed MRUP mining areas indicated an inhospitable habitat for stygofauna.

Troglofauna species were of a moderate diversity when compared with the adjacent Yilgarn Craton and Albany Fraser Province (AFP) (Rockwater 2015c). Three taxa were found to a depth of 10m, at Ambassador, Emperor and Kakarook North, and none were located solely within the MRUP Development Envelope.

The slater *Trichorhina* sp. B21 was sampled in an area over 50km wide, at the Kakarook North, Emperor and Ambassador sites, suggesting that the distribution of the species is widespread (Rockwater 2015c). The pseudocentipede (*Hanseniella sp.* B28) was recorded at Emperor both within and outside of the proposed Development Envelope (Rockwater 2015c). Based on the results of other research, both *Hanseniella* sp. B28 and *Symphella* sp. B19 are likely to have distribution ranges greater than the MRUP area (Rockwater 2015c). It is likely that all troglofauna recorded in the Project area are present at shallow depth in layers that are widespread in the region (Rockwater 2015c). Therefore, it is unlikely that the abundance, diversity and geographic distribution of the troglofauna community or the conservation status of any individual species at MRUP will be impact by the proposed Project (Rockwater 2015c).

7.8.8 Implications for Mine Closure

The main impacts upon fauna are likely to be limited to the loss of individual fauna, loss of habitat and the potential for habitat fragmentation due to the installation of linear infrastructure such as roads and borefield lines.

The implications for mine closure are limited. Vimy plans to establish rehabilitation trials throughout the operation life of the mine to optimise the re-establishment of sustainable vegetation communities and preferred habitats.

7.9 Heritage

7.9.1 Aboriginal Heritage

One Registered Site (ID 1986; Minigwal 3) has been identified within the MRUP and this is located at the edge of the proposed Development Envelope. It is described on the register as an artefact/scatter site and, as such, is an archaeological site (containing physical evidence of past activity) rather than an ethnographic one (significant due to spiritual, social, aesthetic or historical reasons). There were no ethnographic sites recorded during the MRUP surveys, and this is consistent with the lack of any evidence of indigenous (or European settlement) and the absence of any Native Title claim over the area.

7.9.2 Implications for Mine Closure

The implications for mine closure are limited. Consultation with the Wongatha People, the local indigenous group, will continue throughout the life of the mine to ensure, as stakeholders, they are kept informed of the progress of the Project and of any significant changes.

8. Identification and Management of Closure Issues

This Section outlines the identification and management of closure risks for the MRUP. As a starting point, a Closure Risk Identification Workshop (Workshop) was undertaken on 12 October 2015 to provide a facilitated forum for the identification of closure issues (Closure Risk Register) for the following closure domains:

- pits
- overburden landforms
- above ground TSF
- in-pit TSFs
- infrastructure.

For each domain, potential failure modes were considered that have the potential to impact on the objectives of closure. Risks were calculated to prioritise the closure issues and the following hierarchy of controls was used to develop controls for the issues identified (in order of most effective to least effective):

- avoid,
- minimise,
- mitigate,
- rehabilitate
- offset.

The type of control selected was appropriate to the level of risk identified. In all cases the principles of the hierarchy of controls was followed to the guidance of the As Low as Reasonably Achievable (ALARA) strategy. The Closure Risk Identification Workshop report is included as Appendix A.

A total of 61 risks issues were identified and these are summarised in Table 8.1. Following the application of hierarchy of controls, all high risks were able to be recalculated to acceptable risk levels. Key issues identified in the risk assessment are discussed in the sections below.

Table 8.1 Identification Closure Risks

Risk Category	Score	Inherent risk (considers current knowledge base)	Residual risk (post additional control)
Critical risk	17-25	0	0
High risk	11-16	34	0
Medium risk	6-10	26	36
Low risk	1-5	1	25
Total		**61**	**61**

Table 8.2 Identification and Management of Closure Issues

Domain	Closure Tenet or Principle	Identification of Closure Issues	Management of Closure Issues
Backfilled Mine Pits	Safety	• Unconsolidated backfill preferentially consolidates resulting in subsidence. • Mining design will result in voids that have battered slopes in lieu of abandonment bunds which may not meet closure criteria.	• Backfilled Miocene and Eocene materials will be compacted by heavy machinery during construction to avoid the occurrence of subsidence. • Consultation with the regulator and a risk-based approach to safety at closure will determine if abandonment bunds are required and pit depth and slope angle criteria.
	Stability	• Pit edges may be unstable and erosion-prone.	• Geotechnical material characterisation (much already undertaken) will be used to advise stable long-term slope angles suitable for rehabilitation.
	Geotechnical Stability	• Unconsolidated backfill slumps or experiences preferential subsidence resulting in an unstable and undulating post-mine land surface. • Uncontrolled surface water infiltrating into the backfilled material exacerbating preferential consolidation and instability.	• Backfilled Miocene and Eocene materials are compacted by heavy machinery during construction to remove the potential for preferential or localised subsidence. • Surface water flows are limited within the MRUP, due to the predominantly sandy composition of the surface material, and are generally restricted to the localised topographic depressions; subsequently, the catchment and volume of surface water flows is minor and not considered sufficient to enter the backfilled material and exacerbate instability. In addition, the backfilled mine pits will be domed slightly, which will prevent the ingress of surface water.
	Surface or Erosional (Wind/Water) Stability	• Rehabilitated post-mine land surface experiences increased water and wind erosion. This erosion may be exacerbated in response to geotechnical instability (or slumping/subsidence), and variability in permeability leading to tunnel erosion and preferential bypass flow.	• Both the Miocene and Eocene sediments are relatively homogeneous at a macro-level (i.e. primarily clayey) and thus the potential for bypass flow to occur is minimised, with compaction during reconstruction further negating variability in permeability.
	Non-Polluting (Geochemical Stability)	• Overburden backfill materials have undergone preliminary geochemical testing and are not expected to contain potential acid forming (PAF) materials.	• Water balance modelling and geochemical characterisation and leach testing on overburden materials will be used to more comprehensively validate the low risk expected. • Additional baseline data for groundwater quality will be collected as well as ongoing reference monitoring site data.
	Sustainability	• Reconstructed soil profiles cannot sustainably support revegetation.	• There is a good understanding of the limitations of the various soil and overburden materials to revegetation growth, and the capacity of these

Domain	Closure Tenet or Principle	Identification of Closure Issues	Management of Closure Issues
		• Seed ecology of the revegetation species is generally unknown and, therefore, there is uncertainty as to the germination rates of these species (i.e. are they recalcitrant?) • Uncertainty regarding the response of the revegetation species to fire.	materials to support the native vegetation species. The reconstructed soil profiles have, therefore, been designed to ensure that they meet the growth requirements of the proposed revegetation. • Rehabilitation trials will be undertaken during operations to establish the viability and germination rates of the various species selected for revegetation from vegetation types with comparable soil conditions. The incorporation of progressive rehabilitation into mine planning will enable rehabilitation trials and monitoring to provide valuable information as to which species germinate from seed and what specific seed treatments may be required to stimulate germination. • Where appropriate, seed harvesting will be carried out under guidance from DPaW, similar to that carried out in 2010 for the Conospermum toddii (Victoria desert Smokebush) • The ability of the revegetation species to adapt to and survive a fire regime will be investigated – See Gap Analysis (Section 8.1) • Refinement of materials balance from rehabilitation trials results and incorporation back into closure planning activities.
OLs	Safety	• OLs may be unstable.	• Geotechnical material characterisation (much already undertaken) will be used to further refine stable long-term slope angles suitable for rehabilitation.
	Stability	• OLs are currently designed to a height consistent with surrounding natural landforms.	• This risk can be mitigated by determining if the landforms which are significantly higher than those of regional analogues.
	Geotechnical Stability	• Slumping or mass failure of OL or batter slopes.	• The Miocene and Oxidised Eocene materials that will form the central portion of the OL will be excavated at or below field capacity, which is well below the expected Liquid or Plastic Limit of the material; hence, it will have sufficient resistance or strength to prevent slumping. • The potential for subsurface lateral flows, potentially leading to erosion and slumping, to occur in the Quaternary sands is negated by employing the batter slope design outlined in Section 9. Lateral flows are not expected to occur in either this material or at the contact with the underlying clays.
	Surface or	• Excessive water erosion leading to unacceptable rilling or	• The OL batter slopes will be constructed to 10–12° which laboratory-

Domain	Closure Tenet or Principle	Identification of Closure Issues	Management of Closure Issues
	Erosional (Wind/Water) Stability	gullying and release of sediment into the surrounding environment. • Excessive wind erosion of surface sand, diminishing the thickness of the cover system and impacting on the surrounding environment.	scale erosion testing has shown to be stable. Vertical infiltration into the cover sands is typically well above rainfall intensity and, thus, the potential for surface water flow, and erosion, is negated. • The OL has been designed to be no higher than the surrounding sand dunes, which effectively create a protective boundary layer for surfaces at lower elevations. The low batter slope angles will also minimise wind speed acceleration across the surface, which is the driving factor of sediment loss due to wind erosion.
	Non-Polluting (Geochemical Stability)	• Overburden has undergone preliminary geochemical testing and is not expected to contain PAF materials.	• Geochemical characterisation and leach testing on overburden materials will be used to more comprehensively validate the low risk expected. • Additional baseline data for groundwater quality will be collected as well as ongoing reference monitoring site data.
	Sustainability	• Reconstructed soil profiles cannot sustainably support revegetation. • Seed ecology of the revegetation species is generally unknown and therefore there is uncertainty as to the germination rates of these species (i.e. are they recalcitrant?) • Uncertainty regarding the response of the revegetation species to fire. • Uncertainty of final growth medium storage volume and storage locations. Reconstructed soil profiles may not be able to sustainability support vegetation. Potential for disturbance outside of approved areas.	• There is a good understanding of the limitations of the various soil and overburden materials to revegetation growth, and the capacity of these materials to support the native vegetation species. The reconstructed soil profiles have, therefore, been designed to ensure that they meet the growth requirements of the proposed revegetation. • Rehabilitation trials will be undertaken during operations to establish the germination rates of the various revegetation species to be used. The incorporation of progressive rehabilitation into mine planning will enable rehabilitation trials and monitoring to provide valuable information as to what species germinate from seed and what specific seed treatments may be required to stimulate germination. • Rehabilitation works on nearby mine sites will be assessed where appropriate. • The ability of the revegetation species to adapt to and survive a fire regime will be investigated – See Gap Analysis (Section 8.1). • Refinement of materials balance from rehabilitation trials results and incorporation back into closure planning activities.
Above-ground TSF	Safety	• Tailings material preferentially consolidates or excessively shrinks resulting in cracking along the embankment wall contact. Once formed, the size and extent of cracks become	• The potential for further consolidation or shrinkage to occur once the tailings has dried sufficiently to support heavy machinery is considered minimal and, therefore, the risk of cracking along the embankment wall

Domain	Closure Tenet or Principle	Identification of Closure Issues	Management of Closure Issues
		self-perpetuating.	is low. • If needed, establish a practicable method to facilitate the settling of the tailings and these will be incorporated into the Tailings Operating Strategy and Tailings Management Plan to ensure efficient and safe operation of the facility.
	Stability	• Above-ground TSFs may be unstable.	• Geotechnical material characterisation (much already undertaken) will be used to further refine stable long-term slope angles suitable for rehabilitation.
	Geotechnical Stability	• Embankment wall collapses releasing wet tailings into the surrounding environment. • Preferential subsidence resulting in an unstable post-mine land surface and potential tunnel erosion.	• Design and operation of the above ground TSF will be in accordance with the engineering capacity of the facility and adhere to DMP (1999) and ANCOLD (2012) Guidelines for the Design, Construction and Operation of TSFs. • The method of subaqueous deposition will tend to homogenise the tailings material in horizontal layers, reducing the potential for vertical displacement and preferential flows through the tailings.
	Surface or Erosional (Wind/Water) Stability	• Excessive water erosion occurs on the upper surface and batter slopes of the TSF. • Excessive wind erosion occurs on the upper surface and batter slopes of the TSF.	• The potential for water erosion to occur on the upper surface is negated by the Quaternary sand cover to be placed over the more clayey Miocene / oxidised Eocene sediments. Rainfall will rapidly infiltrate the surface, and the sand cover is sufficiently thick to prevent waterlogging. The potential for water erosion on the batter slopes is also negated by the low slope angle of the final slope (i.e. 10 - 12°) and the Quaternary sand cover. The same principle as implemented for the OL cover will be applied to prevent subsurface lateral flows. • The above-ground TSF has been designed to be no higher than the surrounding sand dunes which, effectively, create a protective boundary layer for surfaces at lower elevations. The low batter slope angles will also minimise wind speed acceleration across the surface which is the driving factor of sediment loss due to wind erosion.
	Non-Polluting (Geochemical Stability)	• Tailings materials have undergone preliminary geochemical testing and are not expected to contain PAF materials.	• Geochemical characterisation and leach testing on tails will be used to more comprehensively validate the low risk expected. Additional baseline data for groundwater quality will be collected as well as ongoing reference monitoring site data.

Domain	Closure Tenet or Principle	Identification of Closure Issues	Management of Closure Issues
	Sustainability	• Reconstructed soil profiles cannot sustainably support revegetation. • Seed ecology of the revegetation species is generally unknown and therefore there is uncertainty as to the germination rates of these species (i.e. are they recalcitrant?) • Uncertainty regarding the response of the revegetation species to fire. • Uncertainty of final growth medium storage volume and storage locations. Reconstructed soil profiles may not be able to sustainability support vegetation. Potential for disturbance outside of approved areas.	• There is a good understanding of the limitations of the various soil and overburden materials to revegetation growth, and the capacity of these materials to support the native vegetation species. The reconstructed soil profiles have, therefore, been designed to ensure that they meet the growth requirements of the proposed revegetation. • Rehabilitation trials will be undertaken during operations to establish the germination rates of the various revegetation species to be used. The incorporation of progressive rehabilitation into mine planning will enable rehabilitation trials and monitoring to provide valuable information as to what species germinate from seed and what specific seed treatments may be required to stimulate germination. • The ability of the revegetation species to adapt to and survive a fire regime will be investigated – See Gap Analysis (Section 8.1). • Refinement of materials balance from rehabilitation trials results and incorporation back into closure planning activities.
Below-ground TSF	Safety and Stability	• Tailings material preferentially consolidates resulting in subsidence.	• The potential for further consolidation or shrinkage to occur once the tailings has dried sufficiently to support heavy machinery is considered minimal and, therefore, the risk of subsidence is low. • If needed, establish a practicable method to facilitate the settling of the tailings and these will be incorporated into the Tailings Operating Strategy and Tailings Management Plan to ensure efficient and safe operation of the facility.

Domain	Closure Tenet or Principle	Identification of Closure Issues	Management of Closure Issues
	- Geotechnical Stability	• Preferential subsidence resulting in an unstable and undulating post-mine land surface and potential tunnel erosion. • Uncontrolled surface water infiltrating into the in-pit TSF exacerbating preferential consolidation and instability.	• The potential for further consolidation or shrinkage to occur once the tailings has dried sufficiently to support heavy machinery is considered minimal and therefore the risk of cracking along the embankment wall is low. • Surface water flows are limited within the MRUP, due to the sandy nature and are generally restricted to the localised topographic depressions; subsequently, the catchment and volume of surface water flows is minor and not considered sufficient to enter the backfilled material and exacerbate instability. In addition, the backfilled mine pits will be domed slightly which will prevent the ingress of surface water.
	Surface or Erosional (Wind/Water) Stability	• Rehabilitated post-mine land surface experiences increased water and wind erosion. This erosion may be exacerbated in response to geotechnical instability (or slumping/subsidence), and variability in permeability leading to tunnel erosion and preferential bypass flow.	• The rehabilitated in pit TSF land surface is effectively flat (albeit slightly domed) with a surface cover of Quaternary sand; hence the potential for water erosion is negated. In addition, rehabilitated land surface does not exceed the height of the surrounding sand dunes and thus wind erosion, under prevailing wind conditions, will likely be negligible.
	Non-Polluting (Geochemical Stability)	• Tailings materials have undergone preliminary geochemical testing and are not expected to contain PAF materials	• Geochemical risk can be mitigated by additional geochemical characterisation and leach testing on all tailings materials types. • Undertake a hydrogeological assessment to determine a water balance of the TSF • Geochemical characterisation and leach testing on tails will be used to more comprehensively validate the low risk expected. • Additional baseline data for groundwater quality will be collected as well as ongoing reference monitoring site data.
	Sustainability	• Reconstructed soil profiles cannot sustainably support revegetation. • Seed ecology of the revegetation species is generally unknown and therefore there is uncertainty as to the germination rates of these species (i.e. are they recalcitrant?) • Uncertainty regarding the response of the revegetation species to fire.	• There is a good understanding of the limitations of the various soil and overburden materials to revegetation growth, and the capacity of these materials to support the native vegetation species. The reconstructed soil profiles have, therefore, been designed to ensure that they meet the growth requirements of the proposed revegetation. • Rehabilitation trials will be undertaken during operations to establish the germination rates of the various revegetation species to be used. The incorporation of progressive rehabilitation into mine planning will enable

Domain	Closure Tenet or Principle	Identification of Closure Issues	Management of Closure Issues
		• Uncertainty of final growth medium storage volume and storage locations. Reconstructed soil profiles may not be able to sustainability support vegetation. Potential for disturbance outside of approved areas.	rehabilitation trials and monitoring to provide valuable information as to what species germinate from seed and what specific seed treatments may be required to stimulate or enhance germination. • The ability of the revegetation species to adapt to and survive a fire regime will be investigated – See Gap Analysis (Section 8.1). • Refinement of materials balance from rehabilitation trials results and incorporation back into closure planning activities.
Infrastructure	Safety	• Inadvertent access and harm to the public and fauna	• All above ground inert infrastructure materials that may be considered hazardous to people and fauna will be removed and disposed of appropriately.
	Stability	• Excessive wind and water erosion	• All disturbed infrastructure areas will be reshaped to restore its general baseline hydrological function and/or the original surface topography. As there is no change in surface shape, wind erosion should be kept to a minimum.
	Non-Polluting (Geochemical Stability)	• Physical (i.e. tailings spills) and chemical (i.e. chemical spills) contamination	• All material identified as contaminated will either be remediated to DER guidelines or will be removed to storage in an appropriate non-polluting facility such as a TSF. • Additional baseline data for groundwater quality will be collected as well as ongoing reference monitoring site data.
	Sustainability	• Poor rehabilitation growth and/or sustainability due to physical or chemical limitations • Uncertainty of final growth medium storage volume and storage locations. Reconstructed soil profiles may not be able to sustainability support vegetation. Potential for disturbance outside of approved areas.	• All disturbed infrastructure areas will have any compaction broken up. Once this occurs, the *in situ* soil profile will be accessible which will ensure rehabilitation success. • Refinement of materials balance from rehabilitation trials results and incorporation back into closure planning activities.

8.1 Gap Analysis

Following the review and integration of the Closure Data (Section 7) and the Identification and Management of Closure Issues (Section 8), identified gaps in the understanding of closure processes at the MRUP are listed in Table 8.3.

Table 8.3 Identified Gaps in Closure Understanding and Proposed Strategies to Fill these Gaps

Area	Knowledge gap	Gap-addressing strategy
Geotechnical	• Rheological and hydraulic properties of tailings material are currently unknown; and this will influence predicted seepage from the TSF.	• Geotechnical testing will be undertaken as part of the Definitive Feasibility Study (DFS) for MRUP.
Geochemistry	• Geochemical weathering rates of the tailings and ore materials over time is currently unknown, with current testwork focused only on static programs.	• Sequential and/or kinetic testing of representative waste materials will be undertaken.
Sustainability	• Response of revegetation species to fire and successional processes that follow a fire event are currently unknown.	• Literature review of fire ecology for this area. • Vegetation assemblage monitoring of appropriate analogue sites. • Trials on the response of rehabilitation to fire.
	• The propagation ecology for the proposed revegetation species is currently unknown	• Conduct trials to establish the germination rates of the vegetation assemblage to be used in rehabilitation.
	• Propagation of recalcitrant species is unknown and this information is important in setting practicable completion criteria.	• Monitoring will determine revegetation species composition and trials will be undertaken to test the efficacy of propagation pre-treatments.
	• Growth requirements of native vegetation for rehabilitation are currently unknown. Understanding the requirement of this will assist in optimising rehabilitation methodologies.	• Undertake plant water use measurements to quantify water use requirements of the native vegetation.
	• There is a potential need for microtopographic undulation on reshaped surfaces to assist vegetation regrowth Microtopography significance and practicable construction methods are currently unknown.	• Conduct field trials to test need for microtopography and to determine practicable surface treatments for microtopography.

8.2 Closure Studies and Trials

Vimy understands that it is imperative to gain site specific information to assist in the continual development and improvement of rehabilitation techniques for the MRUP site. Once mining commences, trials will be established for different closure domains and will investigate selected variables to determine the best approach for the rehabilitation of the various closure domains. The selected approach will be continually refined through ongoing trials and monitoring. Trials and studies will assess:

- appropriate seed mixes; seed mixes will be initially selected from species comprising the vegetation units best suited to the topography of landform being rehabilitated and the constructed growth medium profile; the species comprising the vegetation units will be selected based on desired traits (e.g. adaptability, rooting depth, presence of lignotubers, etc.),
- appropriate seeding rates,
- appropriate seed treatments,
- seeding methodologies to minimise disturbance and maximise rehabilitation success,
- viability of provincial seed,
- modified growth medium profile and depth,
- amelioration of the top layer of the modified growth medium (type and rate) and
- geochemical characterisation of materials used to construct waste landforms.

Additional trials and studies that may also be considered include:

- assess the effect of fire upon early germinants, establishing vegetation and specific flora in nearby vegetation associations,
- assess the use of *Labichea eremaea* and *Dicrastylis cundeeleensis* as colonising species as they are commonly recorded in burnt areas (MCPL 2015).

Trials will commence within three years of commencing operations. The results of such trial work will refine the rehabilitation methodology and will supplement further investigations on landform design to facilitate closure objectives being met for the MRUP success.

8.2.1 Shogun Historical Rehabilitation Trial

Closure studies will also include historical rehabilitation already existing at MRUP. Information on historical rehabilitation practices is largely currently anecdotal with few records available.

However, the most significant example is a rehabilitated trial pit on the Shogun deposit. In 1994 this trial pit was backfilled with mixed Miocene and oxidised Eocene geologies (as per the current mine plan). The salvaged sand was spread across the disturbed site at a depth of 10cm and then contour ripped. Nearby Mallee branches laden with green fruit were spread over the site. These were likely to be *Eucalytpus youngiana* (Large Fruited Mallee) or *Eucalyptus leptophylla* (Narrow Leafed Red Mallee). There was no initial seeding or soil amelioration. However, the site was seeded after around 2000. Anecdotal comments indicate that there was no significant revegetation for the first five to 10 years, after which, a relatively dense stand of Mallee became established (Plate 10.1 and 10.2). Unfortunately environmental records were not kept to indicate why this was the case, but it may have been due to the later seeding of the site or adequate and sustained levels of rainfall.

Mattiske Consulting Pty Ltd (MCPL 2015c) was commissioned by Vimy in September 2015 to establish monitoring plots within the Shogun rehabilitation trial pit area and an associated stockpile of sand. The study assessed the species present within the rehabilitated area through quantitative and qualitative data (species presence, percentage foliage cover, photographs of the plots established, field observations and opportunistic species records).

The survey concluded that the vegetation community at the Trial Pit (Shogun 01) does not closely resemble vegetation communities within the local area, mainly due to a lack of understorey species present within the plot. The vegetation community within stockpile of sand (Shogun 02) has similarities to the vegetation unit E8 (MCPL 2015a) with regards to the understorey, consisting mainly of *Acacia fragilis*, *Hakea francisiana* and *Acacia helmsiana*.

The Shogun rehabilitation area was not burnt in a November 2014 fire. However there is evidence of the fire burning up to the edge of the rehabilitation area particularly on the northern side.

Plates 8.3 and 8.4 indicate the rehabilitation of surface disturbance in the Emperor/Shogun area. The figures indicate natural colonisation of the area after a period of three years following the spreading of a top sand layer and contour ripping. The site was not seeded.

Eight of the 14 taxa recorded at the Shogun 01 trial pit are also common to the dunal sands vegetation units (S6-S10). This indicates that these species (listed below) have the potential to be considered good generalists for rehabilitation planning. The investigation indicates that these species are able to grow sustainably in a number of contrasting growth mediums including dunal sands and backfilled overburden material.

- *Callitris verrucosa*
- *Hakea francisiana*
- *Eucalyptus ceratocorys*
- *Eucalyptus gongylocarpa*
- *Eucalyptus rigidula*
- *Olearia incana*
- *Olearia subspicata.*

Prior to commencement of operations, Vimy will also undertake an audit of existing rehabilitation within the MRUP, and potentially from further afield (i.e. associated with borrow pits along the Tropicana Haul Road), to establish whether useful information can be obtained on specific rehabilitation techniques and whether further monitoring should be continued of these sites to enhance the knowledge of rehabilitation with a view to improving rehabilitation techniques proposed for the MRUP.

