

Mining Operations Plan

HVO South

Mine Name	Hunter Valley Operations South		
Company	HV Operations P/L		
Operator	HV Operations P/L		
Mining Title & Leaseholder	CCL714, CL327, CL398, Jointly held by Coal & Allied Operations Pty Ltd & Anotero Pty Limited ML1465, ML1634, ML1682, ML1734, ML 1753		
Original MOP	Approved 17 December 2015	1 January 2016 to 30 November 2018	Original
This Original MOP	25 July 2018	11 July 2018 to 30 July 2023	New MOP to reflect HVO South Mod 5 development consent
Amendment A		11 July 2018 to 30 July 2023	Address RR feedback and revisions to monitoring program
Reporting Officer	Chris Cooper Catherine Lewis		
Date Submitted	15 January 2019		

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26 February 2019

Tony Galvin
General Manager
Hunter Valley Operations
PO Box 315
Singleton NSW 2330

Our ref: DOC19/129070

By email:

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andrew.speechly@hvo.com.au

Dear Tony

**Consolidated Coal Lease (CCL) 714, Coal Lease (CL) 327, CL 398 (1973),
Mining Lease (ML) 1465, ML 1634 and ML 1734, ML 1682 (1992) HVO South
Mining Operations Plan Amendment A:**

NOTICE OF APPROVAL

Pursuant to Condition 3 of CCL 714, CL 327, CL398, ML 1634, ML 1682, ML 1734, and Condition 2 of ML 1465, the