Plate 8.1 Rehabilitation of the Shogun Trial Pit (Shogun 01)

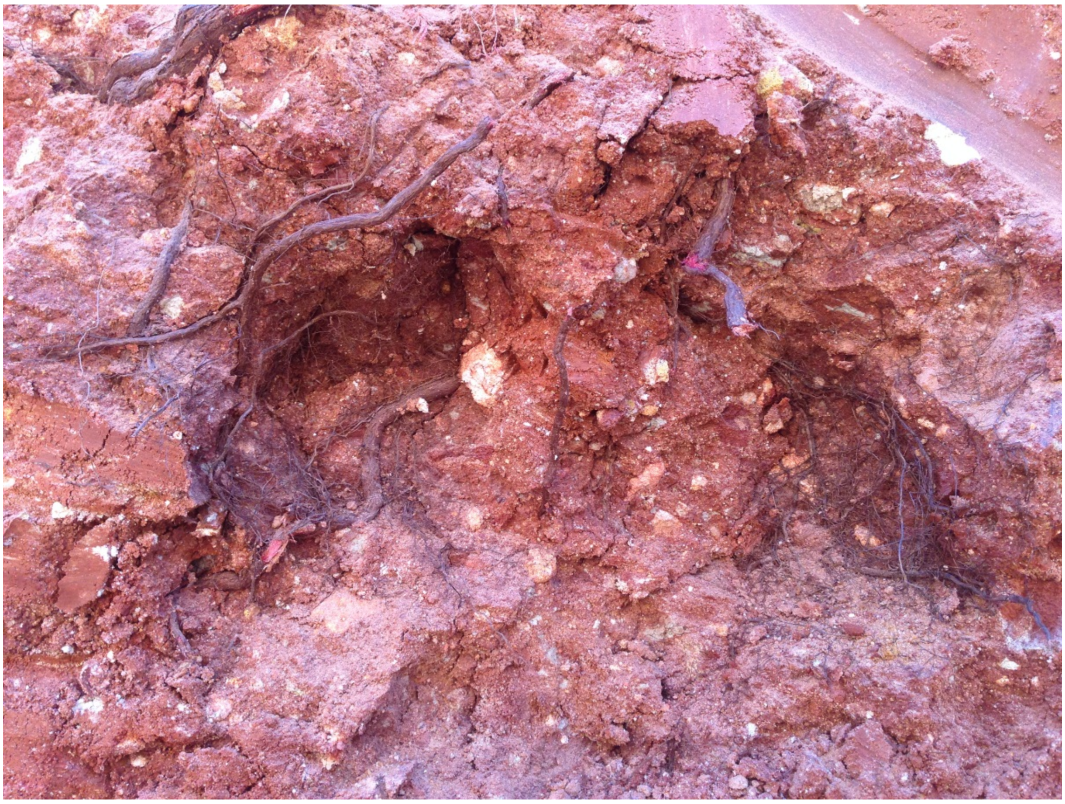


Plate 8.2 Root Exploration of the Overburden Materials in the Rehabilitated Shogun Trial Mine Pit

Plate 8.3 Rehabilitated Turkey's Nest near Emperor (Recontoured, Contour Ripped but not Seeded).

Plate 8.4 Rehabilitated Turkey's Nest Three Years after Rehabilitation.

8.3 Landscape Evolution Modelling of Post-Mine Landforms

To establish the long term evolution of the post-mine landforms, erosion modelling on actual site materials was undertaken using a laboratory scale rainfall simulator, with the results entered into WEPP (Watershed Erosion Prediction Project) to determine the optimal post-mine landform configuration based on the material properties (SWC 2015b). During the rainfall simulator test work, intense rainfall events (including 1:100 year 72 hr event) were incorporated to get accurate measurements of predicted sediment loss and surface runoff.

The WEPP model results showed that the proposed reconstructed soil profiles for the various post-mine landforms were stable at all slope angles, and negligible runoff occurred due to the sandy nature of the surface cover (i.e. the majority of the rainfall infiltrated the surface sands, with sediment losses typically less than DMP stability criteria of 5 t/ha/yr).

To establish the long term stability of the post-mine landforms, SIBERIA Landscape Evolution Modelling (a complex topographic evolution model capable of assessing gully development and incision and landform containment design) was undertaken over a 10,000 year period. Both the above ground TSF and an OL from Ambassador (AWOL) were modelled. Only one OL was modelled as the proposed design and materials of construction are similar (permeable mixed Miocene and Eocene sediments covered by 0.5m of permeable growth medium (nominally Quaternary sands). The aboveground TSF is comprised of 1m of growth medium overlying 1m of mixed Miocene / oxidised Eocene sediments and a 1m capillary break.

The results of the SIBERIA modelling over 10,000 years for the TSF are shown in Figure 8.2 and Figure 8.3. A 3D image of the AWOL landform (to the left of the image) and the above ground TSF (behind AWOL) is illustrated in Figure 8.1. The results of the SIBERIA modelling over 10,000 years for the AWOL and above ground TSF landforms are presented in Figure 8.2 and Figure 8.3 respectively.

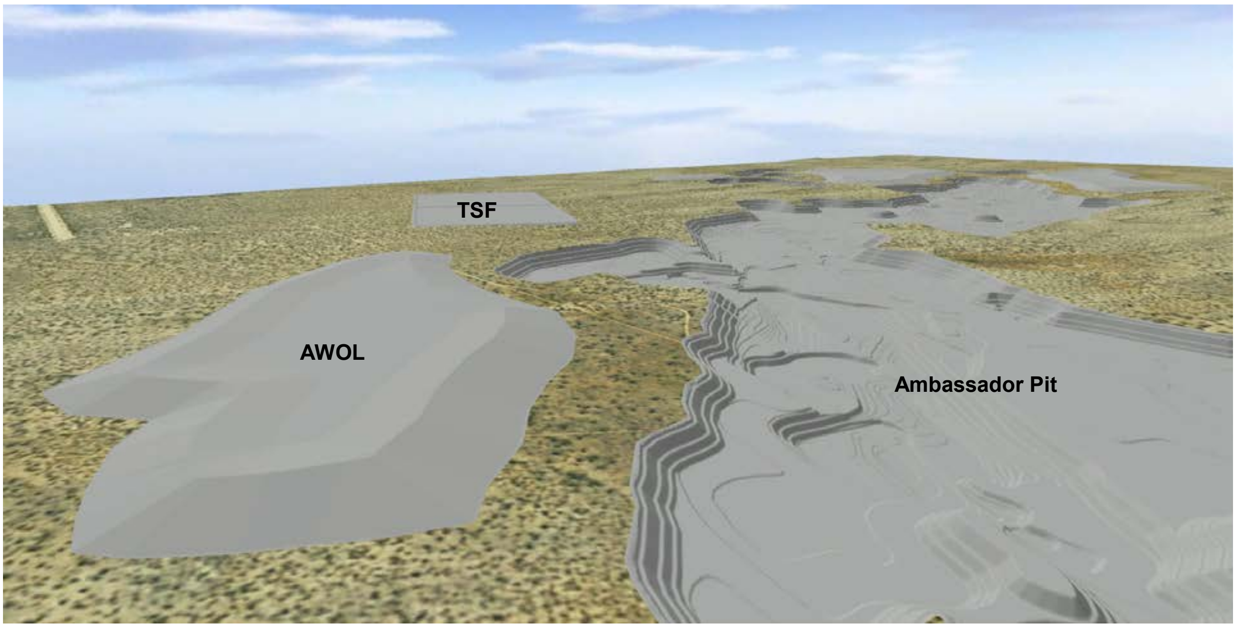


Figure 8.1 3D representation of Ambassador Pit looking towards the northeast during operations

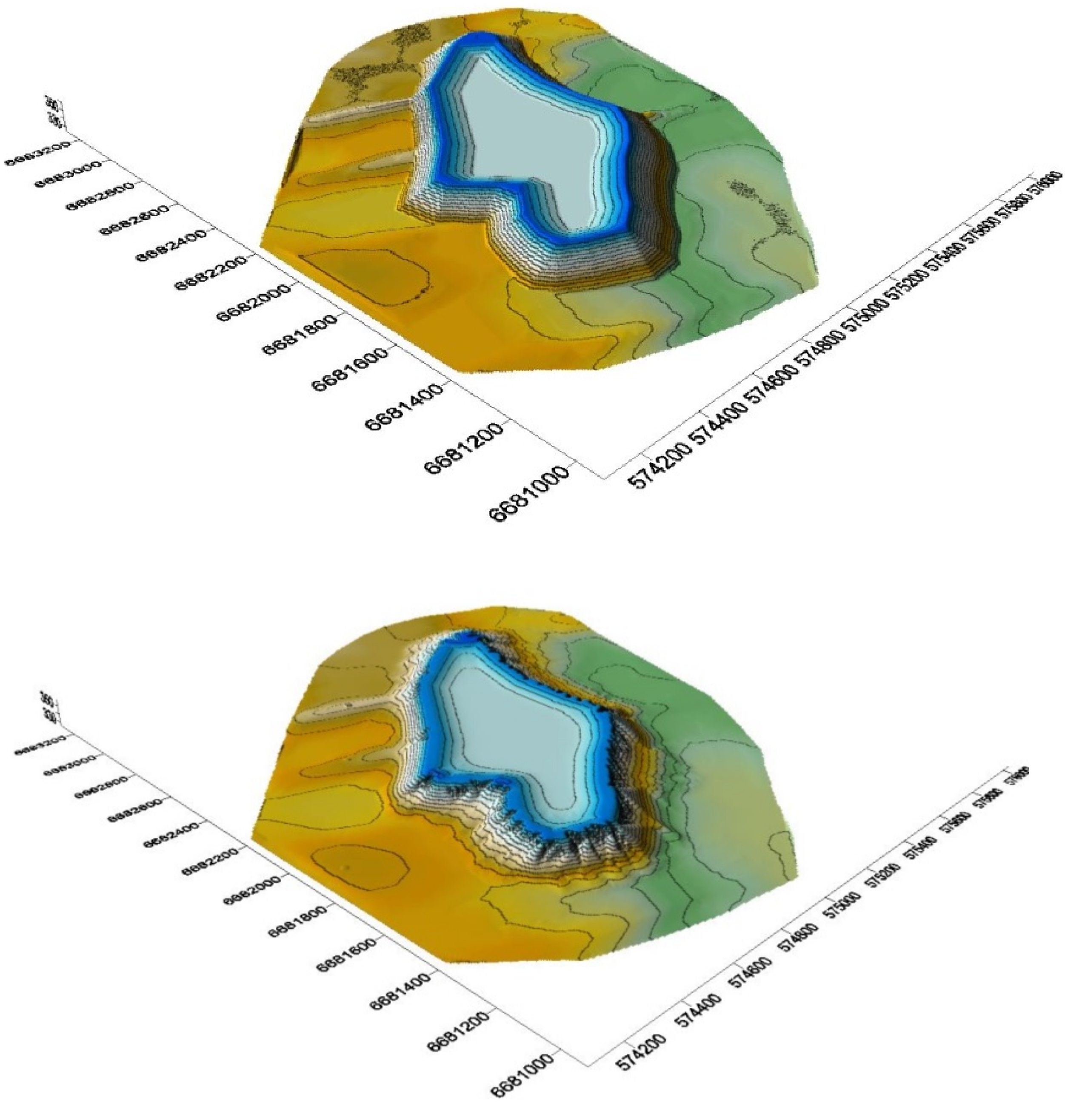


Figure 8.2 **SIBERIA modelling results for the Ambassador OL at end of construction (above) and following 10 000 y of weathering (below).**

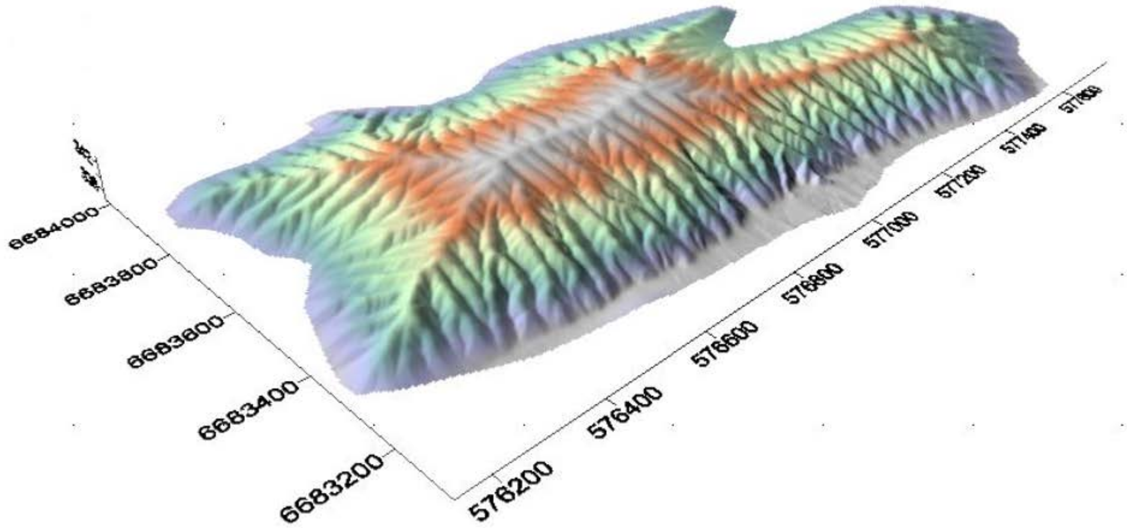


Figure 8.3 SIBERIA modelling results for the above ground TSF following 10 000 yr of weathering

The SIBERIA model results demonstrate that in the absence of vegetation cover:

- The OL landform was more stable than the aboveground TSF due to the high infiltration rates of the OL materials which limited surface runoff reducing the erosion potential.
- The above ground TSF has a limited depth of highly permeable sands covering an engineered wall (high clay content). The contact between the highly permeable sand and low permeable clay engineered wall on the TSF concentrates water during high rainfall events and increases the potential for erosion. Although there is the potential for some of the underlying substrate to become exposed in some of the deeper gullies, in practice surface sealing following infilling and natural dust deposition will limit this.
- In the above ground TSF scenario the magnitude of erosion and sediment loss is substantial, but it is considering a theoretical 10,000 year period (without dust deposition or vegetation cover) and peneplanation (a geomorphological process describing the reduction of hills into plains) of any landform would occur over this period.

The shape of the planned above ground TSF is different to the one modelled, however the internal structure, composition, and design prescription, which influenced the erodibility of the landform, remain the same.

Vegetation establishment and growth was not considered in the SIBERIA model, and thus the results represent worst case. The positive results obtained from the WEPP modelling (Appendix H2), which considers a 100 year period, for the yellow dunal sand cover indicates that over this period, which is sufficient to establish a functioning and sustainable ecosystem on the post-mine landforms, the proposed post-mine landforms will be stable.

8.4 Supplementary studies

Below is a list of projects that have been identified to address gaps in the existing knowledge for MRUP:

- **Groundwater monitoring bores –** There is a need to install a series of nested piezometers or monitoring bores at various distances downstream of the various deposits to establish the potential (or lack of) impact of the tailings seepage on background water quality and to characterise the baseline and temporal pattern of groundwater quality.

  The location of these bores and the required screen depths will be determined using the existing knowledge and understanding of the groundwater system.

- **Seepage monitoring (sensor installation) -** A network of soil moisture sensors will be installed below the above ground TSF to detect where and quantify how much seepage may occur below the clay liner. At several locations, sensors/probes will be installed deeper in the underlying Miocene and Oxidised Eocene sediments to determine whether seepage is occurring through these materials.

  The implementation of such a network would provide Vimy with definitive and quantifiable data as to the occurrence of tailings seepage from the above ground TSF through its operation, rehabilitation and closure.

- **Flora response to fire –** As bushfires play an important role in shaping the landscape and vegetation within the MRUP, an understanding of how the various proposed revegetation species respond to and tolerate fire would be useful. Similar rehabilitation fire response work has been undertaken in the Kimberley Region (similar spinifex dominated landscape) and in the species-rich Kwongan vegetation near Eneabba (mineral sands operations).

- **Seed ecology –** There is currently limited or no understanding as to the number of recalcitrant species in the native seed mix and the requirements to germinate them (and other species) from seed.

  The proposed seed ecology work will entail seed viability and germination trials. This work would test the various typical germination agents, such as smoke water, gibberellic acid, seed scarification, etc., to identify if they are sufficient to germinate the seed of the typical native species, and those likely to be used in rehabilitation (i.e. from the E3 community).

- **Burial effects -** In addition to assessing seed viability and germination from the topsoil/seed bank, the effects of burial on seed viability will be considered as any stockpiling of this material may actually degrade it's quality and reduce its viability; thus negating the time and effort invested to strip and stockpile this material.

- **Soil water dynamics –** Information on how the surficial Quaternary sands wet-up and drain/dry is necessary in order to understand how the native species function, what their reliance on deeper stored soil moisture (i.e. within the Miocene sediments) is, and whether they have specific morphological adaptations to tolerate drought conditions and control transpiration.

- **Plant water use –** By quantifying the ability of the native vegetation to extract soil stored moisture across different soil types enables an understanding of the required cover thickness needed in rehabilitation.

- **Overburden physical and hydraulic characterisation –** With the excavation of the trial mining slots in December there is an opportunity to collect intact samples from the soil, overburden and ore profiles to further the understanding of ecosystem functions and contaminant transport aspects of the project.

- **Slope and material stability –** Given that substantial material will be excavated for the trial mining slots, it would be advantageous to test the stability of the various materials in the field.

- **Wind erosion –** To date there is no actual data on the extent to which wind erosion alters the landscape and in particular the depth or quantity of soil lost and deposited in response to aeolian processes. A ground-based LiDAR system, with attached Trimble DGPS, will be utilised to quantify, with high precision, the volume/depth of soil lost to wind erosion per unit time.

- **Geochemical characterisation –** Geochemical characterisation, covering primarily AMD has only been done on a limited number of samples (i.e. 3 ore materials and their derived tailings and only screen testing completed on the overburden materials – Oxidised Eocene and Miocene sediments). Greater characterisation of the ore, tailings and overburden materials should ideally be undertaken to fully characterise the potential and magnitude of the various materials to generate both acidity and metalliferous drainage.
- **Column leaching or breakthrough experimentation –** The PER and MCP documentation notes the high adsorptive capacity of the carbonaceous materials (i.e. the Permeable Reactive Barrier – PRB), and the geochemical condition of the aquifer system, to effective remove all of the potential environmental contaminants out of the tailings liquor. Although this is likely to be case, there is no documented evidence of this adsorption process occurring and only literature derived values of KD (i.e. adsorption coefficient) were used. Vimy will therefore conduct column or breakthrough experiments to quantity the adsorptive capacity of the carbonaceous materials and confirm the PRB status of this material.
- **Tailings rheology –** Rheology information will be obtained to understand how the tailings will settle, the length of time required to settle (this influences the rehabilitation and closure process) and the properties of the tailings after consolidation.
- **Seepage analysis –** At present only preliminary seepage analysis for both the above-ground (i.e. vertical seepage from the clay liner) and in-pit (i.e. lateral seepage from the pit walls) TSF has been undertaken. This will be updated with more accurate soil physical and hydraulic properties, and soil profile data, as only generic information and data has been used.
- **Solute Fate and Transport –** the solute transport modelling undertaken was only preliminary in nature and will be updated using actual adsorption data.

9. Closure Implementation

The following section details closure activities required to be undertaken for each domain. A closure implementation schedule has been developed and is discussed in Section 9.7.

9.1 Project Wide

9.1.1 Closure activities

The outcomes of the preceding studies and trials will further refine the rehabilitation strategy over life-of-mine and subsequent MCP revisions. Based on the current level of understanding, the rehabilitation and closure tasks for all identified project tenements are to:

- maintain a current inventory of rehabilitation materials, detailing sources and volumes of growth medium and other materials,
- undertake remedial work, as identified from the investigative tasks,
- undertake as-built surveys of final landforms,
- implement rehabilitation monitoring schedule and
- assess compliance with the requirements of the *Contaminated Sites Act 2003*.

9.2 Pits

9.2.1 Background

The upper portion of the growth medium will be progressively stripped from the surface of pits (ahead of the mining front) using both truck and shovel and dozer methods. This material will either be stockpiled around the edge of pits to later be reinstated on top of backfilled mining voids, or be used for capping OLs.

Pits will be initiated with the excavation (truck and shovel) of an initial slot to expose the ore, with the overburden placed in an OL adjacent to the initial slot. This OL will remain as it is not economically feasible to return it to the pit for backfilling. After mining the ore exposed by the first slot, a pit void is created of approximately 200-300m in length. At this point a dozer trap and conveyor waste handling system is installed to progress the mining front and convey the overburden to backfill the mined out section of the pit (initial slot). The backfilling of the pit progresses along the strike length at a similar rate as the mining front (dozer trap) progresses. In some cases, smaller satellite pits which are not large enough for a dozer trap system will be mined with conventional truck and shovel (AMEC Foster Wheeler, 2015).

Following the development of the starter pit, semi-mobile dozer traps and an extensive conveyor system will be used to remove the majority of overburden material (down to the kaolinite layer directly above the ore) to backfill mining voids. Truck and shovel will then be used to remove the kaolinite layer immediately above the ore (this cannot be mined via the dozer trap due to its material strength) and then the ore itself. The kaolinite material will be preferentially backfilled in each mining void. The mining methods will mix the relative similar Miocene and oxidised Eocene sediments and these will be backfilled (using the dozer trap system) to the proposed final reconstructed post-mine land surface. It will be necessary to backfill in stages to optimise the placement of growth medium and overburden from the mining front and avoid double handling where possible (Figure 9.1).

At the completion of mining, a pit void is left as there is no overburden available to fill the section of the pit occupied by the dozer trap. The waste from the satellite pits will be either placed within an OL located outside the pit or be used to backfill the void resulting from the vacated dozer trap. In this case, the satellite pits will not be backfilled. Either way, it is not possible to completely backfill all pits, as voids will remain at the completion of mining of each deposit. The will be three final pit types as described below:

- Fully backfilled pits. These pits will be backfilled to the natural surface with either tailings or overburden or a combination. The backfilling will be progressive.
- Partially backfilled pits. These pits will be backfilled to not less than 10m above the water table. The backfilling will be progressive.
- Combination backfilled pits. These pits will have sections completely backfilled with remaining sections backfilled to not less than 10m above the water table. The backfilling will be progressive.

Following pit backfill, dozers will be used to push stockpiled growth medium a nominal distance of 100m from the pit edge where it has been stockpiled. This method will reinstate an existing landform of undulating sand rises intervened with clayey-sand plains. This landform is found across each proposed mining pit. Growth medium will be used for capping and rehabilitation of OL.

For the partially backfilled pits, stockpiled growth medium will be pushed across the slopes to the edge of the clayey-sand plain base.

Operational phase and post-mine 3D images for Mulga Rock East Deposit and Mulga Rock West Deposits are presented in Figure 9.2 to Figure 9.5 and Figure 9.17 to Figure 9.22 respectively and summarised in Table 9.1.

Total growth medium and overburden volumes are presented in Table 9.2. These volumes indicate that there is significantly more growth medium available through the pre-mining stripping process than is required for rehabilitation.

Table 9.1 Proposed Mine Pit Comparison between Operation and Closure

Mine Pit	Phase	Surface Area (ha)	Maximum Depth (m)	Maximum Volume (m^3)	Comments
Princess	Operation	65	62	22,905,844	• Four interconnected pits
	Closure	0	Surface	0	• Backfilled with tailings (Princess In-pit TSF)
Ambassador	Operation	761	76	260,625,000	• One main pit with four satellite pits at the southern end
	Closure	0	Range between surface and not less than 10m above the water table	0	• Eastern end backfilled with tailings (Ambassador TSF). • Central section backfilled. Western end partially backfilled. • Satellite pits either partially or fully backfilled depending on mining sequence. • All backfilled pits will be reshaped and rehabilitated to support a native vegetation ecosystem.
Shogun	Operation	268	42	33,125,000	• One main pit and two satellite pits to the west
	Closure	0	Range between surface and not less than 10m above the water table	0	• Eastern end backfilled. Western end partially backfilled. • Satellite pits either partially or fully backfilled depending on mining sequence. • All backfilled pits will be reshaped and rehabilitated to support a native vegetation ecosystem.

Mine Pit	Phase	Surface Area (ha)	Maximum Depth (m)	Maximum Volume (m^3)	Comments
Emperor	Operation	942	46	270,000,000	• Single pit
	Closure	0	Range between surface and not less than 10m above the water table	0	• Approximately half backfilled and half partially backfilled. • All backfilled pits will be reshaped and rehabilitated to support a native vegetation ecosystem.
Total	**Operation**	**2,036**	**42-76m**	**586,655,844**	
	Closure	**0**	Range between surface and not less than 10m above the water table	**0**	• All surfaces will be rehabilitated with native vegetation to produce a safe, stable, non-polluting and sustainable post-mine landform.

Table 9.2 Estimated Growth Medium and Overburden Volumes to be Managed for Each Mine Pit (M3)

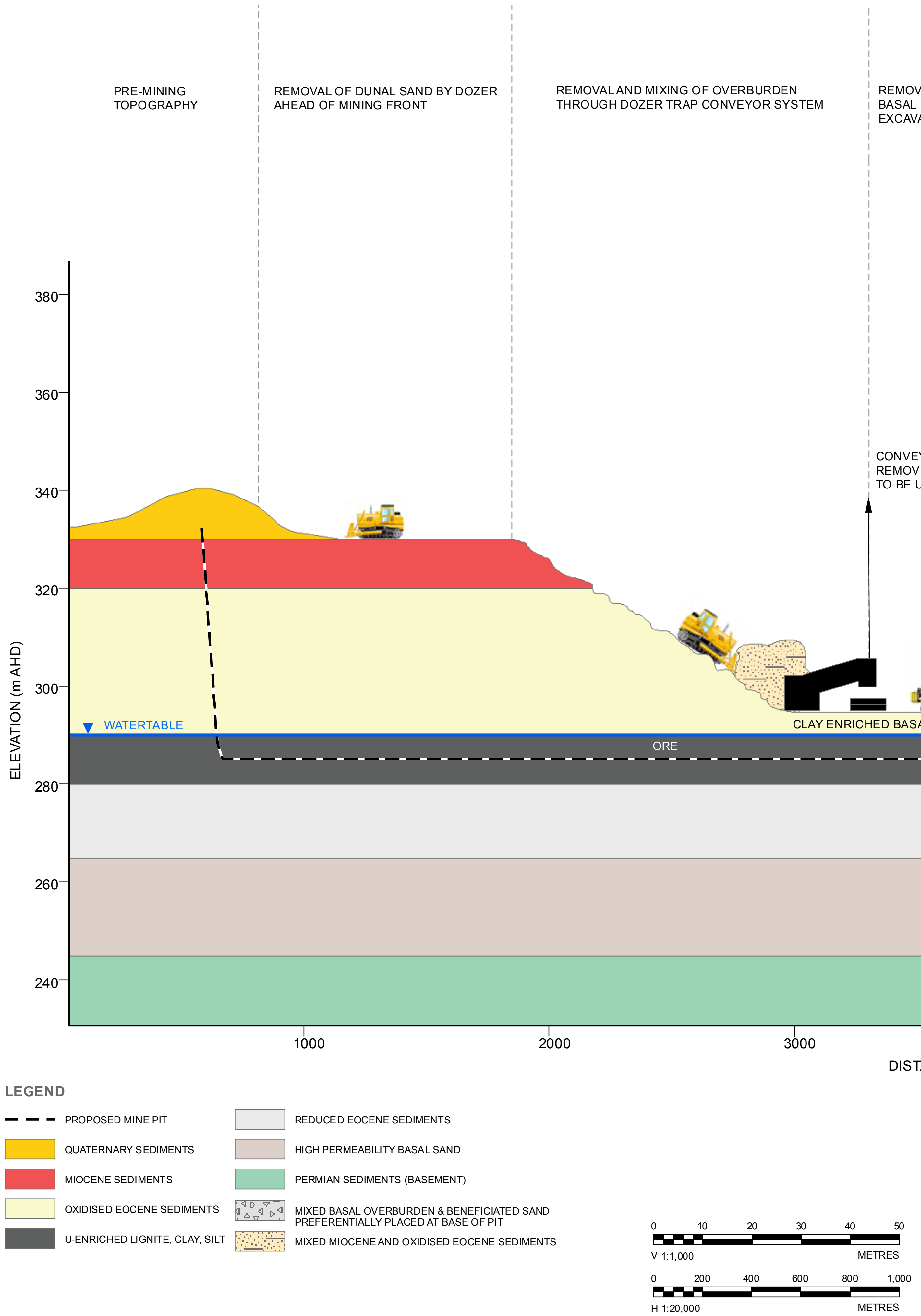
Deposit	Potential salvaged growth medium		Used growth medium	
	Stripped from pits.	Stripped from OL footprints.	Required for pits (including in-pit TSFs)	Required for OL (including TSF)
Princess	1,490,000	1,470,000	990,000	1,740,000
Ambassador	4,700,000	2,800,000	2,880,000	1,380,000
Shogun	2,300,000	1,400,000	920,000	710,000
Emperor	8,950,000	3,720,000	1,280,000	1,860,000
Subtotal	**17,440,000**	**7,920,000**	**5,080,000**	**4,950,000**
Total volume	**25,360,000**		**9,030,000**	

Initial erosion work undertaken by SWC (2015b) for the MRUP soil and overburden materials identified that the clayey portions of the Miocene and oxidised Eocene sediments are highly erodible and will likely yield significant sediment loss at all slope angles given its low permeability and fine, easily detached surface particles. It has been confirmed that these clayey sections are limited with the majority of the units being highly permeable. Quaternary sand is generally stable over the majority of slope angles as the vertical infiltration of rainfall will, in most cases, greatly exceed rainfall intensity. Material characteristics are presented in Table 9.3.

The thickness of the sand cover, and the distribution of the SMU, governs the distribution of the vegetation across the MRUP. A map showing the distribution of the soils across the MRUP is provided in Figure 7.6.

Table 9.3 Key Properties and Behaviour of the Soil and Overburden Materials at the MRUP

Material	Material Class	Beneficial Properties	Limiting Properties
Quaternary sand (including Yellow and Red Sands)	Soil	• Non-dispersive and erosion-resistant. • Negligible surface water flow with vertical infiltration dominating. • Friable, low soil strength and not hardsetting. • Optimal soil chemical properties (i.e. slightly acidic to neutral pH).	• Negligible water holding or PAW content. • High permeability that may exacerbate ponding and subsurface lateral flow at a texture contrast boundary.
Red loam or sandy clay	Soil	• Good water holding and PAW capacity. • Optimal soil chemical properties (i.e. non-saline and neutral – alkaline pH).	• Although non-sodic, the low salinity results in this material being dispersive and highly erodible. • Hardsetting
Calcrete	Overburden	• Physically stable and non-dispersive, non-erodible and non-hardsetting. • High to very neutralising capacity.	• Strongly alkaline and often high salinity that may impact some susceptible species.
Miocene / oxidised Eocene	Overburden	• Sandy regions are physical stable, have low salinity and are slightly acidic in pH. • Clayey regions have optimal water holding and PAW content to support native plant species, although considerable heterogeneity in its spatial distribution exists.	• Sandy regions have low water holding and PAW contents. • Clayey regions are dispersive, erodible, and hardsetting and have a low permeability and relatively high salinity that may impact on revegetation growth.



CLIENT
VIMY RESOURCES LIMITED

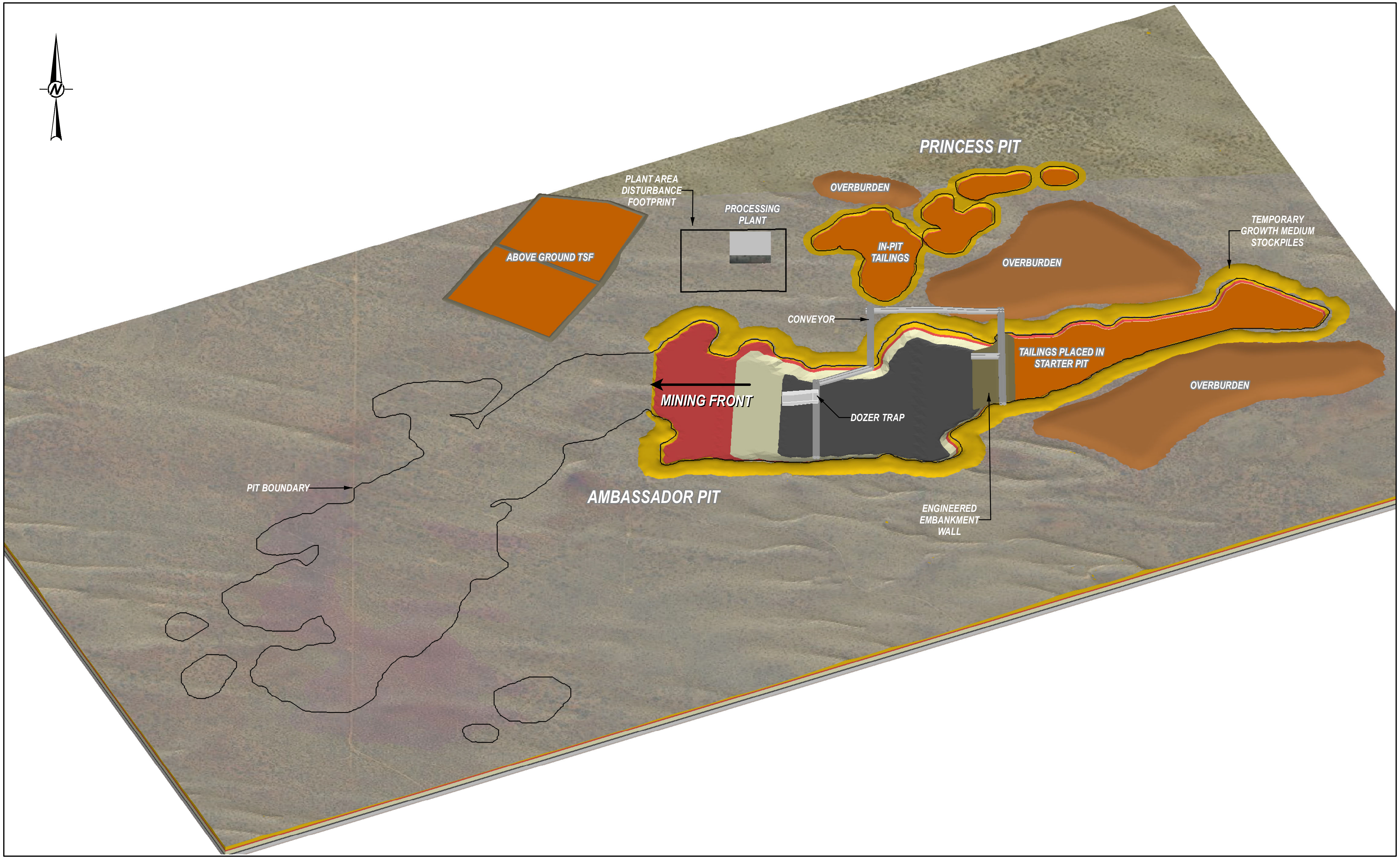
PROJECT
MULGA ROCK URANIUM PROJECT

CONSULTANT
Golder Associates

YYYY-MM-DD	2015-10-29
DESIGNED	MS
PREPARED	MS
REVIEWED	EWC
APPROVED	EWC

TITLE
PROPOSED MINING OF THE MINE PITS AND INTERNAL MANAGEMENT OF SOIL AND OVERBURDEN MATERIALS

PROJECT NO.	CONTROL	REV.	FIGURE
1540340	H1	0	9.1



LEGEND

- QUATERNARY SEDIMENTS
- MIOCENE SEDIMENTS
- OXIDISED EOCENE SEDIMENTS
- OREBODY
- REDUCED EOCENE SEDIMENTS
- HIGH PERMEABILITY BASAL SAND
- PERMIAN SEDIMENTS (BASEMENT)

NOTES

SURFACE TOPOGRAPHY SHOWN WITH NO VERTICAL EXAGGERATION.
MODEL FOR DISPLAY ONLY (NOT TO BE SCALED OFF).

CLIENT
VIMY RESOURCES LIMITED

VIMY RESOURCES

PROJECT
MULGA ROCK URANIUM PROJECT

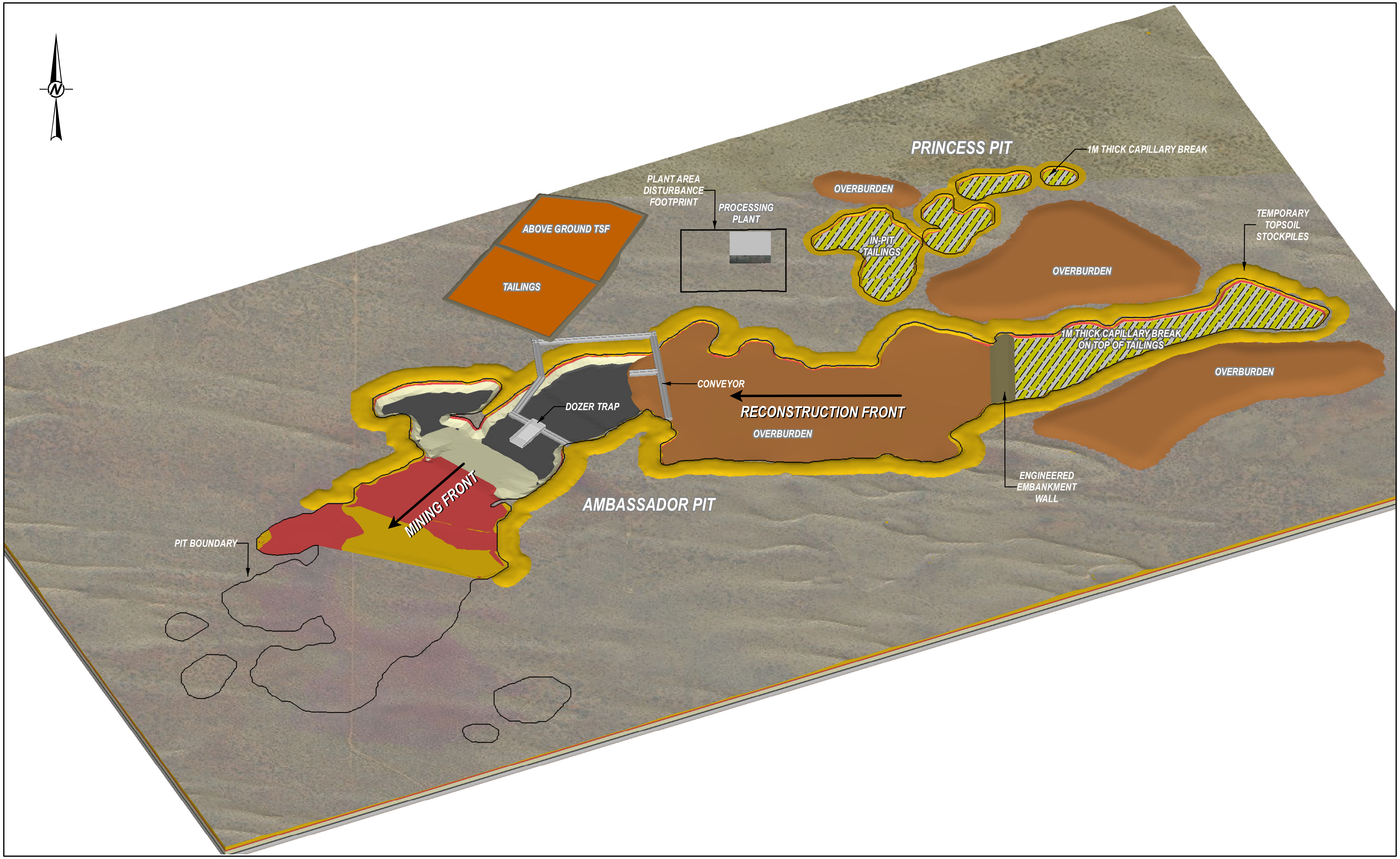
CONSULTANT

Golder Associates

YYYY-MM-DD	2015-10-29
DESIGNED	SAR
PREPARED	SAR
REVIEWED	EWC
APPROVED	EWC

TITLE
3D IMAGE OF THE MULGA ROCK EAST – OPERATION STAGE 1

PROJECT NO.	CONTROL	REV.	FIGURE
1540340	H1	0	9.2



LEGEND

- QUATERNARY SEDIMENTS
- MIOCENE SEDIMENTS
- OXIDISED EOCENE SEDIMENTS
- OREBODY
- REDUCED EOCENE SEDIMENTS
- HIGH PERMEABILITY BASAL SAND
- PERMIAN SEDIMENTS (BASEMENT)

NOTES

SURFACE TOPOGRAPHY SHOWN WITH NO VERTICAL EXAGGERATION.
MODEL FOR DISPLAY ONLY (NOT TO BE SCALED OFF).

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YYYY-MM-DD	2015-10-29
DESIGNED	SAR
PREPARED	SAR
REVIEWED	EWC
APPROVED	EWC

PROJECT
MULGA ROCK URANIUM PROJECT

TITLE
3D IMAGE OF THE MULGA ROCK EAST – OPERATION STAGE 2

PROJECT NO.	CONTROL	REV.	FIGURE
1540340	H1	0	9.3

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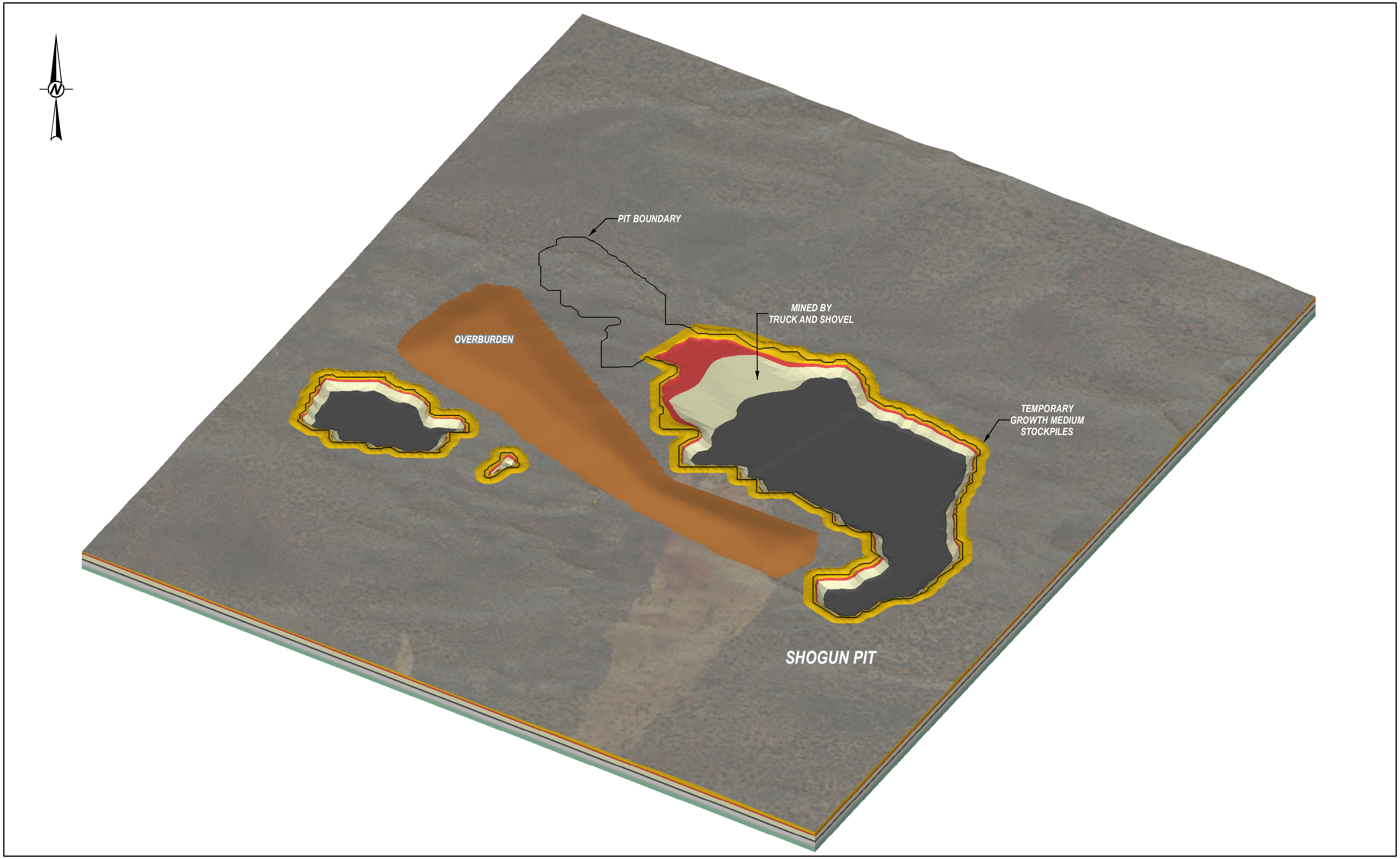

LEGEND

- QUATERNARY SEDIMENTS
- MIOCENE SEDIMENTS
- OXIDISED EOCENE SEDIMENTS
- OREBODY
- REDUCED EOCENE SEDIMENTS
- HIGH PERMEABILITY BASAL SAND
- PERMIAN SEDIMENTS (BASEMENT)

NOTES

SURFACE TOPOGRAPHY SHOWN WITH NO VERTICAL EXAGGERATION.
MODEL FOR DISPLAY ONLY (NOT TO BE SCALED OFF).

CLIENT
VIMY RESOURCES LIMITED

VIMY RESOURCES

PROJECT
MULGA ROCK URANIUM PROJECT

CONSULTANT

Golder Associates

YYYY-MM-DD	2015-10-29
DESIGNED	SAR
PREPARED	SAR
REVIEWED	EWC
APPROVED	EWC

TITLE
3D IMAGE OF THE MULGA ROCK WEST – SHOGUN OPERATION

PROJECT NO.	CONTROL	REV.	FIGURE
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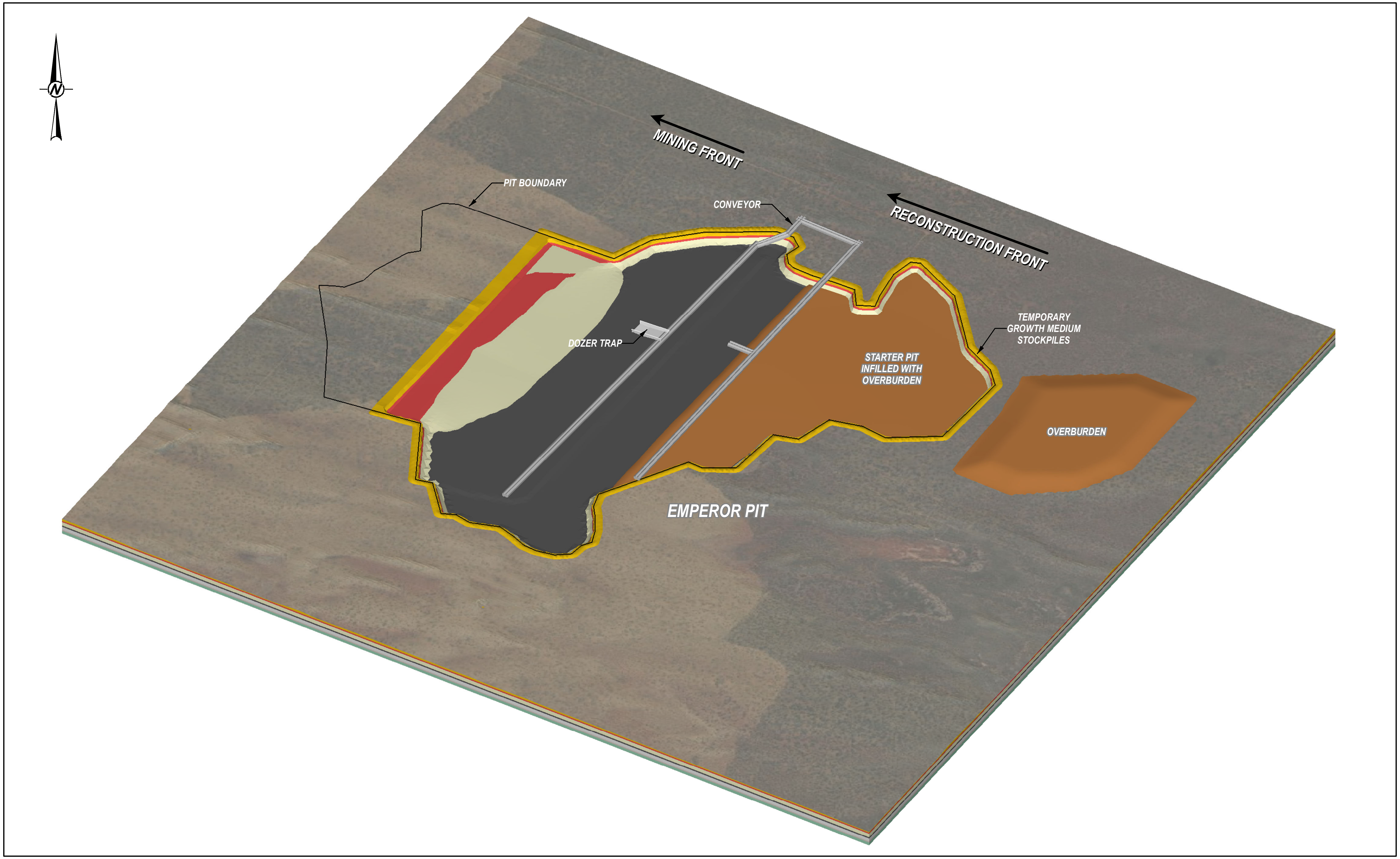


LEGEND

QUATERNARY SEDIMENTS	REDUCED EOCENE SEDIMENTS
MIOCENE SEDIMENTS	HIGH PERMEABILITY BASAL SAND
OXIDISED EOCENE SEDIMENTS	PERMIAN SEDIMENTS (BASEMENT)
OREBODY	

NOTES

SURFACE TOPOGRAPHY SHOWN WITH NO VERTICAL EXAGGERATION.
MODEL FOR DISPLAY ONLY (NOT TO BE SCALED OFF).

CLIENT
VIMY RESOURCES LIMITED

PROJECT
MULGA ROCK URANIUM PROJECT

CONSULTANT
Golder Associates

YYYY-MM-DD	2015-10-29
DESIGNED	SAR
PREPARED	SAR
REVIEWED	EWC
APPROVED	EWC

TITLE
3D IMAGE OF THE MULGA ROCK WEST – EMPEROR OPERATION

PROJECT NO.	CONTROL	REV.	FIGURE
1540340	H1	0	9.5

9.2.2 Closure activities

For fully backfilled pit sections:

- Apply a cover of undulating growth medium up to a thickness of not less than 1.0m to natural surface for a distance of up to 100m from the pit perimeter.
- Where it is considered necessary to encourage water infiltration and stabilisation, techniques should be applied to create micro-topographical landscapes. Appropriate methods will be determined through trials.
- Seed rehabilitated surfaces with selected provenance seed mix suitable for the landform.

For partially backfilled pit sections:

- Regrade slopes to a safe, stable angle (angle to be determined following consultation with key stakeholders).
- Apply a cover of growth medium up to a thickness of not less than 1.0m on slopes and pit base for a distance of up to 100m from the pit perimeter.
- Where it is considered necessary to encourage water infiltration and stabilisation, techniques should be applied to create micro-topographical landscapes. Appropriate methods will be determined through trials.
- Seed rehabilitated surfaces with selected provenance seed mix suitable for the landform.

For combined backfilled pit sections:

- As for backfilled and partially backfilled pits.

9.3 Overburden Landforms

Eight OLs are proposed for the MRUP. The progressive backfilling (full or partial) of pits, has minimised the number and volume of the OL planned (Table 9.4).

The OL design is preliminary and it is currently anticipated to be approximately 30m high (RL 360), which is approximately 16m above the height of the local dunes (RL 344) but approximately 10m lower than the highest regional dunes several kilometres to the south. The OL will be constructed in three 10m lifts with back sloping berms approximately 5-10m in length landform (Figure 9.6). The outer slope will be graded to a nominal 12^{o}. It is acknowledged that wind erosion under the prevailing climatic conditions plays an important role in shaping the current dunal landscape and the final design may alter depending on the results of trials undertaken.

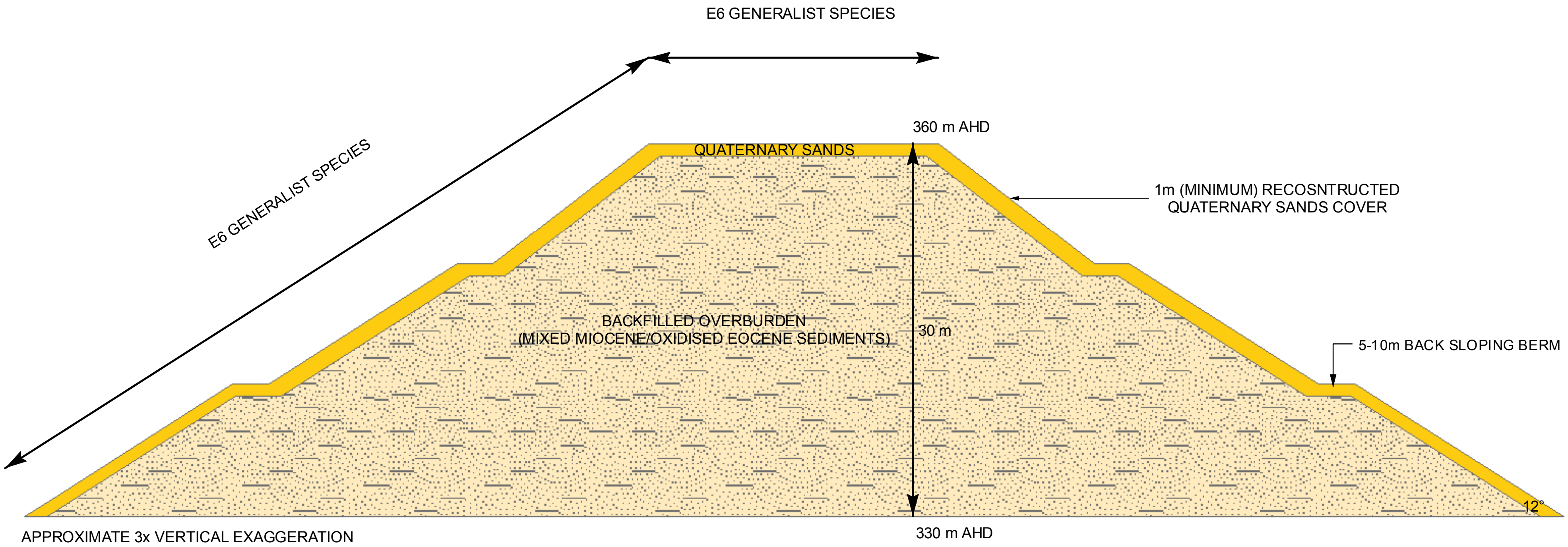
Table 9.4 Proposed OL Comparison between Operation and Closure

OL	Surface Area (footprint) (ha)	Maximum height (m)	Maximum Volume (m^3)	Changes at closure
PNOL (Princess North OL)	16.3	30	2,266,800	Landform removed at closure. Used for construction and rehabilitation of the above-ground TSF and rehabilitation of the Princess In-pit TSF cover.
PEOL (Princess East OL)	130.7	30	25,214,000	Landform size reduced at closure. Used for the rehabilitation of the Princess In-pit TSF cover.
AEOL (Ambassador East OL)	136	30	23,715,000	
ASOL (Ambassador South OL)	32.9	30	4,675,600	
AWOL (Ambassador West OL)	106.5	30	19,947,000	Used for TSF cover. Final size reduced.
SOL (Shogun OL)	141.9	30	34,800,000	
EEOL (Emperor East OL)	135.2	30	35,577,000	
ESOL (Emperor South OL)	237	30	68,329,000	
Total	**936.5**	**30**	**214,524,400**	

9.3.1 Closure activities

For OLs:

- Apply a cover of growth medium to an appropriate thickness as determined by trials/studies.
- Where it is considered necessary to encourage water infiltration and stabilisation, techniques should be applied to create micro-topographical landscapes. Appropriate methods will be determined through trials.
- Seed rehabilitated surfaces with selected provenance seed mix suitable for the landform.



APPROXIMATE 3x VERTICAL EXAGGERATION
NOT TO SCALE

CLIENT
VIMY RESOURCES LIMITED

VIMY RESOURCES

CONSULTANT
Golder Associates

YYYY-MM-DD	2015-10-29
DESIGNED	MS
PREPARED	MS
REVIEWED	EWC
APPROVED	EWC

PROJECT
MULGA ROCK URANIUM PROJECT

TITLE
POTENTIAL OL DESIGN TO CREATE A STABLE AND SUSTAINABLE POST-MINE LANDFORM

PROJECT NO.	CONTROL	REV.	FIGURE
1540340	H1	0	9.6

9.4 Tailings Storage Facilities (TSF)

Three TSFs are proposed for the MRUP, one above ground TSF and two in-pit TSFs.

9.4.1 Above ground TSF

A single, above ground TSF with two cells is proposed. Based on preliminary designs and processing water balance calculations, it is likely to have a construction footprint of around 106ha (GHD, 2015a). This facility will be located to the west of the proposed processing plant and has been strategically positioned to coincide with a large topographic depression immediately to the north of Ambassador Pit. The base (or toe) of the as-built TSF corresponds with the 334m AHD contour, with the surrounding dunes having a maximum elevation of 344m AHD. This placement ensures that the single lift, approximately 8-10m high TSF, will not protrude higher than the surrounding dune crests, reducing the potential for wind erosion of the tailings surface prior to rehabilitation.

Based on relationships established in the soil investigation by SWC (2015) between topography and soil distribution, the profile underlying the proposed TSF location will consist of a 1–4m thick calcrete layer (upper surface elevation of 330m AHD), with an overlying one metre thick reddish brown loam to sandy clay layer (upper surface elevation of 331m AHD) and a Quaternary dunal sand layer of up to eight metres thick. A cross-section (Figure 9.7) along the long-axis of the proposed above ground TSF location illustrates how the height of this landform will not extend beyond the surrounding landscape.

Construction of the above ground TSF will involve stripping the surficial dunal sand (growth medium) to expose the underlying loamy clays, and utilising the sands to construct the outer embankments of the TSF. The basal clays and material imported from the adjacent Princess Pit, will be conditioned through modifying the soil moisture to achieve the required optimal moisture content and compacted to form a clay liner system that adheres to the Water Quality Protection Note No. 27 issued by Department of Water (2010). This clay layer will directly overlay calcrete, which will readily neutralise seepage that may occur through the floor of the TSF[1]. SWC (2015b) identified that the calcrete material has an ANC in the order of 100kg H_2SO_4/t and therefore has appreciable capacity to neutralise acidic seepage water.

Seepage analysis of the above ground TSF has also been undertaken by SWC (2015c) to assess the potential impacts that seepage through the clay layer may have on the surrounding environment. Analysis showed that the movement of a seepage plume through effectively 30–40m of unsaturated sediment will be limited and any liquor reaching the groundwater represents <0.5% of the total aquifer volume below the TSF. Solute fate and transport modelling on the potential risks of tailings seepage within the groundwater system has been undertaken by GHD (2015b). This work showed that long term change in groundwater quality is not expected.

The Quaternary sands are not suitable for construction of the TSF embankment walls, and consequently clayey material from either the base of the TSF or imported from the Princess Pit will need to be utilised on the inner embankment walls to stabilise them. All design and construction will be undertaken in accordance with ANCOLD (2012) guidelines and are detailed in the GHD (2015a) report.

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[1] A permeability of 10^{-9}m/s, as required in DoW (2010) WQPN, equates to 3.2cm/year of allowable seepage.

[2] Spacing of PVC pipes to be determined as part of future, integrated TSF design specifications.

Tailings from the mining of the Princess Deposit will be discharged into the above ground TSF at a solids ratio of around 40% (final solids content to be confirmed following additional test work). Tailings will be discharged using a peripheral spigot system, to allow for continuous discharge at increasing levels in the TSF – this process is used throughout the mining industry. Subaqueous tailings deposition (i.e. below a free water surface) will be employed for the above ground TSF to eliminate the potential for dust generation to occur from a dried, crusted tailings surface. This method of deposition will also facilitate the homogeneous distribution of tailings particles at each discharge level, as beaching of the tailings is avoided (as occurs in typical sub-aerial tailings discharge).

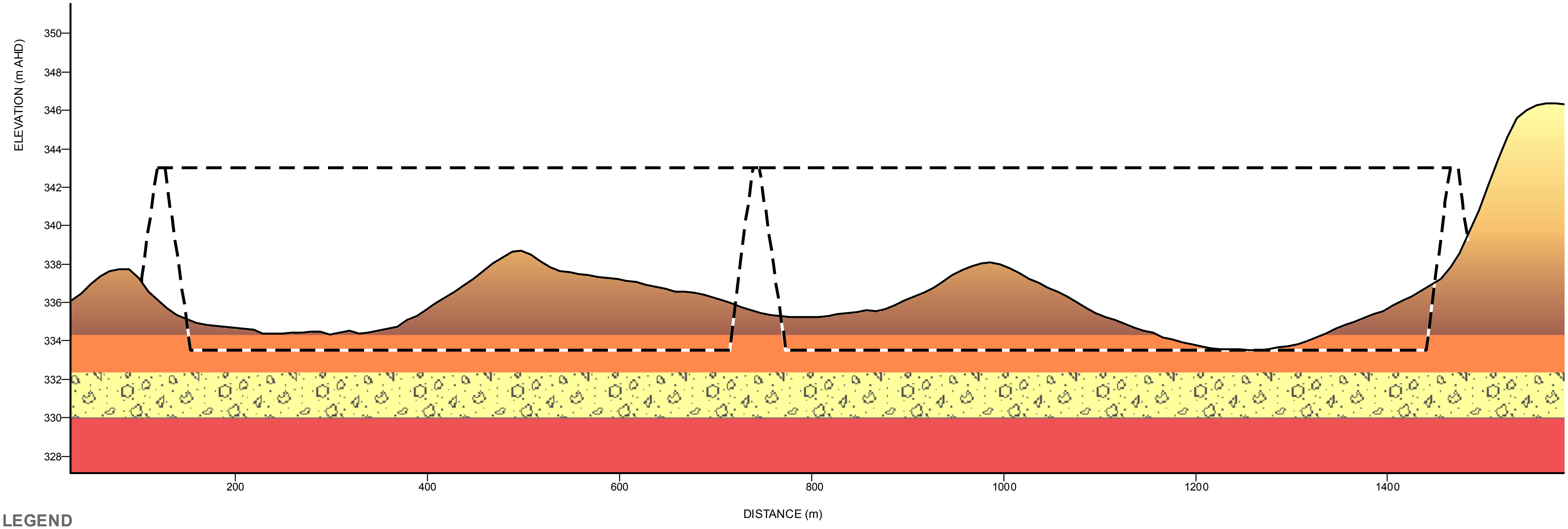
Rehabilitation of the above ground TSF will occur once the tailings material has dried and consolidated sufficiently to support the weight of heavy machinery. Based on normal draining and consolidation processes, the time period required to achieve this density/strength, and thus to commence rehabilitation earthworks, is likely to be two to five years following cessation of tailings discharge.

9.4.2 In-pit TSF

For the in-pit TSF, there are no specific construction requirements as the pit walls (for the Princess Pit) and reconstructed mixed Miocene / oxidised Eocene profile (for the Ambassador Pit) will form the embankment walls of the TSF. A schematic diagram showing the Princess and Ambassador in-pit TSFs is provided in Figure 9.8 and Figure 9.9. A layer of beneficiated coarse sand will be placed on the base of the mine pit, which will facilitate initial downward seepage of tailings liquor and draining and consolidation of the tailings material.

Similar to the above ground TSF, tailings deposition in the in-pit TSFs will occur subaqueously, with a solids content of around 40%. Preliminary unsaturated zone hydraulic modelling using HYDRUS 2D/3D shows that the potential for lateral movement of tailings seepage into the side walls is limited by the low permeability of the material at field moisture conditions (i.e. at or drier than field capacity).

Path: G:\Spatial_Information_Group\GIS_WORKSPACE_AUSTRALIA\01_WA\SH5107_MINIGWAL\1540340\Projects\APPENDIX\Rev0\1540340-H1-F009.7-Rev0.mxd



LEGEND

- PROPOSED ABOVE GROUND TSF (AS-BUILT)
- DUNAL SAND
- REDDISH BROWN SANDY LOAM
- CALCRETE
- MIOCENE SEDIMENTS

0 2 4 6 8 10
V 1:300 METRES

0 50 100 150 200
H 1:6,000 METRES

CLIENT
VIMY RESOURCES LIMITED

VIMY RESOURCES

CONSULTANT

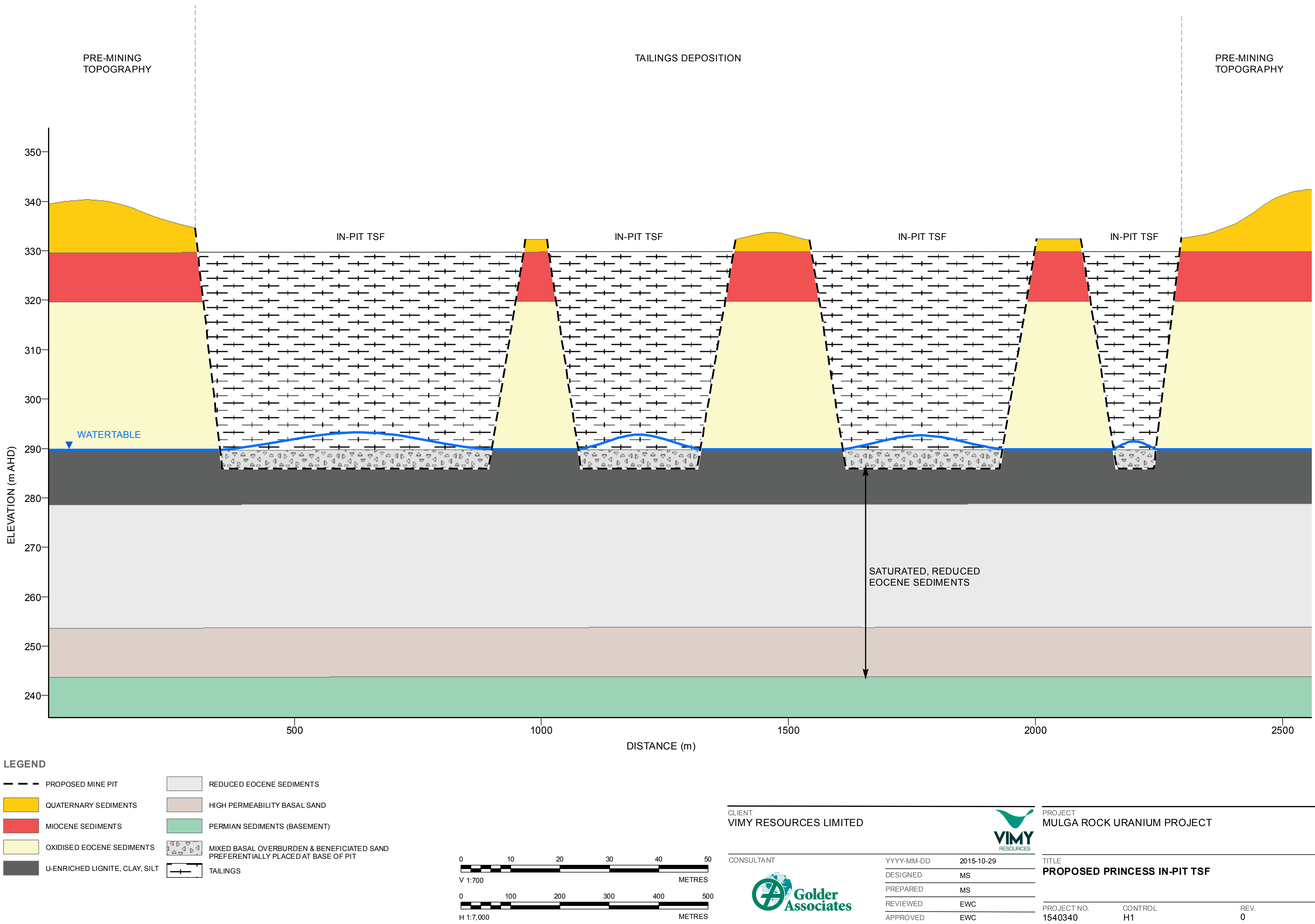
Golder Associates

YYYY-MM-DD	2015-10-29
DESIGNED	MS
PREPARED	MS
REVIEWED	EWC
APPROVED	EWC

PROJECT
MULGA ROCK URANIUM PROJECT

TITLE
CROSS SECTION THROUGH PROPOSED ABOVE GROUND TSF LOCATION

PROJECT NO.	CONTROL	REV.	FIGURE
1540340	H1	0	**9.7**



CLIENT
VIMY RESOURCES LIMITED

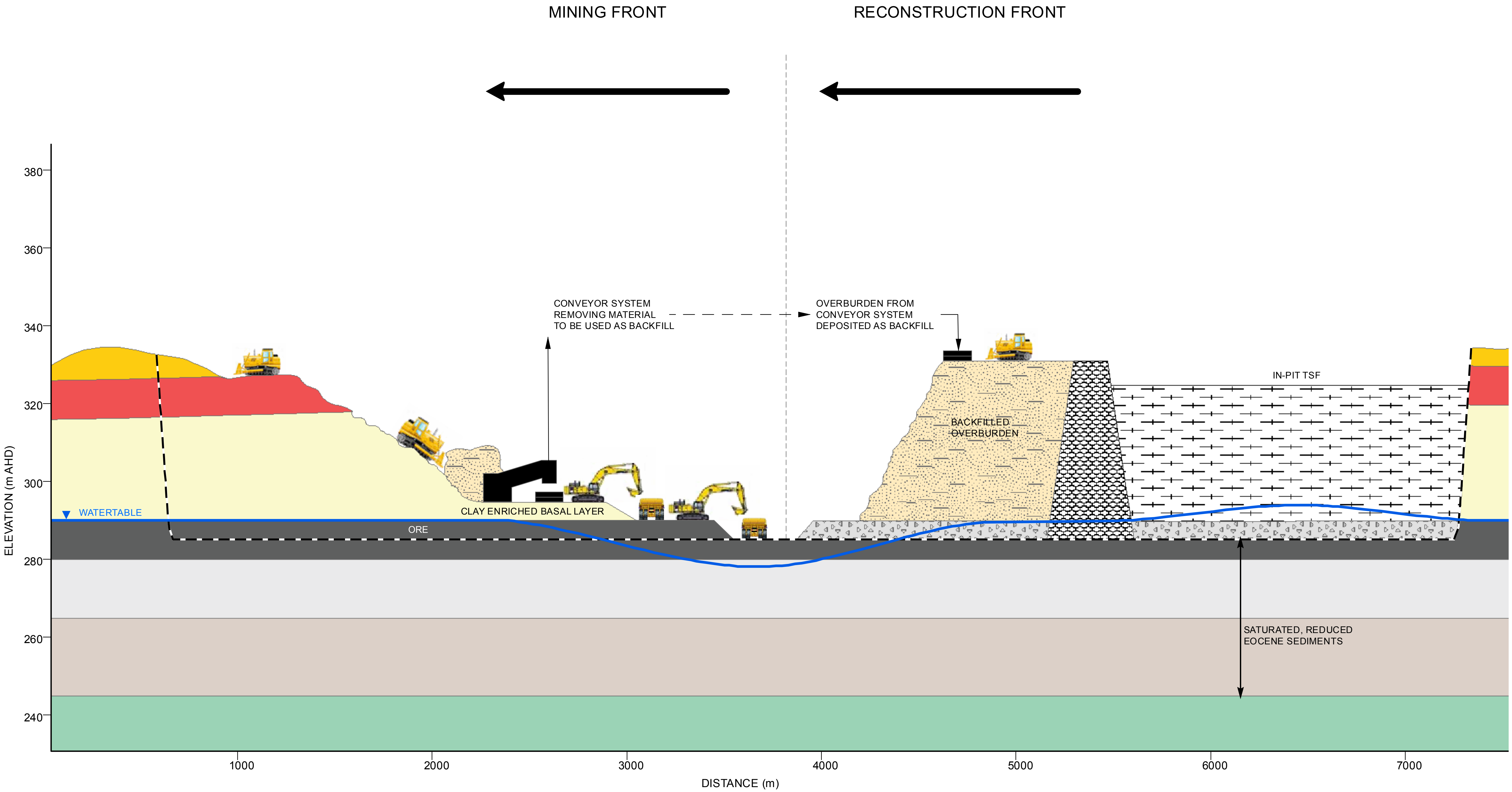
CONSULTANT
Golder Associates

YYYY-MM-DD	2015-10-29
DESIGNED	MS
PREPARED	MS
REVIEWED	EWC
APPROVED	EWC

PROJECT
MULGA ROCK URANIUM PROJECT

TITLE
PROPOSED PRINCESS IN-PIT TSF

PROJECT NO.	CONTROL	REV.	FIGURE
1540340	H1	0	9.8



LEGEND

- PROPOSED MINE PIT
- QUATERNARY SEDIMENTS
- MIOCENE SEDIMENTS
- OXIDISED EOCENE SEDIMENTS
- U-ENRICHED LIGNITE, CLAY, SILT
- REDUCED EOCENE SEDIMENTS
- HIGH PERMEABILITY BASAL SAND
- PERMIAN SEDIMENTS (BASEMENT)
- MIXED BASAL OVERBURDEN & BENEFICIATED SAND PREFERENTIALLY PLACED AT BASE OF PIT
- MIXED MIOCENE AND OXIDISED EOCENE SEDIMENTS
- TAILINGS
- ENGINEERED EMBANKMENT WALL

0 10 20 30 40 50
V 1:1,000 METRES

0 200 400 600 800 1,000
H 1:20,000 METRES

CLIENT VIMY RESOURCES LIMITED		PROJECT MULGA ROCK URANIUM PROJECT	
CONSULTANT Golder Associates	YYYY-MM-DD	2015-10-29	TITLE PROPOSED AMBASSADOR IN-PIT TSF
	DESIGNED	MS	
	PREPARED	MS	
	REVIEWED	EWC	PROJECT NO. 1540340 · CONTROL H1 · REV. 0 · FIGURE 9.9
	APPROVED	EWC	

9.4.3 Closure activities

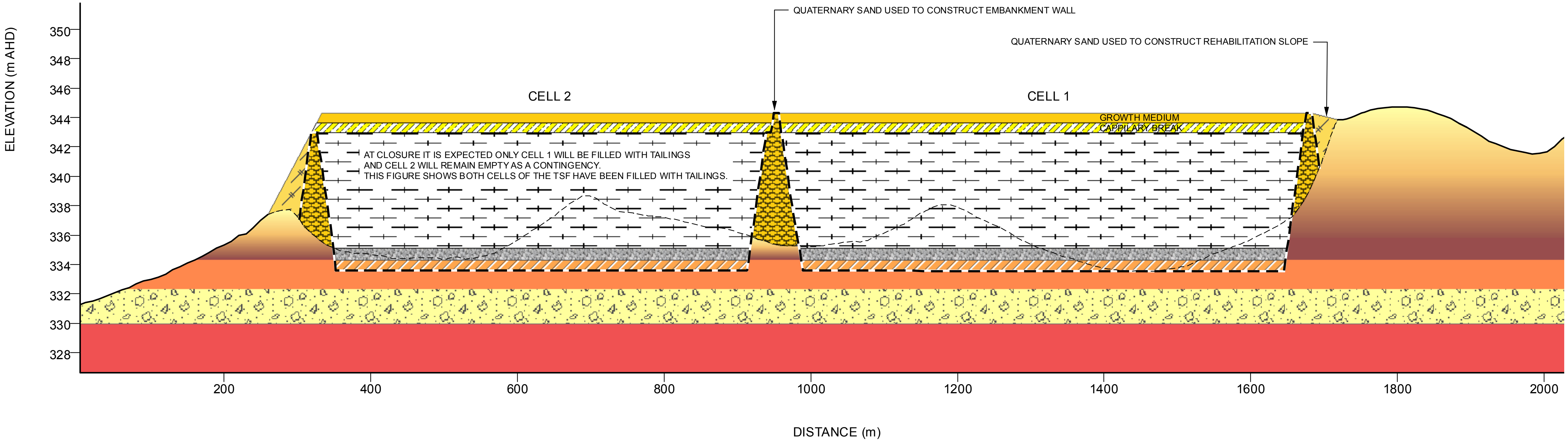
For the above ground TSF:

- Construct a 1m thick capillary break layer utilising crushed and screened (to remove particles less than 2mm in diameter) from the material silcrete or calcrete material. The removal of fine materials will prevent a hydraulic connection being established between the tailings material and the surface growth medium layers resulting in solutes, including salts, impacting on the quality of the surface soils.
- Reconstruct a growth medium and store-release cover over the capillary break. The thickness of this growth medium will be approximately 1m. This sandy material has negligible water holding capacity, but will facilitate the lateral development of plant roots, thus maximising the volume of water accessed by the vegetation. Similar to the upper surface of the mixed Miocene / oxidised Eocene material, the upper surface of the reconstructed Quaternary sand layer will be slightly raised along the TSF embankment wall contact to promote any ponded surface water flows away from the batter slope. This contact will be stabilised by using competent silcrete or calcrete such that a 2m wide 'edge' will be placed around the crest of the TSF embankment wall.
- The surficial Quaternary Sands are expected to represent a good growth medium for the majority of understorey and groundcover species. Comprising SMU 1 and 2, these soils are non-saline, with salinity levels <10mS/m. Quaternary Sands and Miocene sediment are been termed the 'Biologically Active Zone' in that they (SWC, 2015b);
  - are non-dispersive and non-erodible,
  - have negligible surface water flow with vertical infiltration dominating,
  - are friable, low soil strength and not hardsetting,
  - have optimal soil chemical properties (i.e. slightly acidic to neutral pH).
- The upper surface of the TSF (i.e. upper surface of the yellow sand) will be scarified or ripped to create local-scale heterogeneity in the land surface that will promote vertical infiltration of rainfall whilst facilitating the formation of a thin bound layer over the surface preventing it from being eroded by prevailing winds. Ripping or scarifying will occur over the entire upper surface of the TSF, including the embankment walls, to break up the clayey material underlying the liner system. Techniques will be determined through trials.
- Seed rehabilitated surfaces with selected provenance seed mix suitable for the landform.

Rehabilitation of the embankment slopes of the above ground TSF will consist of the following stages:

- Where necessary, additional sand will be added to the sandy embankment slopes to produce a maximum 12° slope. Erosion work conducted by SWC (2015) clearly shows that at this angle, the sands are stable, with negligible runoff being generated even during an intense 100-year storm event. With these materials, vertical infiltration of rainfall is maximised. Texture contrast or duplex layers are avoided near the surface as this may promote lateral movement or erosion at this contact and impact on the structural integrity of the rehabilitated walls;
- The reconstructed TSF walls will be scarified or ripped to create local-scale heterogeneity in the land surface that will promote vertical infiltration of rainfall whilst facilitating the formation of a thin bound layer over the surface preventing it from being eroded by prevailing winds. Techniques will be determined through trials.
- Seed rehabilitated surfaces with selected provenance seed mix suitable for the landform.

A cross-section of the rehabilitated above ground TSF is shown in Figure 9.10.



LEGEND

- PROPOSED ABOVE GROUND TSF (AS-BUILT)
- QUATERNARY SEDIMENTS
- MIOCENE SEDIMENTS
- TAILINGS
- CAPILLARY BREAK
- DUNAL SAND
- REDDISH BROWN SANDY LOAM
- CLAY LINER
- CALCRETE
- REHABILITATION SLOPE
- EMBANKMENT WALL
- UNDERDRAINAGE SYSTEM

0 5 10 15 20 25
V 1:300 METRES

0 100 200 300 400 500
H 1:6,000 METRES

CLIENT	VIMY RESOURCES LIMITED	PROJECT	MULGA ROCK URANIUM PROJECT
CONSULTANT	Golder Associates	TITLE	**PROPOSED REHABILITATION OF ABOVE GROUND TSF**
YYYY-MM-DD	2015-10-31		
DESIGNED	MS		
PREPARED	MS		
REVIEWED	EWC		
APPROVED	EWC		

PROJECT NO.	CONTROL	REV.	FIGURE
1540340	H1	0	**9.10**

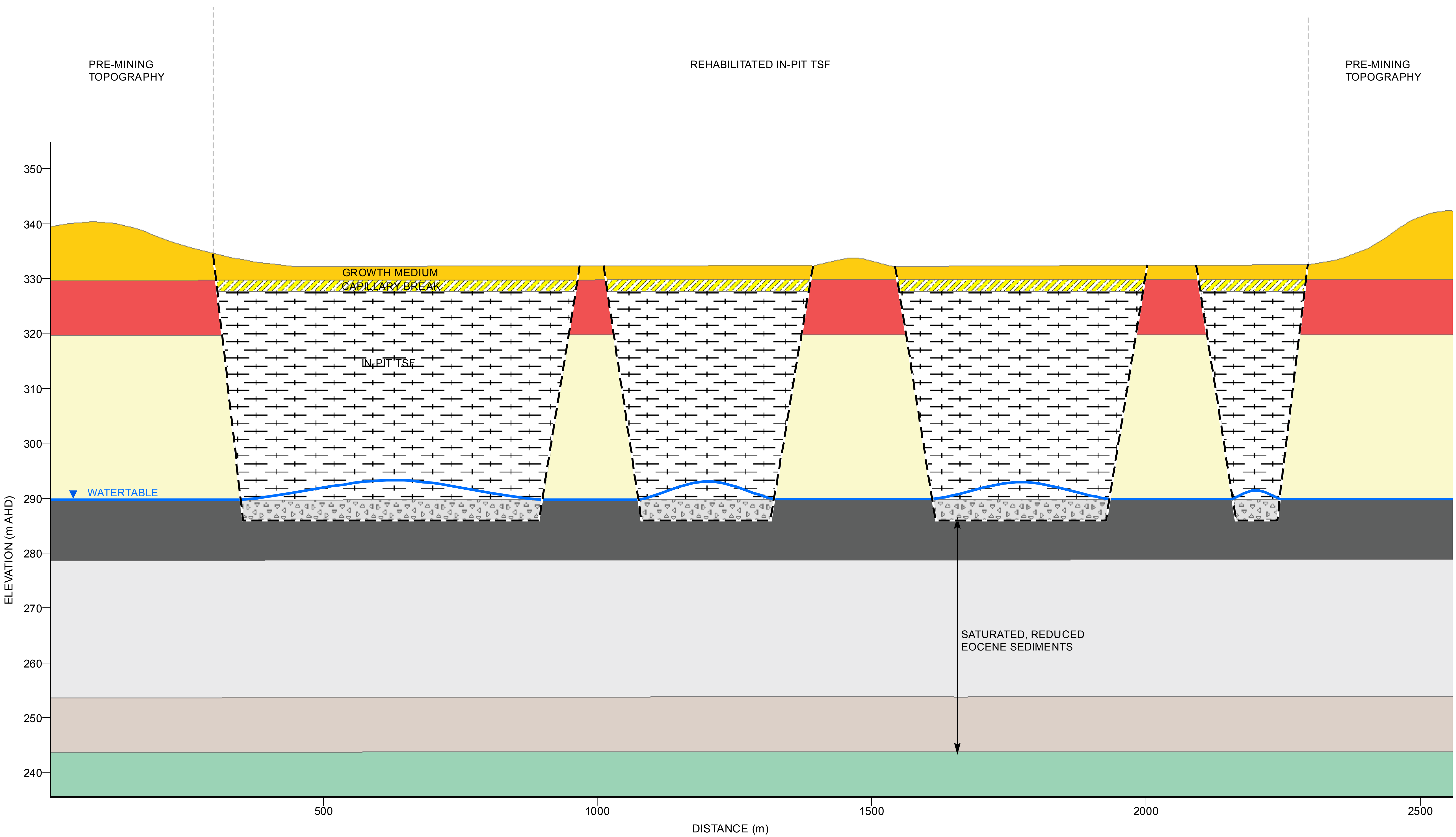
9.5 In-pit TSFs

9.5.1 Closure activities

Rehabilitation of the top of the in-pit TSFs will be similar to that for the above ground TSF and will consist of the following stages:

- Construct a 1m thick capillary break layer utilising crushed and screened silcrete or calcrete material. This capillary break will prevent the upward capillary migration of solutes, including salts into the overlying growth medium.
- Reconstruct a growth medium or store-release cover which will consist of a surficial cover of yellow sand overlying the Miocene / oxidised Eocene material. The thickness of this sand layer will be approximately 1m, and as with the underlying mixed Miocene / oxidised Eocene sediments, the final depth of this cover will depend on the final tailings deposition surface. A minimum thickness of 1m is required to prevent the underlying Miocene / oxidised Eocene sediments from drying out (i.e. acting as an evaporative buffer).
- The reconstructed TSF walls will be scarified or ripped to create local-scale heterogeneity in the land surface that will promote vertical infiltration of rainfall whilst facilitating the formation of a thin bound layer over the surface preventing it from being eroded by prevailing winds. Techniques will be determined through trials.
- Seed rehabilitated surfaces with selected provenance seed mix suitable for the landform.

A schematic diagram showing the proposed rehabilitated Princess and Ambassador East In-pit TSFs are shown in Figure 9.11 and Figure 9.12, respectively.



LEGEND

- PROPOSED MINE PIT
- QUATERNARY SEDIMENTS
- MIOCENE SEDIMENTS
- OXIDISED EOCENE SEDIMENTS
- U-ENRICHED LIGNITE, CLAY, SILT
- REDUCED EOCENE SEDIMENTS
- HIGH PERMEABILITY BASAL SAND
- PERMIAN SEDIMENTS (BASEMENT)
- MIXED BASAL OVERBURDEN & BENEFICIATED SAND PREFERENTIALLY PLACED AT BASE OF PIT
- TAILINGS
- CAPILLARY BREAK

0 10 20 30 40 50
V 1:700 METRES

0 100 200 300 400 500
H 1:7,000 METRES

CLIENT
VIMY RESOURCES LIMITED

VIMY RESOURCES

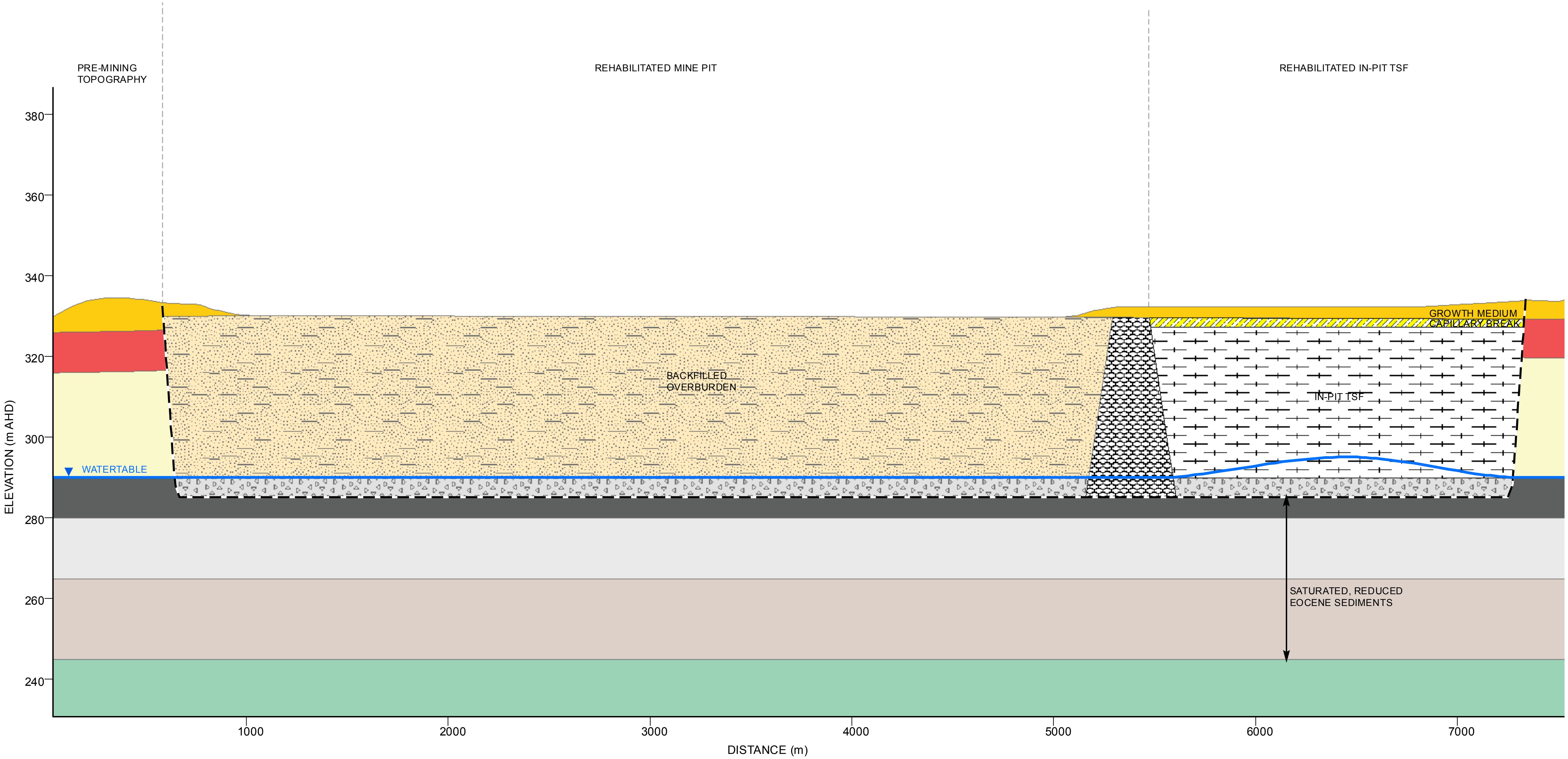
CONSULTANT
Golder Associates

YYYY-MM-DD	2015-10-29
DESIGNED	MS
PREPARED	MS
REVIEWED	EWC
APPROVED	EWC

PROJECT
MULGA ROCK URANIUM PROJECT

TITLE
PROPOSED REHABILITATION OF PRINCESS IN-PIT TSF

PROJECT NO.	CONTROL	REV.	FIGURE
1540340	H1	0	9.11



LEGEND

- PROPOSED MINE PIT
- QUATERNARY SEDIMENTS
- MIOCENE SEDIMENTS
- OXIDISED EOCENE SEDIMENTS
- U-ENRICHED LIGNITE, CLAY, SILT
- REDUCED EOCENE SEDIMENTS
- HIGH PERMEABILITY BASAL SAND
- PERMIAN SEDIMENTS (BASEMENT)
- MIXED BASAL OVERBURDEN & BENEFICIATED SAND PREFERENTIALLY PLACED AT BASE OF PIT
- MIXED MIOCENE AND OXIDISED EOCENE SEDIMENTS
- TAILINGS
- ENGINEERED EMBANKMENT WALL
- CAPILLARY BREAK

0 10 20 30 40 50
V 1:1,000 METRES

0 200 400 600 800 1,000
H 1:20,000 METRES

CLIENT	VIMY RESOURCES LIMITED	PROJECT	MULGA ROCK URANIUM PROJECT
CONSULTANT	Golder Associates	TITLE	PROPOSED REHABILITATION OF AMBASSADOR IN-PIT TSF
YYYY-MM-DD	2015-10-29		
DESIGNED	MS		
PREPARED	MS		
REVIEWED	EWC		
APPROVED	EWC		

PROJECT NO.	CONTROL	REV.	FIGURE
1540340	H1	0	9.12

9.6 Infrastructure

In nearly all cases, with the exception of borrow pits, the various infrastructure components will be installed on the existing land surface. The soil investigation undertaken by SWC (2015) identified that there is negligible topsoil within the MRUP and thus topsoil stripping prior to installation of the infrastructure is not required (i.e. it can be installed directly onto the existing land surface).

In cases where geotechnical considerations for infrastructure placement requires the excavation of surface soils (i.e. to access the more geotechnically stable underlying clays/clayey sands or to excavate foundations), the excavated material will be stockpiled, adjacent or as close to the infrastructure as practical, so that this material can be replaced when it is rehabilitated for closure.

The principal material to be targeted for road sub-base and footing will be the loamy clay material directly above the calcrete layer, and the calcrete material itself. Borrow pits will generally be for the construction of infrastructure away from the direct mining areas, as a large proportion of the material to be used to construct the foundations/footings/sub-base will be captured during mining of the Princess Pit, thus avoiding the addition of this material to an OL. These borrow pits will predominately be located within the defined topographic depressions to avoid the need to excavate excess Quaternary sand.

9.6.1 Closure activities

Actual infrastructure to be removed will be determined during stakeholder consultation for the MRUP as there is a potential that certain features, such as roads and the airstrip, may be left in place for future utilisation.

Rehabilitation of the infrastructure will consist of the following stages:

- Any residual liquids, chemicals and hazardous materials from pipes, tanks and storage will be removed. Contaminated material will be remediated, and if necessary, removed and disposed of at an appropriately licensed facility.
- Concrete pads will be broken up and either disposed of onsite, used as clean landfill in areas of existing disturbance where the landform is amenable to filling, or transported offsite for disposal in an appropriate clean fill facility. Large concrete footings remaining in place (i.e., below 0.5m bgl) will be made safe and buried *in situ*.
- There is a potential that below ground infrastructure, such as pipes and utilities, may be left in place, dependent upon potential environment risks.
- Assess for contaminated soils. Remove all contaminated soils from the area by removing the upper 1m of soil and disposing within the TSF. Radioactive contamination is managed via the Radioactive Waste Management Plan (MRUP-EMP-029).
- Apply a cover of undulating growth medium up to a thickness of 1.0m.
- Rip entire area where practical.
- Seed rehabilitated surfaces with selected provenance seed mix suitable for the landform.

Rehabilitation of the borrow pits will consist of the following stages:

- Reshaping the edges of the borrow pits so that the final slope angle is around 12°.
- Apply a cover of undulating growth medium up to a thickness of 1.0m.
- Where it is considered necessary to encourage water infiltration and stabilisation, techniques should be applied to create micro-topographical landscapes. Appropriate methods will be determined through trials.
- Seed rehabilitated surfaces with selected provenance seed mix suitable for the landform.

9.7 Implementation Schedule

Vimy understands the importance and need for progressive rehabilitation and revegetation given the extended LOM of the operation (i.e. 16 years), large spatial extent of the Project (i.e. Development Envelope of 9,998ha and an approved clearing footprint of 2,374ha) and a mining rate of 4.5 million tonnes per annum. The mine schedule has been designed to facilitate backfilling of the mine pits, behind the mining front, and subsequent rehabilitation of the backfill surface. Given the sandy nature of the surficial soils and their propensity to generate dust (i.e. wind erosion), the mine schedule has been designed to minimise the area of land 'open' (i.e. cleared or yet to be rehabilitated) and maximise the areas 'closed' (i.e. yet to be cleared or areas rehabilitated).

Implementation of progressive rehabilitation is seen by Vimy as a beneficial and favourable process as it enables continuous and iterative learning and refinement of rehabilitation processes, through an 'action – response' approach. The extended LOM of the operation and proposed mining approach (i.e. backfilling of the mine void) allows for the long term performance of implemented rehabilitation activities and processes to be monitored to accurately assess both their ecosystem function (e.g. response to fire, dispersal mechanisms of vegetation and/or colonisation of fauna) and environmental impacts.

The proposed mining approach and schedule will allow for progressive rehabilitation of the operations, with closure domains rehabilitated as far as practicable within a timely manner. A proposed mining, operational and rehabilitation schedule is shown Table 9.5. This schedule is preliminary.

The preliminary mining, operational and rehabilitation schedule to be implemented at the MRUP is outlined below:

- Pre-stripping and mining commences in the Princess deposit initially followed by Ambassador in year 1. The overburden excavated will be used in the construction of the various infrastructure components, including the above ground TSF (i.e. for clay liner and embankment wall material).
- Excess material from the Princess Pit will be stockpiled adjacent to the pit for a prolonged period of time for later use in the final rehabilitation and closure of the above ground TSF (years 6-8) and Princess In-pit TSF (years 11-13). Any remaining material will be reshaped to form the Princess OL, which will be rehabilitated in years 14 to 16.
- The pre-stripped overburden from the starter pit in the eastern section of the Ambassador deposit will form the AEOL. Given this stockpiled material will be used in the rehabilitation of the Ambassador In-pit TSF, this OL cannot be rehabilitated until all of the TSF is covered. Any remaining material will be reshaped and rehabilitated to form a final AEOL.
- Tailings generated from the processing of the Princess Pit ore will be deposited into the above ground TSF (Cell 1), which will operate for a period of 18 months, or until mining in the Princess Pit has ceased. Cell 2 of the above ground TSF will be used only as a storage contingency.
- Rehabilitation of the above ground TSF (Cell 1) will likely occur 4 years after the cessation of tailings deposition (year 6).

- The overburden from AMB EW2 (i.e. next cut from the TSF) will be excavated and stockpiled in the AEOL.
- Rehabilitation of the Ambassador Pit (moving from East to West) will likely commence in year 7 (at NTH5) and given its size will continue to STH2 at year 19.
- At year 8 tailings deposition ceases in the Princess In-pit TSF and commences in the Ambassador In-pit TSF. Tailings deposition in this TSF will continue for approximately 9 years (i.e. until year 16), or the end of mining.
- Rehabilitation of the Princess In-pit TSF will likely be undertaken in years 11 to 13, approximately two years after cessation of tailings deposition.
- Mining at the Shogun and Emperor Deposits will commence in years 2 and 8, respectively, and continue to years 14 and 18 respectively. Rehabilitation of the starter OLs will be restricted as some of the stockpiled material will go back into the mine void; hence rehabilitation of the remaining material will occur around years 11 to 13 (Shogun) and years 19 to 21 (Emperor), with the rehabilitation of the corresponding mine pits expected to extend out to year 14 (Shogun) and year 21 (Emperor).
- Rehabilitation of the Ambassador Pit is expected to be completed in year 26.
- Rehabilitation monitoring in earnest will commence in year 7, but rehabilitation monitoring of the trials and other disturbance areas will likely commence in year 3.

Table 9.5 Proposed Mining, Operation and Rehabilitation Schedule for the MRUP (this is tentative and subject to change as the Project develops)

Area	Domain	Region	Proposed Schedule (Years)																										
			0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
	Plant																												
	Above ground TSF																												
Princess	Mine Pits	NTH1																											
		NTH2																											
		CNT1																											
		STH1																											
		STH2																											
	Overburden Landforms	PNOL																											
		PEOL																											
Ambassador	Mine Pits	NTH1																											
		NTH2																											
		NTH3																											
		NTH4																											
		NTH5																											
		NTH6																											
		NTH7																											
		NTH8																											
		NTH9																											
		NTH10																											
		STH2																											
		STH3																											
		STH4																											
		STH5																											
		STH6																											
		STH7																											
		STH8																											
		STH9																											
		STH10																											
		STH11																											
		STH12																											
	Overburden Landforms	AEOL																											
		AWOL																											
		ASOL																											

Area	Domain	Region	Proposed Schedule (Years)																										
			0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
Shogun	Mine Pits	EST1																											
		EST2																											
		EST3																											
		EST4																											
		EST5																											
		EST6																											
		CNT1																											
		CNT2																											
		CNT3																											
		WST2																											
		WST3																											
	Overburden Landforms	SOL																											
Emperor	Mine Pits	NTH3																											
		NTH4																											
		NTH5																											
		NTH6																											
		NTH7																											
		NTH8																											
		NTH9																											
		NTH10																											
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		NTH13																											
		NTH14																											
		NTH15																											
		NTH16																											
		NTH17																											
	Overburden Landforms	EEOL																											
		ESOL																											
All	Rehabilitation monitoring																												

KEY

	Plant construction
	Mining
	Operation
	Tailings disposal (in-pit)
	Rehabilitation
	Rehabilitation monitoring

9.8 Unexpected or Unplanned Closure

Vimy understands that the long LOM of the Project and future changes in the economic environment may result in unplanned or unexpected permanent closure or suspension of operations under care and maintenance. As these events may represent an appreciable environmental risk, the DoE, DMP and EPA require that consideration is given in the CMCP to addressing and mitigating any potential impacts to the environment, and which may result in an unacceptable liability to the State.

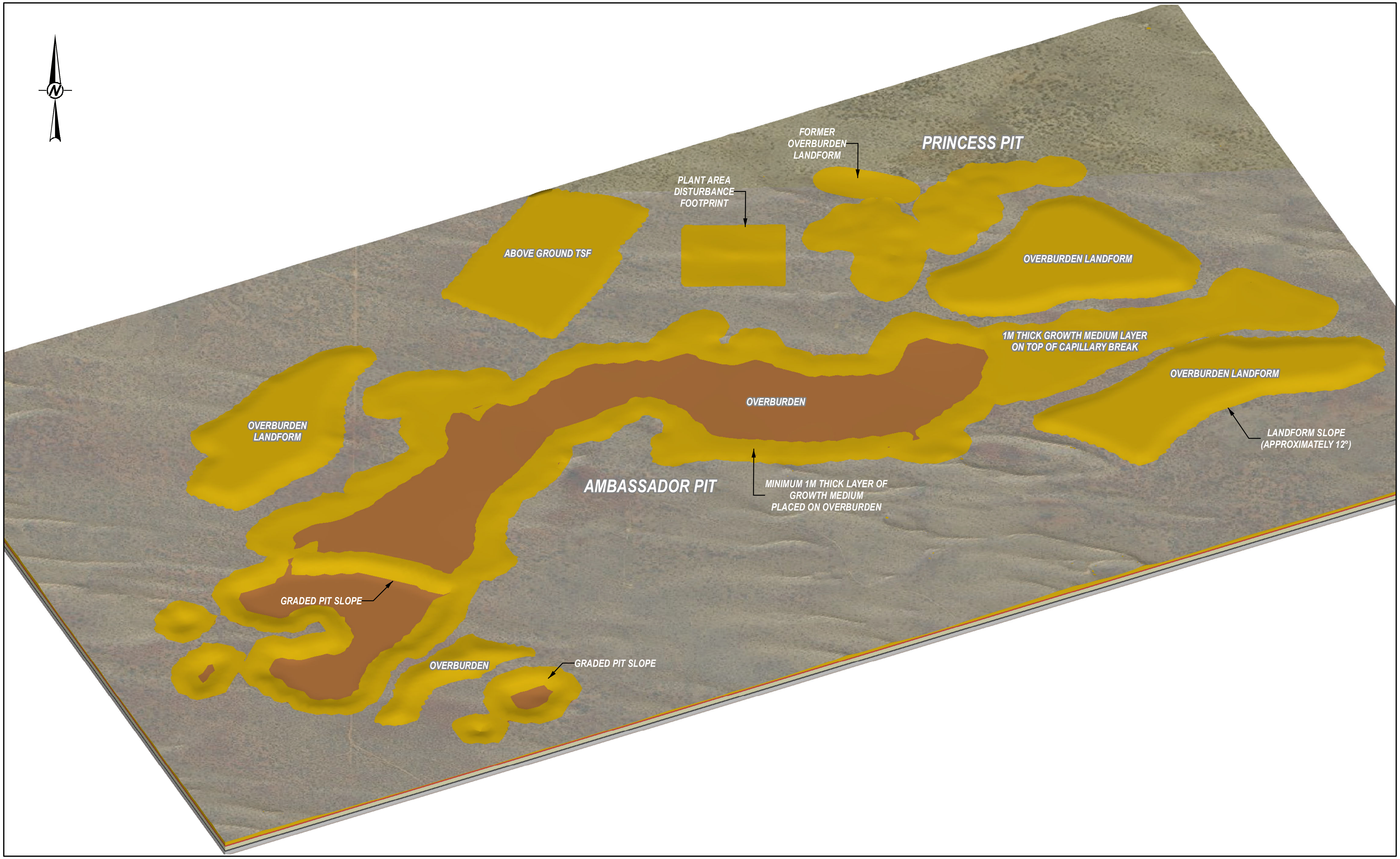
Progressive rehabilitation is the best mechanism to protect against unplanned or unexpected closure or suspension of operations. Through progressive rehabilitation, the area of land left open and not rehabilitated to an acceptable agreed standard is kept to a practicable minimum, reducing the potential liability of the site. As described in Section 9.7, Vimy is committed to progressive rehabilitation throughout the life of the operation. In addition to progressive rehabilitation during operations, planning for unexpected closure or suspension of operations at the MRUP will involve the following:

- making safe closure domains so that they do not represent a risk to humans and animals,
- preventing potential physical (e.g. erosion, subsidence) and chemical (e.g. acid and/or metalliferous drainage) pollution pathways from either establishing or exacerbating over time and
- secure and signpost the site to prevent inadvertent entry.

Unexpected or unplanned closure with regards to radiation within the MRUP is covered in the Radioactive Waste Management Plan (MRUP-EMP-029).

9.9 Post-Mine Landform

The expected post-mine landforms of the MRUP are illustrated in Figure 9.17 to Figure 9.19. Revegetated post-mine landforms of the MRUP are illustrated in Figure 9.20 to Figure 9.22.



LEGEND

- QUATERNARY SEDIMENTS
- MIOCENE SEDIMENTS
- OXIDISED EOCENE SEDIMENTS
- OREBODY
- REDUCED EOCENE SEDIMENTS
- HIGH PERMEABILITY BASAL SAND
- PERMIAN SEDIMENTS (BASEMENT)

NOTES

SURFACE TOPOGRAPHY SHOWN WITH NO VERTICAL EXAGGERATION.
MODEL FOR DISPLAY ONLY (NOT TO BE SCALED OFF).

CLIENT
VIMY RESOURCES LIMITED

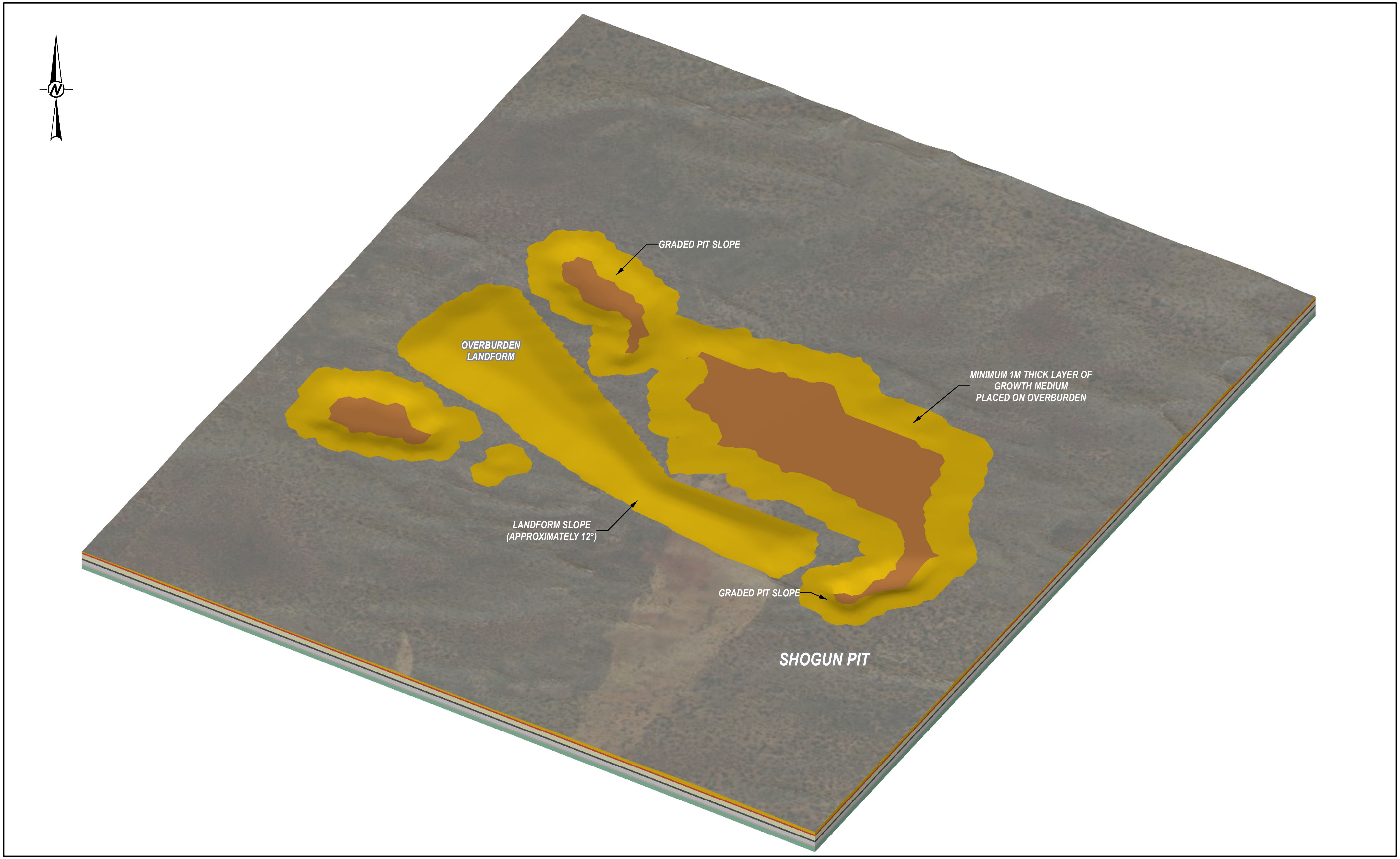
PROJECT
MULGA ROCK URANIUM PROJECT

CONSULTANT
Golder Associates

YYYY-MM-DD	2015-11-06
DESIGNED	SAR
PREPARED	SAR
REVIEWED	EWC
APPROVED	EWC

TITLE
3D IMAGE OF THE MULGA ROCK EAST – CLOSURE

PROJECT NO.	CONTROL	REV.	FIGURE
1540340	H1	0	9.13



LEGEND

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- MIOCENE SEDIMENTS
- OXIDISED EOCENE SEDIMENTS
- OREBODY
- REDUCED EOCENE SEDIMENTS
- HIGH PERMEABILITY BASAL SAND
- PERMIAN SEDIMENTS (BASEMENT)

NOTES

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CLIENT
VIMY RESOURCES LIMITED

VIMY RESOURCES

PROJECT
MULGA ROCK URANIUM PROJECT

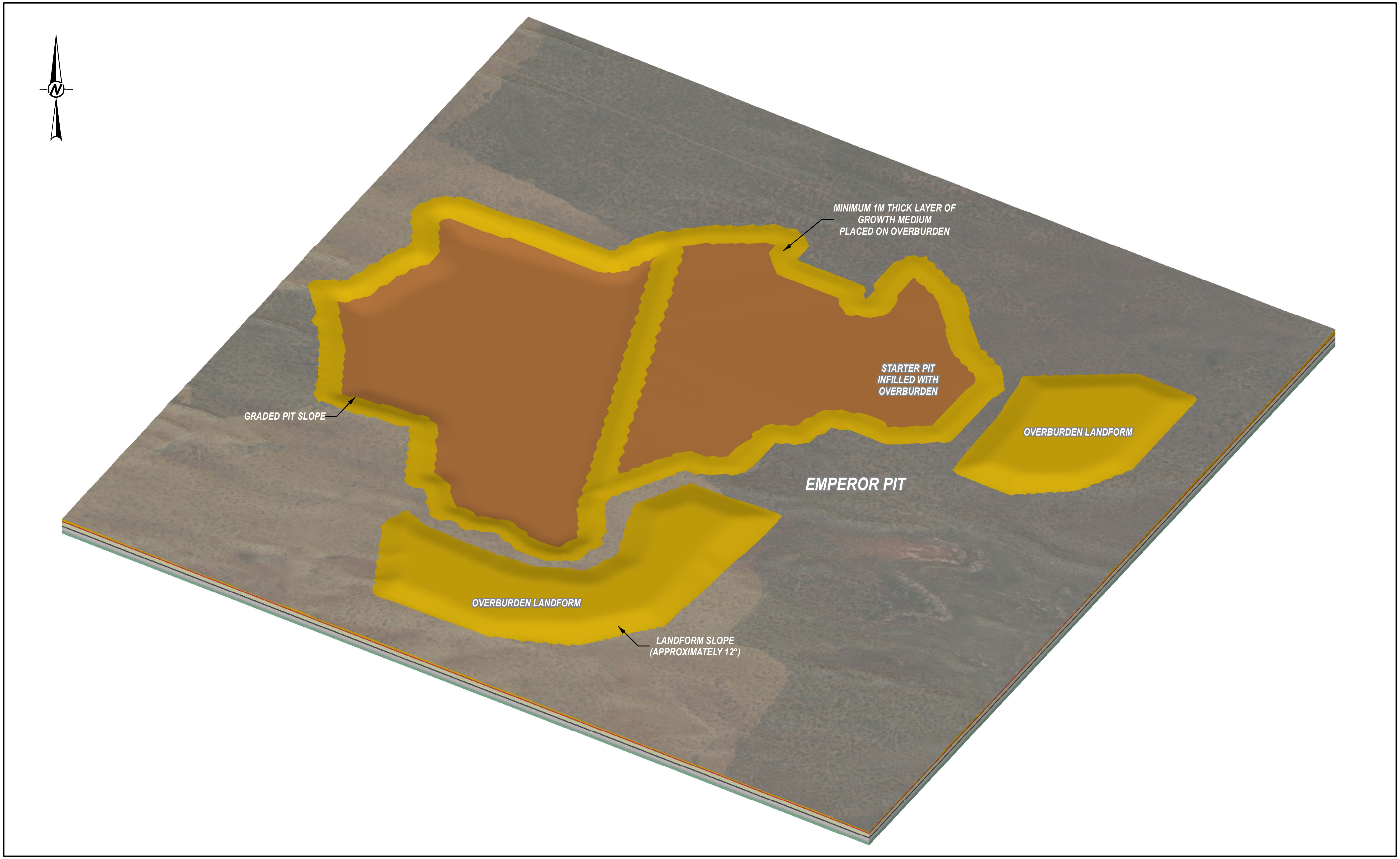
CONSULTANT

Golder Associates

YYYY-MM-DD	2015-11-06
DESIGNED	SAR
PREPARED	SAR
REVIEWED	EWC
APPROVED	EWC

TITLE
3D IMAGE OF THE MULGA ROCK WEST – SHOUGUN CLOSURE

PROJECT NO.	CONTROL	REV.	FIGURE
1540340	H1	0	9.14



LEGEND

- QUATERNARY SEDIMENTS
- MIOCENE SEDIMENTS
- OXIDISED EOCENE SEDIMENTS
- OREBODY
- REDUCED EOCENE SEDIMENTS
- HIGH PERMEABILITY BASAL SAND
- PERMIAN SEDIMENTS (BASEMENT)

NOTES

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CLIENT
VIMY RESOURCES LIMITED

PROJECT
MULGA ROCK URANIUM PROJECT

CONSULTANT
Golder Associates

YYYY-MM-DD	2015-11-06
DESIGNED	SAR
PREPARED	SAR
REVIEWED	EWC
APPROVED	EWC

TITLE
3D IMAGE OF THE MULGA ROCK WEST – EMPEROR CLOSURE

PROJECT NO.	CONTROL	REV.	FIGURE
1540340	H1	0	**9.15**

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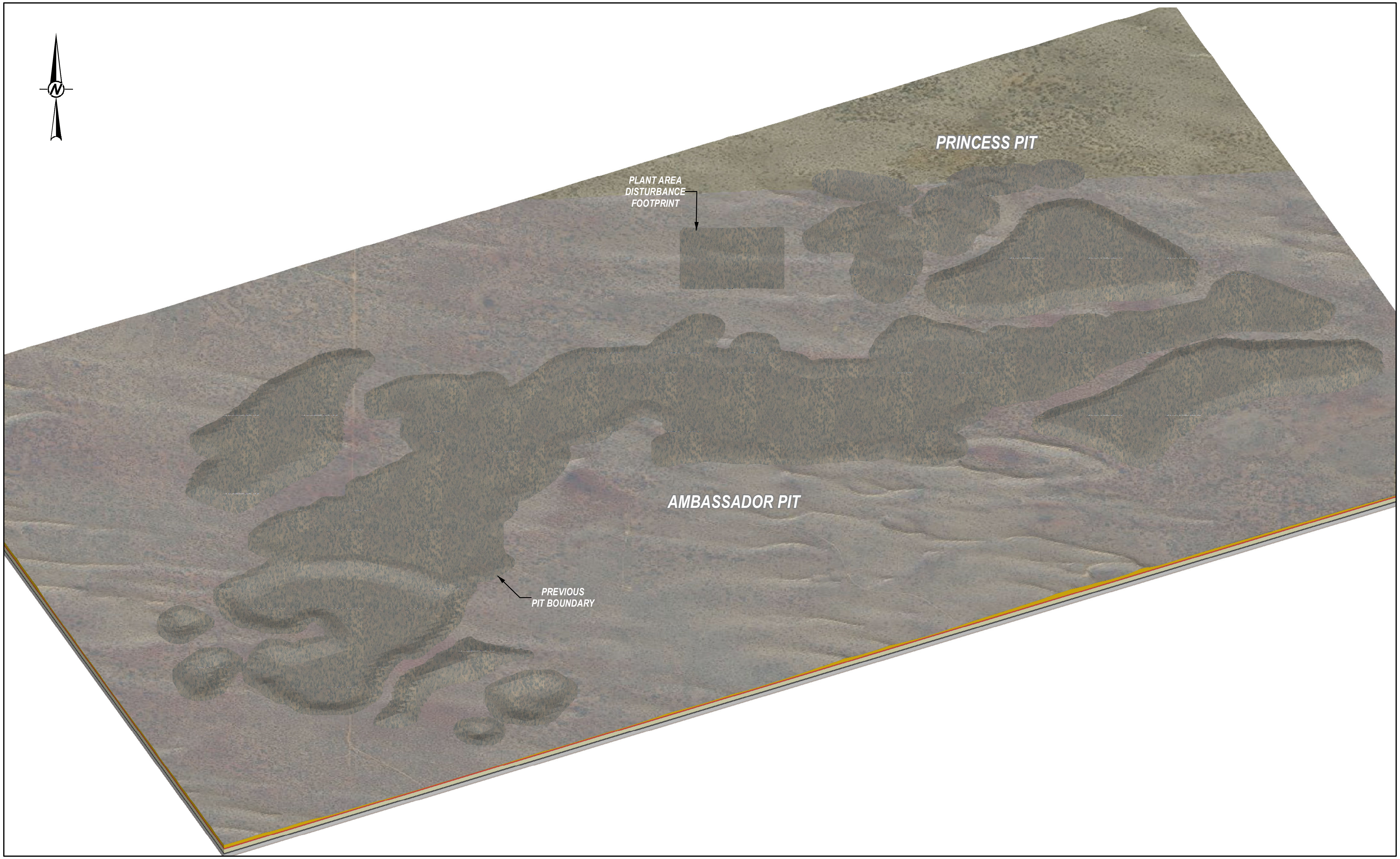

LEGEND

- QUATERNARY SEDIMENTS
- MIOCENE SEDIMENTS
- OXIDISED EOCENE SEDIMENTS
- OREBODY
- REDUCED EOCENE SEDIMENTS
- HIGH PERMEABILITY BASAL SAND
- PERMIAN SEDIMENTS (BASEMENT)

NOTES

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MODEL FOR DISPLAY ONLY (NOT TO BE SCALED OFF).

CLIENT
VIMY RESOURCES LIMITED

VIMY RESOURCES

PROJECT
MULGA ROCK URANIUM PROJECT

CONSULTANT

Golder Associates

YYYY-MM-DD	2015-11-06
DESIGNED	SAR
PREPARED	SAR
REVIEWED	EWC
APPROVED	EWC

TITLE
3D IMAGE OF THE MULGA ROCK EAST – CLOSURE (REVEGETATED)

PROJECT NO.	CONTROL	REV.	FIGURE
1540340	H1	0	9.16

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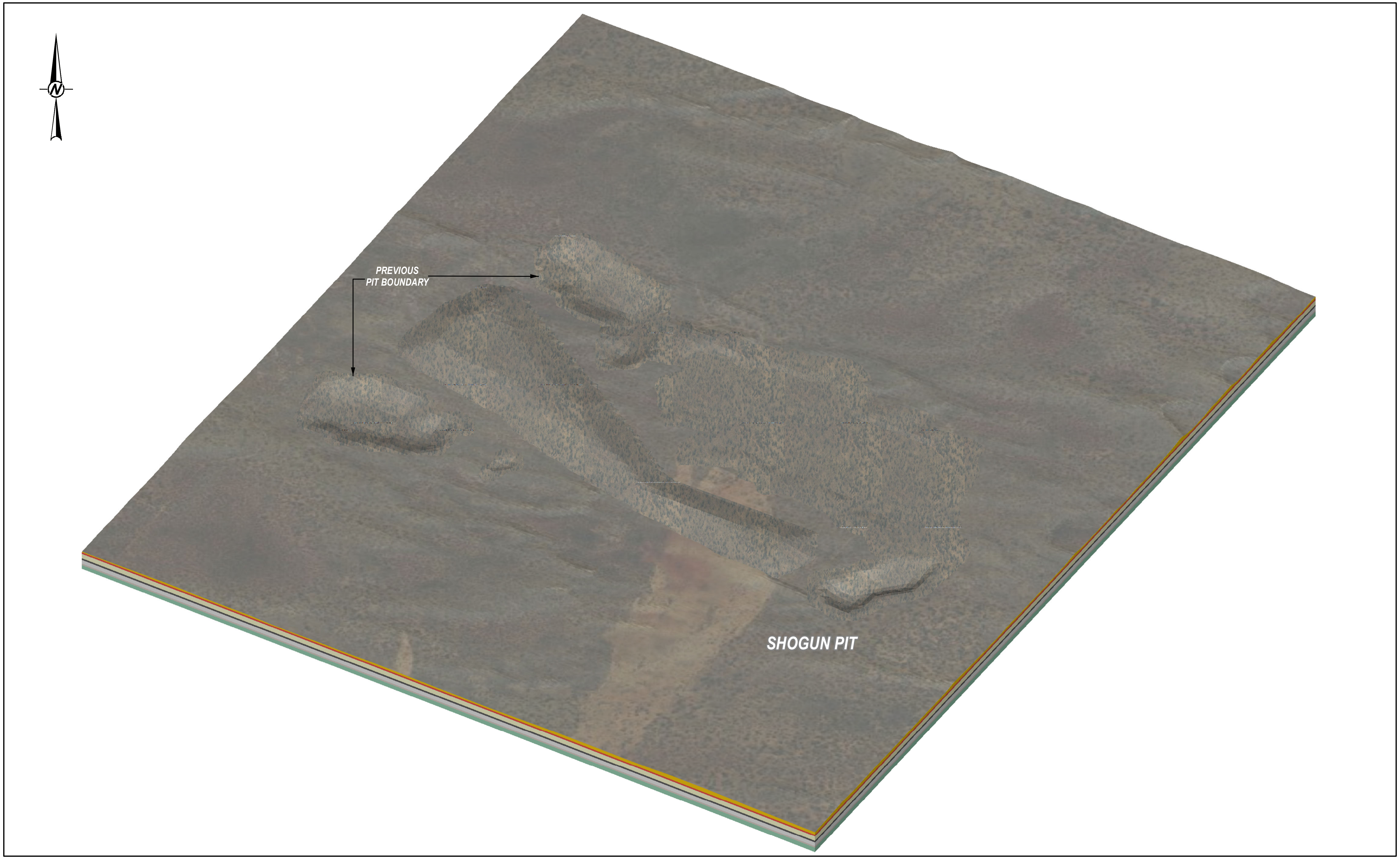

LEGEND

QUATERNARY SEDIMENTS	REDUCED EOCENE SEDIMENTS
MIOCENE SEDIMENTS	HIGH PERMEABILITY BASAL SAND
OXIDISED EOCENE SEDIMENTS	PERMIAN SEDIMENTS (BASEMENT)
OREBODY	

NOTES

SURFACE TOPOGRAPHY SHOWN WITH NO VERTICAL EXAGGERATION.
MODEL FOR DISPLAY ONLY (NOT TO BE SCALED OFF).

CLIENT
VIMY RESOURCES LIMITED

CONSULTANT
Golder Associates

YYYY-MM-DD	2015-11-06
DESIGNED	SAR
PREPARED	SAR
REVIEWED	EWC
APPROVED	EWC

PROJECT
MULGA ROCK URANIUM PROJECT

TITLE
3D IMAGE OF THE MULGA ROCK WEST – SHOGUN CLOSURE (REVEGETATED)

PROJECT NO.	CONTROL	REV.	FIGURE
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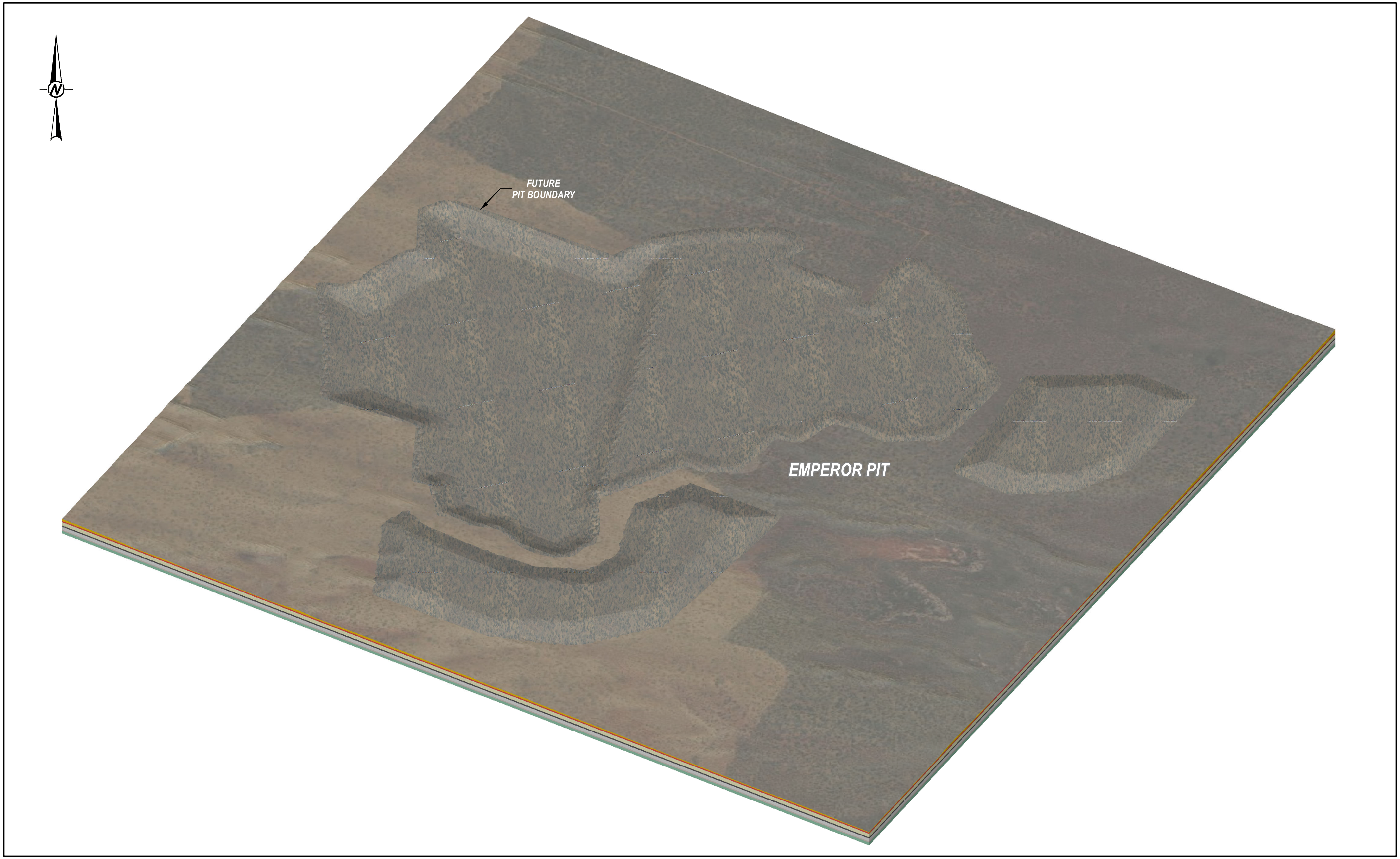

LEGEND

- QUATERNARY SEDIMENTS
- MIOCENE SEDIMENTS
- OXIDISED EOCENE SEDIMENTS
- OREBODY
- REDUCED EOCENE SEDIMENTS
- HIGH PERMEABILITY BASAL SAND
- PERMIAN SEDIMENTS (BASEMENT)

NOTES

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CLIENT
VIMY RESOURCES LIMITED

VIMY RESOURCES

CONSULTANT

Golder Associates

YYYY-MM-DD	2015-11-06
DESIGNED	SAR
PREPARED	SAR
REVIEWED	EWC
APPROVED	EWC

PROJECT
MULGA ROCK URANIUM PROJECT

TITLE
3D IMAGE OF THE MULGA ROCK WEST – EMPEROR CLOSURE (REVEGETATED)

PROJECT NO.	CONTROL	REV.	FIGURE
1540340	H1	0	9.18

10. Closure Monitoring and Maintenance

Vimy acknowledges that monitoring is a crucial aspect to any rehabilitation program and is required to test the efficacy of treatments and provide quantitative data on rehabilitation performance for adaptive management of procedures and processes. Monitoring is integral to the success of rehabilitation and through a feedback process to continually refine rehabilitation techniques to achieve the agreed closure objectives. Additionally, any monitoring program must be aligned with the stakeholder agreed completion criteria (Section 6.1), to ensure that relevant data is being collected.

Monitoring of analogue sites will inform completion criteria reviews to ensure the key performance indicators adequately reflect natural, temporal and spatial variation for communities typical for the region. This feedback loop will be an important component of the adaptive management of the MRUP.

Monitoring post-decommissioning rehabilitation will then demonstrate that completion criteria have been met. Given the early stage of the MRUP, specific monitoring programs to apply to the various environmental aspects of the MRUP have not been established. Through life-of-mine, and in consultation with relevant stakeholders, specific monitoring programs will be developed to provide the necessary feedback mechanisms to adapt and direct closure management. The monitoring program for MRUP will be developed to comply with *Guidelines for Preparing Mine Closure Plans* (DMP/EPA 2015) and the Environmental Protection Agency (EPA) Guidance Statement No. 6 for *Rehabilitation of terrestrial ecosystems* (EPA 2006). Monitoring programs will be developed so that they align with stakeholder expectations to ensure that only relevant data is collected.

The proposed monitoring program will be designed to assess rehabilitation to a natural ecosystem of similar values to the original ecosystem. Main components of the monitoring program will include:

- selection of appropriate analogue sites with justification of their selection,
- description of field monitoring procedures,
- description of floristic data provided by the monitoring method,
- procedures for assessment of rehabilitation success,
- provision of closure criteria in accordance with DMP and EPA guidelines,
- procedures to evaluate the success of rehabilitation processes and
- frequency and period of monitoring based on the outcomes and recommendations from rehabilitation trials and research.

Monitoring of analogue sites will inform completion criteria reviews to ensure the key performance indicators adequately reflect natural, temporal and spatial variation for communities typical for the region. This feedback loop will be an important component of the adaptive management of the MRUP.

Monitoring will also include historical rehabilitation already existing at MRUP. Information on historical rehabilitation practices for is currently anecdotal with few records available.

10.1 Monitoring Programme Overview

In accordance with government guidelines (EPA 2006, DMP/EPA 2015) a monitoring program should describe the methodology to derive cost effective quantitative data pertaining to:

Identification of keystone (dominant) plant species present in vegetation associations;

- measures for keystone species,
- measures of weed species and
- plant density, diversity and foliage cover measures including relative values for all species recorded in monitoring transects.

The data provided by the monitoring program are applicable to:

- providing clear completion criteria for rehabilitation assessment,
- identification of keystone and other native species to target for rehabilitation and
- evaluation of rehabilitation process success, e.g. success of rehabilitation programs.

10.2 Monitoring Methodology

10.2.1 Vegetation

Monitoring of rehabilitation and analogue vegetation will involve the following techniques:

- photographic monitoring points – to provide rapid qualitative assessment of vegetation quality and performance,
- establishment of permanent transects or quadrats. Variables of species composition, density and foliage cover will be determined,
- opportunistic observations – for the monitoring of DRF and Priority Flora and
- trait analysis – assessment of functional requirements of the vegetation.

Vegetation monitoring sites in rehabilitation should be located within topographic or geomorphic unit (i.e. batter slopes, top/crest of landform). For rehabilitated areas, the number of transects will be influenced by the size, structure and rehabilitation history of the site. Where possible, transects should be installed to represent each area rehabilitated at a different time or utilising different methods to accurately portray an overall picture of the entire rehabilitated area.

For analogue communities, a sufficient number of transect will be installed and monitored within each appropriate vegetation community to provide accurate measures of vegetation quality and performance (MCPL 2105a).

10.2.2 Weeds

As part of the vegetation monitoring program, weed monitoring will be included. Values for weeds in rehabilitation will be compared to these in comparable analogue sites.

10.2.3 Landform Stability

Monitoring of landform stability may involve:

- photo monitoring points
- ground-based or airborne LiDAR and
- direct measurements of erosion and sediment loss.

10.2.4 Surface Water Monitoring

No monitoring of surface water will be undertaken as negligible surface water accumulates or flows occur across the site.

10.2.5 Groundwater Monitoring

Monitoring of groundwater and potential groundwater impacts will be established in the Operation Licence for the site. This will continue into closure.

10.2.6 Radiation Monitoring

Aspects of radiation monitoring are covered in the Radioactive Waste Management Plan (MRUP-EMP-029).

10.2.7 Auditing against completion criteria

Auditing against completion criteria will be conducted until relinquishment or MRF levy obligation is deemed rehabilitated.

10.3 Monitoring frequency

The frequency of monitoring will be based on risk and be specified in consultation with key stakeholders. The Monitoring requirements will be specified in the Environmental Monitoring Management Plan (MRUP-EMP-032).

10.4 Reporting

Environmental reporting requirements are expected to be those typical of most West Australian mine sites:

- annual environmental reports,
- MRF annual submissions on disturbance and progressive rehabilitation,
- incident reporting governed by the specific regulations governing the incident and
- Mine Closure Review every 3 years.

11. Financial Provisioning of Closure

Vimy acknowledge that mining operations create environmental change and cause environmental disturbance, and that rehabilitation and revegetation of these operations is required to close and relinquish the site. The costs associated with these rehabilitation and closure works are significant, and Vimy proposes to undertake provisioning of rehabilitation and closure on a regular basis to ensure adequate funds are made available to progressively rehabilitate the site, conduct post-closure monitoring and fund and further management activities.

Closure costing will estimate the cost of closure for the Project using third party rates. The majority of the closure rehabilitation work will be completed during operations and, as such, the cost associated with this work will not be reflected within the closure provision. Vimy consider the closure costing provision for the Project to be subject to change over mine life.

Mine closure financial provisioning will include consideration of the following indirect costs aspects (typically associated with socio-economics, redundancy, post-closure management/administration and external consultants):

- socio-economic costs such as social risk assessments, community consultation, baseline community assessments and community and cultural heritage,
- redundancy costs and aspects such as service and notice payments, transition/outplacement costs, retraining, relocation, mobilisation, attrition, redeployment and retention,
- post-closure monitoring such as environmental, geotechnical and site integrity,
- external consultation costs to conduct additional studies that may be required to support closure,
- post-closure management/administration costs required until bond relinquishment is achieved

11.1 Financial Costing Assumptions

The overall closure costing assumptions that will be made are outlined below:

- The closure cost review is based on liability that exists as described in this MCP version.
- Direct closure costs are based on the limit of existing and approved disturbance areas. Potential new disturbance areas have not been included. However, it is the intention that these areas will be considered as part of future reviews of the closure plan as they occur, at which time the closure cost estimate will be adjusted accordingly. As such, the direct costs are representative of the current liability.
- In-direct closure costs (employee wages, environmental monitoring, ongoing leases/licences/rates etc.) costs are considered to be incurred following the cessation of mining, through the active closure phase and through lease relinquishment.
- At this early stage of closure replanning the current mine closure date is assumed to be indicative only and will be continually reviewed as part of the ongoing mine closure process.

12. Management of Information and Data

A closure, environment and community database is maintained by Vimy to ensure all the baseline data, mining records, logistical and site procedures are housed in a centralised framework for the effective management and retrieval of information and data relevant to closure.

In accordance with s84AA of the *Mining Act 1978*, Vimy will implement a management strategy to review and update this CMCP every three years (or at such time as specified in writing) and submit it to the DMP for review. The updated will capture and summarise current closure planning information associated with:

- closure planning prior to cessation of operations,
- implementation of the closure program of works,
- post-closure monitoring and reporting period and
- financial provision.

This plan will also be reviewed periodically and updated accordingly for currency with legislation, standards, guidelines and operational requirements.

13. References

AMEC Foster Wheeler, 2015. *Mulga Rock Uranium Project, Scoping Study*. Unpublished report prepared for Vimy Resources Limited, September 2015.

ANCOLD, 2012. *Guidelines on Planning, Design, Construction, Operation and Closure of Tailings Dams.* May 2012.

ANSTO, 2015. *Mulga Rocks Tailings Characterisation Testwork*. Unpublished report prepared by Australian Nuclear Science and Technology Organisation for Vimy Resources Limited, February 2015.

Bennelongia, 2015. *Short-range Endemic Fauna at the Mulga Rock Uranium Project.* Unpublished report prepared for Vimy Resources Limited, February 2015. [PER APPENDIX B7]

DITR (2015). *Leading Practice Sustainable Development Program for the Mining Industry - Risk Assessment and Management*. Department of Industry, Tourism and Resources, Canberra, Australia. 95pp.

DITR, 2006*. Mine Closure and Completion*. Guideline published as part of the Leading Practice Sustainable Development Program for the Mining Industry. October 2006.

DITR, 2007. *Managing Acid and Metalliferous Drainage.* Guideline published as part of the Leading Practice Sustainable Development Program for the Mining Industry. February 2007.

DMP/EPA, 2015. *Guidelines for Preparing Mine Closure Plans*. May 2015.

DotE, 2015a. *Hibbertia crispula in species profile and threats database*, Commonwealth of Australia. Available from: http://www.environment.gov.au/cgibin/sprat/public/publicspecies.pl?taxon_id=15222

DotE, 2015b. *Southern Marsupial Mole (Notoryctes typhlops)* Environment Australia Fact sheet.

DoW 2010. *Water Quality Protection Note 27: Liners for Containing Pollutants Using Engineered Soils.*

DPaW, 2015. *FloraBase – the Western Australian Flora*, Western Australian Herbarium, Government of Western Australia. http://florabase.dpaw.wa.gov.au

EPA 2006. *Guidance Statement Number 6 for Rehabilitation of Terrestrial Ecosystems*

GHD, 2015a. *Mulga Rock Uranium Project: Dispersion Modelling*. Unpublished report prepared for Vimy Resources Limited, May 2015. [PER APPENDIX E1]

GHD, 2015b. *Mulga Rock Uranium Project: Groundwater Impact Assessment of Tailings and Process Water Disposal to Princess Pit.* Unpublished report prepared for Vimy Resources Limited, May 2015. [PER APPENDIX D8]

ICMM (2008). Planning for Integrated Mine Closure: Toolkit. International Council on Mining and Metals London, UK. 86pp.

Keighery, B. J. (1994). Bushland plant survey. A guide to plant community survey for the community. Wildflower Society of WA (Inc.). Nedlands, Western Australia.

Martinick, 1986. *Mulga Rock: Flora, Fauna and Radioecology Survey.* Unpublished report prepared by Martinick WG and Associates Pty Ltd for PNC Exploration (Australia) Pty Ltd, January 1986. [PER APPENDIX B1]

MCA ANZMEC 2000. *Strategic Framework for Closure*

MCPL, 2008. *Flora and Vegetation Survey of Narnoo Project Area.* Unpublished report prepared by Mattiske Consulting Pty Ltd for Energy and Minerals Australia. August 2008.

MCPL, 2013. *Flora and Vegetation Survey of Mulga Rock Project Area*. Unpublished report prepared by Mattiske Consulting Pty Ltd for Energy and Minerals Australia. June 2013.

MCPL, 2015a. *Assessment of Flora and Vegetation for the Mulga Rock Uranium Project, Great Victoria Desert, WA.* Unpublished report prepared by Mattiske Consulting Pty Ltd for Vimy Resources Limited, April 2015. [PER APPENDIX A1]

MCPL, 2015b. *Regional Hibbertia crispula (P1 and Vulnerable) Survey, Great Victoria Desert, WA.* Unpublished report prepared by Mattiske Consulting Pty Ltd for Vimy Resources Limited, February 2015. [PER APPENDIX A2]

MCPL, 2015c. *Assessment of Flora and Vegetation Survey Conducted for the Mulga Rock Uranium Proejct, Great Vicotira Desert, WA*. Unpublished report prepared by Mattiske Consulting Pty Ltd for Vimy Resources Limited, October 2015.

Ninox, 2010. *A Fauna Survey of the Proposed Mulga Rock Project Area, Great Victoria Desert, Western Australia - Interim Report.* Unpublished report prepared by Ninox Wildlife Consulting Pty Ltd for Energy and Minerals Australia Limited, January 2010. [PER APPENDIX B2]

Ninox, 2015a. *A Report on the Southern Marsupial Mole, Mulga Rock Uranium Project, Great Victoria Desert, Western Australia*. Unpublished report prepared by Ninox Wildlife Consulting Pty Ltd for Vimy Resources Limited, May 2015. [PER APPENDIX B4]

Ninox, 2015b. *An Updated Report on the Herpetofauna of the Proposed Mulga Rock Uranium Project Area, Great Victoria Desert, Western Australia*. Unpublished report prepared by Ninox Wildlife Consulting Pty Ltd for Vimy Resources Limited, April 2015. [PER APPENDIX B6]

Rockwater 2015c. *Mulga Rock Project: Subterranean Fauna Pilot Study*. Unpublished report prepared for Vimy Resources Limited, March 2015. [PER APPENDIX C2]

Rockwater, 2015a. *Results of Hydrogeological Investigations and Numerical Modelling, Mulga Rock Mining Areas.* Unpublished report prepared for Vimy Resources Limited, May 2015. [PER APPENDIX D2]

Rockwater, 2015b. *Results of Hydrogeological Investigations and Numerical Modelling, Planned Kakarook North Borefield.* Unpublished report prepared for Vimy Resources Limited, April 2015. [PER APPENDIX D1]

SWC, 2015a. *Physicochemical Characterisation of Tailings from the Mulga Rock Uranium Project.* Unpublished report prepared by Soilwater Consultants for Vimy Resources Limited, May 2015. [PER APPENDIX D9]

SWC, 2015b. *Terrain Analysis and Materials Characterisation for the Mulga Rock Uranium Project.* Unpublished report prepared by Soilwater Consultants for Vimy Resources Limited, May 2015. [PER APPENDIX H2]

SWC, 2015c. *Mulga Rock Uranium Project Tailings Storage Facility Seepage Analysis.* Unpublished report prepared by Soilwater Consultants for Vimy Resources Limited, June 2015. [PER APPENDIX D10]

Vimy, 2015. *Draft Camera Trapping Protocol - Sandhill Dunnart (Sminthopsis psammophila*) - *Mulga Rock Project Area* - Draft. Unpublished report by Vimy Resources Pty Ltd, March 2015. [PER APPENDIX B3]

Vimy, 2015b. *Fauna Assessment: Malleefowl (Leipoa ocellata), Mulga Rock Project Area.* Unpublished report by Vimy Resources Pty Ltd , May 2015. [PER APPENDIX B5]

Woolard, 2015. *Mulga Rock Uranium Project: Stygofauna Pilot Assessment #1.* Unpublished report prepared by Woolard Consulting Pty Ltd for Vimy Resources Limited, April 2015. [PER APPENDIX C1]

Appendix A

Mulga Rock Uranium Project: Closure Risk Identification Workshop Report

Golder Associates Pty Ltd for Vimy Resources Pty Ltd, October 2015

TECHNICAL MEMORANDUM

DATE 26 October 2015 **PROJECT No.** 1540340-001-TM-Rev1

TO Adam Pratt, Environmental, Health and Safety Manager
Vimy Resources Limited

CC

FROM Clint McCullough **EMAIL** cmccullough@golder.com.au

CONCEPTUAL MINE CLOSURE PLAN RISK ASSESSMENT

1.0 INTRODUCTION

This Risk Assessment was developed for the Conceptual Mine Closure Plan (CMCP) prepared as part of the Public Environmental Review (PER) for the proposed Mulga Rock Uranium Project (MRUP).

The Mulga Rock Uranium Project (MRUP) is located approximately 240 km east-north-east of Kalgoorlie-Boulder in the Shire of Menzies in the Great Victoria Desert of Western Australia. The area is remote, comprising series of large, generally parallel sand dunes, with inter-dunal swales and broad flat plains.

The closest residential town to the Project is Laverton approximately 200 km to the north-west. Other regional residential communities include Pinjin Station homestead located approximately 100 km to the west, Coonana Aboriginal community situated approximately 130 km to the south-south-west, Kanandah Station homestead positioned approximately 150 km to the south-east and the Tropicana Gold Mine approximately 110 km to the north-east of the Project.

The ore body was laid down in a fault-driven lacustrine and estuarine paleochannel. Mining will be undertaken by large scale open mining methods with backfilling of the pit progressing along the strike length at the same rate as the mining front.

2.0 SCOPE OF WORK AND OBJECTIVE

The scope of work was to undertake a mine closure risk assessment commensurate with the conceptual project stage that met the requirements of the Guidelines for Preparing Mine Closure Plans (DMP and the EPA 2015). The objective of the Risk Assessment is identify and prioritises the key issues facing the MRUP through a structured, systematic process.

3.0 APPROACH

The risk assessment was conducted using standard qualitative risk assessment techniques consistent with the Australian Standard for Risk Management (AS/NZS 4360:1999 leading industry guidance documents (References). The risk matrix and associated definitions are shown in Table 1.

The risk assessment was facilitated by Michael Woods (Golder Associates Pty Ltd (Golder) EHS Specialist – Mining) and attended by:

- Clint McCullough – Golder Principal Mine Closure Specialist
- Edward Clerk – Golder Principal EHS Specialist - Mining
- Gay Bradley – Golder Senior Environmental Scientist
- Karen Mackenzie – Golder Principal Geochemist.

Additional support and input was provided by Adam Pratt – Vimy Resources' Environment, Health and Safety Manager

Management measures were selected in accordance with the following hierarchy of controls.

- Avoid
- Minimise
- Mitigate
- Rehabilitate
- Offset.

Table 1: Risk matrix used for risk assessment

			1	2	3	4	5
Likelihood	Rare	1	Low	Low	Low	Low	Low
	Unlikely	2	Low	Low	Medium	Medium	Medium
	Possible	3	Low	Medium	Medium	High	High
	Likely	4	Low	Medium	High	High	Critical
	Almost certain	5	Low	Medium	High	Critical	Critical

The following actions are undertaken for the identified risk categories:

- **Critical** Risks that significantly exceed the risk acceptance threshold and need urgent and immediate action.
- **High** Risks that exceed the risk acceptance threshold and require protective management. It includes risks for which protective actions have been taken, but further risk reduction is impractical. However active monitoring is required and the latter requires the signoff of the Resident Manager.
- **Medium** Risks that lie on the risk acceptance threshold and require active monitoring. The implementation of additional control measures could be used to reduce the risk further.
- **Low** Risks that are below the risk acceptance threshold and do not require active management. Certain risks could require additional monitoring.

Definitions of likelihood and consequence are described below.

3.1 Likelihood definitions

- Will only occur in exceptional circumstances. <1% probability. Event may occur in a 10 year period. Unlikely even in the long term.
- Will occur in most circumstances. 99% probability. Occurs almost immediately or monthly.
- Will probably occur in most circumstances. >50% and <99% probability. Could occur annually.
- Event might occur. >20% and <50% probability. Might occur within 2-4 year period.
- Event is not expected. >1% and <20% probability. Could occur over a 5 to 10 year period.

3.2 Consequence definitions

Economic Impact (A$)

- Little or minor loss to property or equipment. Approximately $0 to $20k.
- Minor or superficial damage that may require repair. Approximately $20k to $200k.
- Moderate damage requiring repair. Approximately $200k to $750k.
- Major damage requiring significant corrective action. Approximately $750k to $2M.
- Closure actions seriously affected and requiring urgent action. >$2M.

Health and Safety

- Minor injury or illness to less than 10 individuals. Usually self-treated.
- Minor injury between 10 and 100 people. Injury with low level short-term symptoms. First Aid treatment.
- Minor injury or illness to >100 people, or injury resulting in professional medical treatment.
- Major injury or illness for more than 10 people, or injury causing over 10 days recuperation or medical treatment.
- Fatalities and/or severe or permanent disability or impairment.

Environment

- Single event causing negligible harm. Alteration/disturbance to habitat within natural variability. Less than 1% environment affected.
- Systematic with potential for local or short-term impact. 1-5% of habitat affected, measurable change to ecosystem component without major change in function. Reestablishment in less than 1 year.
- Local or off-site impact. 5 to 30% of habitat affected, measurable change to ecosystem component without major change in function. Reestablishment in 1-2 years.
- Non-reversible local and/or off-site impact. 30 to 90% or habitat affected. Measurable change to ecosystem component with major change in function. Recovery in 2-10 years.
- Long-term irreversible damage. Over 90% of habitat affected. Irreversible impact to ecosystem function with recovery (if at all) in over 10 years.

Community/Reputation

- Concern to client, site or immediate neighbours. Isolated community impact avoided.
- Minor local complaints with small local reputation impact. Unresolved low-level community dissatisfaction.
- Attention from media or heightened concern by local community. Community dissatisfaction with social harm resulting in minor business impact.
- National media coverage with impact to management credentials. Community dissatisfaction with social harm resulting in major business impact. Prominent international media coverage over several days. Reputation severely tarnished with significant social harm.

Legal and Compliance

- Non-conformance with internal requirement with very low potential for impact.
- Non-compliance with external or internal requirement with low potential for impact. Prosecution unlikely, may draw attention from regulator.
- Non-compliance with internal or external requirement with moderate potential for impact. Minor penalties for breach of legislation, contract, permit or licence. Significant hardship from regulator.
- Non-compliance with internal or external requirement with moderate potential for impact. Moderate penalties for breach of legislation, contract, permit or licence. Significant difficulties gaining approvals.
- Breach of licences, legislation, regulation or repeated noncompliance with high potential for prosecution. Breach of contract with significant penalty clauses imposed. Systemic non-conformance with Corporate or Product Group work cycles or standards.

The risk assessment identified occupational health and safety and environmental hazards pre-decommissioning and without any controls. The worst case consequence and likelihood of the unmanaged risk was determined, followed by identification of potential control measures to limit the level of risk. The hazards with controls were once again assessed, and the updated consequence and likelihood evaluated, followed by on-going monitoring and measurement following closure.

4.0 RESULTS AND DISCUSSION

The results of the risk assessment are summarised in Table 2.

Table 2: Summary of Risk Assessment Results

Risk category	Score	Inherent risk (considers current knowledge base)	Residual risk (post additional control)
Critical risk	17-25	0	0
High risk	11-16	34	0
Medium risk	6-10	26	36
Low risk	1-5	1	25
Total		**61**	**61**

Impacts identified with the highest inherent risk and their controls were as follows.

- Landform aesthetics

  Overburden landforms (OL) are currently designed to a height above immediate surrounding natural landforms. This risk can be mitigated by determining if the landforms which are significantly higher than those in the immediate area, meet regional analogues.

- Pit Abandonment Bunds

  Mining design will result in voids that have battered slopes in lieu of abandonment bunds which may not meet closure criteria. This risk can be mitigated by consulting with the regulator on the removal of the abandonment bund and desired maximum depth and slope angle criteria.

- Suitability of growth media characteristics and effect on rehabilitation

  The mine plan will result in OL. The characteristic of the material are understood however the landform design may not support a sustainable vegetation community. This risk can be mitigated by conducting growth trials for mining pit and for overburden landforms. The relative importance of seed bank versus resprouting plants (from lignotubers) during revegetation trials also needs to be established.

5.0 SUMMARY AND CONCLUSIONS

Issues considered of significance were grouped into four categories, these being safety, stability, non-polluting and sustainability. Risks were able to be controlled by a series of measures. The proposed measures considerably reduce overall risk, to acceptable levels.

6.0 REFERENCES

ANZECC/ARMCANZ (2000). *Australian and New Zealand guidelines for fresh and marine water quality. National Water Quality Management Strategy Paper No 4*. Australian and New Zealand Environment and Conservation Council & Agriculture and Resource Management Council of Australia and New Zealand, Canberra. 1,500pp.

ANZMEC/MCA (2000). *Strategic Framework for Mine Closure*. Australian and New Zealand Minerals and Energy Council/Minerals Council of Australia, Canberra, Australia. 27pp.

DITR (in press). Leading Practice Sustainable Development Program for the Mining Industry - Preventing Acid and Metalliferous Drainage Handbook Department of Industry, Tourism and Resources., Canberra, Australia.

DMP/EPA (2011). *Guidelines for preparing mine closure plans*. Western Australian Department of Mines and Petroleum (DMP), Environmental Protection Authority of Western Australia (EPA), Perth, Australia. 78pp.

ICMM (2008). *Planning for Integrated Mine Closure: Toolkit*. International Council on Mining and Metals London, UK. 86pp.

IFC (2007). *Environmental, Health and Safety Guidelines for Mining*, http://www1.ifc.org/wps/wcm/connect/1f4dc28048855af4879cd76a6515bb18/Final%2B-%2BMining.pdf?MOD=AJPERES&id=1323153264157, Accessed: May 2012.

McCullough, C. D. (2011). Mine Pit Lakes: Closure and Management. Australian Centre for Geomechanics (ACG), Perth, Australia. 183pp.

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Attachments: A: Risk assessment matrix

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ASSESSMENT A

Risk assessment matrix

Risk Assessment for Conceptual Mine Closure Plan

Item No	Domain	Closure Principal	Aspect	Hazard	Consequence	Inherent risk				Additional control	Residual risk			Source
						L	C	RISK	Mitigating factor relevant to the inherent risk		L	C	RISK	
1	Overburden Landforms	Aesthetics	Aesthetics	Aesthetics	Design 16 m above surrounding landforms.	5	3	15	Although the 360 m RL is higher than the dunes in the immediate vicinity of the proposed OLs, there are dunes higher than this only 1.5 km to the south.	Assess whether regional analogues for comparison with design	5	1	5	Golder CMCP workshop and Vimy EHS Manager
2	Backfill pits	Voids	Voids	Voids	Mining method will result in voids. Design provides for battered slopes without abandonment bund.	5	3	15		Need to investigate removal of abandonment bund. Maximum depth and slope angle need to be confirmed.	2	3	6	Golder CMCP workshop and Vimy EHS Manager
3	In Pit Tailings Storage Facility	Revegetation	Revegetation	Revegetation	Assumption that the growth media is viable for various vegetation communities	3	3	9	Revegetation species will be preferentially selected as those that can be sustainably supported by the growth media.	Conduct growth trials for mining pit and for overburden landforms. The relative importance of seed bank versus resprouting plants (from lignotubers) during revegetation trials needs to be established.	2	3	6	Golder CMCP workshop and Vimy EHS Manager
4	Overburden Landforms	Revegetation	Revegetation	Revegetation	Assumption that the growth media is viable for various vegetation communities	3	3	9	Revegetation species will be preferentially selected as those that can be sustainably supported by the growth media.	Conduct growth trials for mining pit and for overburden landforms. The relative importance of seed bank versus resprouting plants (from lignotubers) during revegetation trials needs to be established.	2	3	6	Golder CMCP workshop and Vimy EHS Manager
5	Tailings Storage Facility	Revegetation	Revegetation	Revegetation	Assumption that the growth media is viable for various vegetation communities	3	3	9	Revegetation species will be preferentially selected as those that can be sustainably supported by the growth media.	Conduct growth trials for mining pit and for overburden landforms. The relative importance of seed bank versus resprouting plants (from lignotubers) during revegetation trials needs to be established.	2	3	6	Golder CMCP workshop and Vimy EHS Manager
6	Backfill pits	Revegetation	Revegetation	Revegetation	Drought - lack of sufficient rainfall during and after germination	3	3	9	Growth requirements of the revegetation species must be matched with the capability of the reconstructed soil profile to support these requirements. If this occurs, then it counters the effect of drought by delaying the onset of germination until the correct conditions occur.	Understand climate and plan post-closure monitoring duration to capture likely rainfall events. Time seeding to maximise likely germination and seedling survival.	2	3	6	Golder CMCP workshop and Vimy EHS Manager
7	In Pit Tailings Storage Facility	Revegetation	Revegetation	Revegetation	Drought - lack of sufficient rainfall during and after germination	3	3	9	Growth requirements of the revegetation species must be matched with the capability of the reconstructed soil profile to support these requirements. If this occurs, then it counters the effect of drought by delaying the onset of germination until the correct conditions occur.	Understand climate and plan post-closure monitoring duration to capture likely rainfall events. Time seeding to maximise likely germination and seedling survival.	2	3	6	Golder CMCP workshop and Vimy EHS Manager

Item No	Domain	Closure Principal	Aspect	Hazard	Consequence	Inherent risk				Additional control	Residual risk			Source
						L	C	RISK	Mitigating factor relevant to the inherent risk		L	C	RISK	
8	Overburden Landforms	Revegetation	Revegetation	Revegetation	Drought - lack of sufficient rainfall during and after germination	3	3	9	Growth requirements of the revegetation species must be matched with the capability of the reconstructed soil profile to support these requirements. If this occurs, then it counters the effect of drought by delaying the onset of germination until the correct conditions occur.	Understand climate and plan post-closure monitoring duration to capture likely rainfall events. Time seeding to maximise likely germination and seedling survival.	2	3	6	Golder CMCP workshop and Vimy EHS Manager
9	Tailings Storage Facility	Revegetation	Revegetation	Revegetation	Drought - lack of sufficient rainfall during and after germination	3	3	9	Growth requirements of the revegetation species must be matched with the capability of the reconstructed soil profile to support these requirements. If this occurs, then it counters the effect of drought by delaying the onset of germination until the correct conditions occur.	Understand climate and plan post-closure monitoring duration to capture likely rainfall events. Time seeding to maximise likely germination and seedling survival.	2	3	6	Golder CMCP workshop and Vimy EHS Manager
10	Infrastructure	Stability	Erosion - Wind	Erosion - Wind	Excessive wind erosion of post mining land surface leading to loss of growth media.	4	4			Design OLs using understanding of materials and landform evolution modelling. Current landform evolution models do not consider wind erosion, only water erosion; hence rates of wind erosion, and potential impacts on rehabilitation will need to be established by field trials and LiDAR measurements.	2	4	8	Golder CMCP workshop and Vimy EHS Manager
11	In Pit Tailings Storage Facility	Non-Polluting	Geochemical - Radiological	Insufficient capping layer or erosion of capping material.	Radon emission and capping performance does not meet commitments and background levels	3	3	12	Industry knowledge shows a 2 m of capping is be sufficient to reduce radon emission rates to below background levels. Quaternary sand overburden materials are radiologically benign.	Understand materials balance and handle/encapsulate impermeable materials. Design landform using understanding of materials and landform evolution modelling.	1	3	3	Golder CMCP workshop and Vimy EHS Manager
12	Tailings Storage Facility	Non-Polluting	Geochemical - Radiological	Insufficient capping layer or erosion of capping material.	Radon emission and capping performance does not meet commitments and background levels	3	3	12	Industry knowledge shows A 2 m of capping is be sufficient to reduce radon emission rates to below background levels. Quaternary sand overburden materials are radiologically benign.	Understand materials balance and handle/encapsulate impermeable materials. Design landform using understanding of materials and landform evolution modelling	1	3	3	Golder CMCP workshop and Vimy EHS Manager
13	In Pit Tailings Storage Facility	Sustainability	Revegetation	Placement of growth media storage sites away from final landforms,	Increased rehabilitation cost.	3	4	12		Design optimal locations for cover materials to minimise handling costs.	1	3	3	Golder CMCP workshop and Vimy EHS Manager
14	Overburden Landforms	Sustainability	Revegetation	Lack of growth media placed close to use due to lack of planning,	Increased rehabilitation cost.	3	4	12		Design optimal locations for cover materials to minimise handling costs.	1	3	3	Golder CMCP workshop and Vimy EHS Manager
15	Tailings Storage Facility	Sustainability	Revegetation	Lack of growth media placed close to use due to lack of planning,	Increased rehabilitation cost.	3	4	12		Design optimal locations for cover materials to minimise handling costs.	1	3	3	Golder CMCP workshop and Vimy EHS Manager

Item No	Domain	Closure Principal	Aspect	Hazard	Consequence	Inherent risk				Additional control	Residual risk			Source
						L	C	RISK	Mitigating factor relevant to the inherent risk		L	C	RISK	
16	Infrastructure	Sustainability	Access/Egress	Potential uncertainty as to reinstatement or realignment of Nippon Highway alignment or other transport route.	Increased costs.	4	3	12		Engage stakeholders and incorporate their expectations into mine operational and closure planning design and closure costing	2	3	6	Golder CMCP workshop and Vimy EHS Manager
17	Backfill pits	Stability	Erosion - Wind	Wind erosion of the post mine surface leading unstable materials.	Unstable landform with open voids.	4	4	16		Backfilled pits are below surrounding sand dune landforms. Areas will be stabilised through revegetation.	3	3	9	Golder CMCP workshop and Vimy EHS Manager
18	Tailings Storage Facility	Stability	Erosion - Water	Excessive water erosion on the upper surface and batter slope leading to rilling or gullying and release of sediment into the surrounding environment.	Release of tailings into the environment. Failure of capping layer resulting in radon release.	3	4	12		Design TSF to ANCOLD guidelines	2	5	10	Golder CMCP workshop and Vimy EHS Manager
19	Overburden Landforms	Stability	Landform Design	Revised terraced overburden landform design (30 m height) with multiple benches unlikely to provide long term stability	Slumping or mass failure of overburden land form or batter slope. Increased erosion and unstable landform.	3	4	12	The OL material does not tunnel so any ponded water on back sloped benches will infiltration and move vertically down the profile. The benefit of using benches is that is breaks up the slope. The benefit of berms is that it provides a safety mechanism by breaking the overall slope into mini-catchments; hence three batter slope portions, separated by 8-10 m back sloping berms, is more stable than one long continuous slope.	Design OLs using understanding of materials and landform evolution modelling. Monitor stability using field trials and LiDAR measurements. Adjust landform design based on landform performance during operations.	2	4	8	Golder CMCP workshop and Vimy EHS Manager
20	Infrastructure	Stability	Erosion - Water	Erosion leads to landform instability and revegetation failure	Failure to establish sustainable vegetation communities.	3	4	12		Species selection based on regional analogue sites and tested through trials. Reference sites to be identified.	2	3	6	Golder CMCP workshop and Vimy EHS Manager
21	Overburden Landforms	Stability	Erosion - Water	Excessive water erosion leading to unacceptable rilling or gullying and release of sediment into the surrounding environment.	Disturbance outside of approved areas.	3	4	12		Design OLs using understanding of materials and landform evolution modelling	2	4	8	Golder CMCP workshop and Vimy EHS Manager
22	Overburden Landforms	Stability	Landform Placement	Failure of terrace design through erosion leading to disturbance outside of approved foot print.	Disturbance outside of approved areas.	3	4	12		Redesign landforms to mimic natural landforms and assess disturbance area. Investigate repositioning of overburden landforms within the pit disturbance area to minimise disturbance foot pit.	2	4	8	Golder CMCP workshop and Vimy EHS Manager

Item No	Domain	Closure Principal	Aspect	Hazard	Consequence	Inherent risk				Additional control	Residual risk			Source
						L	C	RISK	Mitigating factor relevant to the inherent risk		L	C	RISK	
23	Infrastructure	Non-Polluting	Contamination	Insufficient or inappropriate onsite disposal of decommissioned infrastructure or impacted soil.	Contamination of the environment. Insufficient space to dispose leading to increased costs or failure to meet closure objectives.	4	3	12		Contamination assessment undertaken prior to closure. Removal and/or remediation to appropriate standard and/or waste facility undertaken. Compliance with Con. Sites Act 2003.	1	2	2	Golder CMCP workshop and Vimy EHS Manager
24	Backfill pits	Sustainability	Revegetation	Lack of growth media placed close to use due to lack of planning,	Increased rehabilitation cost.	3	4	12		Understand materials balance. Plan soil profiles close to pit.	1	3	3	Golder CMCP workshop and Vimy EHS Manager
25	Backfill pits	Sustainability	Revegetation	Seed ecology of the revegetation species unknown and uncertainty as to germination rates.	Unstainable revegetation communities	3	4	12		Review knowledge of revegetation species. Trials assemblages and undertake progressive revegetation.	1	4	4	Golder CMCP workshop and Vimy EHS Manager
26	In Pit Tailings Storage Facility	Sustainability	Revegetation	Seed ecology of the revegetation species unknown and uncertainty as to germination rates.	Unstainable revegetation communities	3	4	12		Review knowledge of revegetation species. Trials assemblages and undertake progressive revegetation.	1	4	4	Golder CMCP workshop and Vimy EHS Manager
27	Overburden Landforms	Sustainability	Revegetation	Seed ecology of the revegetation species unknown and uncertainty as to germination rates.	Unstainable revegetation communities	3	4	12		Review knowledge of revegetation species. Trials assemblages and undertake progressive revegetation.	1	4	4	Golder CMCP workshop and Vimy EHS Manager
28	Tailings Storage Facility	Sustainability	Revegetation	Seed ecology of the revegetation species unknown and uncertainty as to germination rates.	Unstainable revegetation communities	3	4	12		Review knowledge of revegetation species. Trials assemblages and undertake progressive revegetation.	1	4	4	Golder CMCP workshop and Vimy EHS Manager
29	In Pit Tailings Storage Facility	Safety	Voids	Tailings material preferentially consolidates or shrinks excessively resulting in cracking along pit walls. Potential for self-perpetuating voids and cracks	Open voids	3	4	12		Potential for further consolidation or shrinkage determined with test work reflecting tails chemistry.	1	3	3	Golder CMCP workshop and Vimy EHS Manager

Item No	Domain	Closure Principal	Aspect	Hazard	Consequence	Inherent risk L	Inherent risk C	Inherent risk RISK	Mitigating factor relevant to the inherent risk	Additional control	Residual risk L	Residual risk C	Residual risk RISK	Source
30	Tailings Storage Facility	Safety	Voids	Tailings material preferentially consolidates or shrinks excessively resulting in cracking along pit walls. Potential for self-perpetuating voids and cracks	Open voids	3	4	12		Potential for further consolidation or shrinkage determined with test work reflecting tails chemistry.	1	3	3	Golder CMCP workshop and Vimy EHS Manager
31	Backfill pits	Safety	Geotechnical	Unconsolidated backfill preferentially consolidates resulting in cracking along pit walls. Potential for self-perpetuating voids and cracks	Open voids	3	4	12		Backfilled materials to be compacted by heavy machinery to avoid large macro pores.	1	2	2	Golder CMCP workshop and Vimy EHS Manager
32	Backfill pits	Stability	Erosion - Water	Variable permeability leading to tunnel erosion and preferential bypass flow	Unstable landform with open voids.	3	4	12		Backfilled pits are below surrounding sand dune landforms. Relatively homogeneous nature of material	1	3	3	Golder CMCP workshop and Vimy EHS Manager
33	Overburden Landforms	Stability	Erosion - Wind	Wind erosion of 30 m height landform and the nature of the material	Unstable landform and disturbance outside of approved areas.	4	3	12		Understand materials balance and handle/encapsulate impermeable materials. Design OLs using understanding of materials and landform evolution modelling	3	3	9	Golder CMCP workshop and Vimy EHS Manager
34	In Pit Tailings Storage Facility	Stability	Erosion - Wind	Wind erosion of the post mine surface leading unstable materials.	Unstable landform with open voids.	3	4	12		Backfilled pits are below surrounding sand dune landforms. Design using understanding of materials and landform evolution modelling.	3	3	9	Golder CMCP workshop and Vimy EHS Manager
35	Infrastructure	Contamination	Contamination	Contamination	Insufficient assessment or classification of the waste streams to enable placement within onsite facilities	3	3	9		Contamination assessment on infrastructure waste streams undertaken prior to placement in pits or OL. Compliance with Contaminated Sites Act 2003.	1	3	3	Golder CMCP workshop and Vimy EHS Manager
36	Backfill pits	Geochemical - AMD	Geochemical - AMD	Geochemical - AMD	Knowledge gap relating to temporal changes in groundwater.	3	3	9	The background water quality data has been adequately characterised to assess the impacts of the MRUP. There is groundwater chemistry data (at varying levels) for 526 drill holes over the MRUP. Temporal data has been collected for a few of boreholes, primarily associated with the abstraction and reinjection borefields.	Continue to collect baseline data for groundwater quality as well as ongoing reference monitoring site data. Vimy plans to install 10 nested monitoring bores at varying distances downstream of the mine pits to monitor change in groundwater quality in response to mining and tailings backfill operations.	1	2	2	Golder CMCP workshop and Vimy EHS Manager

Item No	Domain	Closure Principal	Aspect	Hazard	Consequence	Inherent risk				Additional control	Residual risk			Source
						L	C	RISK	Mitigating factor relevant to the inherent risk		L	C	RISK	
37	Backfill pits	Geochemical - AMD	Geochemical - AMD	Geochemical - AMD	Partially known overburden geochemical properties. Unlikely to be acidic but may have still have leachable content and acid generating material. Could have acid generating material in overburden.	2	3	6	The MRUP is currently undergoing active natural ASS oxidation, hence there is continual addition of acidity and metals to the groundwater system. Seepage from the OLs are unlikely to reach the groundwater system, given the depth of the underlying Miocene and Eocene sediments, and the very low permeability of this material at its current field capacity moisture content. There is limited standard geochemical characterisation data available for the overburden, however there is multi-element data from the geological drilling (including Total S) and confirmatory screen testing, to clearly confirm the presence/absence and distribution of sulfides and potential AMD materials. The Eocene overburden above the orebody has already undergone extensive oxidation and acidification in the past resulting in the stripping of most metals and metalloids. Remaining residuals are likely to be located in the crystal mineral structure and not available for release.	Leach testing on landform materials. Although additional geochemical testing is scheduled to be undertaken, there is sufficient information to appropriately manage the handling and utilisation of the overburden materials and to establish their risks to the environment. The basal 2-5 m of the overburden profile, which is influenced by the capillary wetting front, particularly where the basal kaolinite occurs, is less weathered and therefore does contain AMD. This material will be preferentially stripped and deposited back at the base of the mine pit to be saturated when the water table recovers.	1	2	2	Golder CMCP workshop and Vimy EHS Manager
38	In Pit Tailings Storage Facility	Geochemical - AMD	Geochemical - AMD	Geochemical - AMD	Geochemical properties. Unlikely to be acidic but may have still have leachable content and acid generating material.	2	3	6	Refer to item 37.	Geochemical characterisation and leach testings of tailings types. Although additional geochemical testing is scheduled to be undertaken, there is sufficient information to appropriately manage the handling and utilisation of the overburden materials and to establish their risks to the environment.	1	2	2	Golder CMCP workshop and Vimy EHS Manager
39	Overburden Landforms	Geochemical - AMD	Geochemical - AMD	Geochemical - AMD	Geochemical properties. Unlikely to be acidic but may have still have leachable content	2	3	6	Only the Quaternary sand, Miocene and upper portion of the Eocene sediments will be stored in the OL. Whilst no traditional AMD characterisation, or ASLP, has been undertaken, given the depositional and post-depositional history of these materials the risk of them resulting in AMD is very low and they can effectively be considered benign. Refer to item 37.	Geochemical characterisation and leach testing on all landform materials. Further geochemical characterisation, including state and kinetic test work, is planned for 2016.	1	2	2	Golder CMCP workshop and Vimy EHS Manager

Item No	Domain	Closure Principal	Aspect	Hazard	Consequence	Inherent risk				Additional control	Residual risk			Source
						L	C	RISK	Mitigating factor relevant to the inherent risk		L	C	RISK	
40	Tailings Storage Facility	Geochemical - AMD	Geochemical - AMD	Geochemical - AMD	Geochemical properties. Unlikely to be acidic but may have still have leachable content	3	3	9	Testwork indicates that the tailings will contain 2-3% sulfides and up to 40% organic matter, particularly the beneficiated material. Although this level of sulfides, in the absence of alkalinity (i.e. caustic added to stabilise the reagents) would at first glance represent an ARD issue; however, the very high organic matter will likely consume all of the oxygen in the tailings during bacterial decomposition, whilst the tailings will likely remain below the 600 mV (SHE) required to convert the Fe^{2+} to Fe^{3+}; hence, all potential oxidising agents have been removed and thus the risk of the tailings oxidising and generating excessive acidity that will impact on the groundwater quality is considered low. It is correct that minimal leach testing of the tailings has been undertaken, hence the tailings are not properly characterised for their risk of metalliferous drainage, but even if this is so, the receiving groundwater environment is already acidic and contains elevated metals.	Geochemical characterisation and leach testings of tailings types. Although additional geochemical testing is scheduled to be undertaken, there is sufficient information to appropriately manage the handling and utilisation of the overburden materials and to establish their risks to the environment.	1	2	2	Golder CMCP workshop and Vimy EHS Manager
41	Backfill pits	Revegetation	Revegetation	Revegetation	Material characteristics.	2	3	6	Assessments of the growth medium and its capabilities have been undertaken. The materials can support vegetation.	Conduct growth trials to test the capability of the Miocene and Eocene sediments to support the sustainable growth of selected revegetation species.	2	3	6	Golder CMCP workshop and Vimy EHS Manager
42	In Pit Tailings Storage Facility	Revegetation	Revegetation	Revegetation	Material characteristics.	2	3	6	Assessments of the growth medium and its capabilities have been undertaken. The materials can support vegetation.	Conduct growth trials to test the capability of the Miocene and Eocene sediments to support the sustainable growth of selected revegetation species.	2	3	6	Golder CMCP workshop and Vimy EHS Manager
43	Overburden Landforms	Revegetation	Revegetation	Revegetation	Material characteristics.	2	3	6	Assessments of the growth medium and its capabilities have been undertaken. The materials can support vegetation.	Conduct growth trials to test the capability of the Miocene and Eocene sediments to support the sustainable growth of selected revegetation species.	2	3	6	Golder CMCP workshop and Vimy EHS Manager
44	Tailings Storage Facility	Revegetation	Revegetation	Revegetation	Material characteristics.	2	3	6	Assessments of the growth medium and its capabilities have been undertaken. The materials can support vegetation.	Conduct growth trials to test the capability of the Miocene and Eocene sediments to support the sustainable growth of selected revegetation species.	2	3	6	Golder CMCP workshop and Vimy EHS Manager
45	Backfill pits	Geochemical - Salinity	Geochemical - Salinity	Geochemical - Salinity	Salinity properties of mixed overburden.	2	3	6	The salinity profiles are known from drill holes.	Conduct growth trials to test the capability of the Miocene and Eocene sediments to support the sustainable growth of selected revegetation species.	1	3	3	Golder CMCP workshop and Vimy EHS Manager

Item No	Domain	Closure Principal	Aspect	Hazard	Consequence	Inherent risk L	Inherent risk C	Inherent risk RISK	Mitigating factor relevant to the inherent risk	Additional control	Residual risk L	Residual risk C	Residual risk RISK	Source
46	In Pit Tailings Storage Facility	Geochemical - Salinity	Geochemical - Salinity	Geochemical - Salinity	Salinity properties of mixed overburden.	2	3	6	The salinity profiles are known from drill holes.	Conduct growth trials to test the capability of the Miocene and Eocene sediments to support the sustainable growth of selected revegetation species. A capillary break will be included to prevent the upward capillary rise of elevated salinity levels in the tailings.	2	3	6	Golder CMCP workshop and Vimy EHS Manager
47	Infrastructure	Sustainability	Revegetation	Inappropriate placement or management of salvaged growth medium during operations leading to a lack of/reduce suitability of growth media.	Failure to establish sustainable revegetation communities.	2	3	6		Conduct growth trials to test the capability of the Miocene and Eocene sediments to support the sustainable growth of selected revegetation species.	1	3	3	Golder CMCP workshop and Vimy EHS Manager
48	Overburden Landforms	Non-Polluting	Geochemical - Salinity	Unknown salinity properties for mixed overburden underlying growth media	May limit re-vegetation success. Failure to establish sustainable vegetation community.	2	3	6	The salinity profiles are known from drill holes.	Conduct growth trials to test the capability of the Miocene and Eocene sediments to support the sustainable growth of selected revegetation species.	1	3	3	Golder CMCP workshop and Vimy EHS Manager
49	Tailings Storage Facility	Non-Polluting	Geochemical - Salinity	Unknown salinity properties for mixed overburden underlying growth media	May limit re-vegetation success. Failure to establish sustainable vegetation community.	2	3	6		Conduct growth trials to test the capability of the Miocene and Eocene sediments to support the sustainable growth of selected revegetation species.	1	3	3	Golder CMCP workshop and Vimy EHS Manager
50	Tailings Storage Facility	Stability	Erosion - Wind	Wind erosion of the upper surface and batter slope leading to reduced capping and unstable embankment walls	Release of tailings into the environment. Failure of capping layer resulting in radon release.	2	4	8	The capping system is to include 1 m of growth medium and 1 m of capillary break material (calcrete or silcrete coarse material). The capillary break material will be resistant to wind erosion, as will the traditionally constructed embankment walls; hence the risk of wind erosion resulting in exposure of the tailings is very small.	Confirm availability of materials through materials balance.	2	3	6	Golder CMCP workshop and Vimy EHS Manager
51	Infrastructure	Safety	Access/Egress	Insufficient decommissioning of infrastructure leaving voids, protrusions, unstable materials	Potential harm to fauna and inadvertent access by the public.	3	3	9		All above ground infrastructure removed. Holes and depressions made safe	1	5	5	Golder CMCP workshop and Vimy EHS Manager

Item No	Domain	Closure Principal	Aspect	Hazard	Consequence	Inherent risk				Additional control	Residual risk			Source
						L	C	RISK	Mitigating factor relevant to the inherent risk		L	C	RISK	
52	Backfill pits	Non-Polluting	Geochemical - AMD	Unknown properties. Unlikely to be acidic but may have still have leachable content and acid generating material. Could have acid generating material in overburden.	Generation of acid material and release to environment	2	3	6	The MRUP is currently undergoing active natural ASS oxidation, hence there is continual addition of acidity and metals to the groundwater system. Seepage from the OLs are unlikely to reach the groundwater system, given the depth of the underlying Miocene and Eocene sediments, and the very low permeability of this material at its current field capacity moisture content. There is limited standard geochemical characterisation data available for the overburden, however there is multi-element data from the geological drilling (including Total S) and confirmatory screen testing, to clearly confirm the presence/absence and distribution of sulfides and potential AMD materials. The Eocene overburden above the orebody has already undergone extensive oxidation and acidification in the past resulting in the stripping of most metals and metalloids. Remaining residuals are likely to be located in the crystal mineral structure and not available for release.	Leach testing on landform materials. Although additional geochemical testing is scheduled to be undertaken, there is sufficient information to appropriately manage the handling and utilisation of the overburden materials and to establish their risks to the environment. The basal 2-5 m of the overburden profile, which is influenced by the capillary wetting front, particularly where the basal kaolinite occurs, is less weathered and therefore does contain AMD. This material will be preferentially stripped and deposited back at the base of the mine pit to be saturated when the water table recovers.	1	2	2	Golder CMCP workshop and Vimy EHS Manager
53	Backfill pits	Sustainability	Revegetation	Assumption that the growth media is viable for various vegetation communities	Unsustainable revegetation communities	3	3	9	Assessments of the growth medium and its capabilities have been undertaken. The materials can support vegetation.	Conduct growth trials to test the capability of the Miocene and Eocene sediments to support the sustainable growth of selected revegetation species.	2	3	6	Golder CMCP workshop and Vimy EHS Manager
54	Tailings Storage Facility	Stability	Geotechnical	Engineered embankment wall collapses	Release of tailings into the environment. Failure of capping layer resulting in radon release.	2	5	10		Design TSF to ANCOLD guidelines	1	5	5	Golder CMCP workshop and Vimy EHS Manager
55	Backfill pits	Sustainability	Revegetation	Uncertainty of revegetation species to fire.	Failure to establish sustainable vegetation community. Failure to achieve completion criteria in timely manner.	3	3	9		Revegetate species of local provenance and investigate resilient to fire.	1	2	2	Golder CMCP workshop and Vimy EHS Manager
56	In Pit Tailings Storage Facility	Sustainability	Revegetation	Uncertainty of revegetation species to fire.	Failure to establish sustainable vegetation community. Failure to achieve completion criteria in timely manner.	3	3	9		Revegetate species of local provenance and investigate resilient to fire.	1	2	2	Golder CMCP workshop and Vimy EHS Manager
57	Overburden Landforms	Sustainability	Revegetation	Uncertainty of revegetation species to fire.	Failure to establish sustainable vegetation community. Failure to achieve completion criteria in timely manner.	3	3	9		Revegetate species of local provenance and investigate resilient to fire.	1	2	2	Golder CMCP workshop and Vimy EHS Manager

Item No	Domain	Closure Principal	Aspect	Hazard	Consequence	Inherent risk				Additional control	Residual risk			Source
						L	C	RISK	Mitigating factor relevant to the inherent risk		L	C	RISK	
58	Tailings Storage Facility	Sustainability	Revegetation	Uncertainty of revegetation species to fire.	Failure to establish sustainable vegetation community. Failure to achieve completion criteria in timely manner.	3	3	9		Revegetate species of local provenance and investigate resilient to fire.	1	2	2	Golder CMCP workshop and Vimy EHS Manager
59	In Pit Tailings Storage Facility	Stability	Erosion - Water	Variable permeability leading to tunnel erosion and preferential bypass flow	Unstable landform with open voids.	3	3	9		Backfilled pits are below surrounding sand dune landforms. Relatively homogeneous nature of material	1	3	3	Golder CMCP workshop and Vimy EHS Manager
60	Backfill pits	Sustainability	Landform Design	Pit lake develops through placement of fill with insufficient cover above the ground water table	Pit lake adds planning risk and closure cost	2	3	6		Ensure pre-mining water balance is understood and sufficient backfill is planned for.	1	2	2	Golder CMCP workshop and Vimy EHS Manager
61	Overburden Landforms	Stability	Permeability	External placement of kaolin clay leading to reduced infiltration and increased erosion	Unstable landform	1	3	3		Understand materials balance and handle/encapsulate impermeable materials. Design OLs using understanding of materials and landform evolution modelling	1	4	4	Golder CMCP workshop and Vimy EHS Manager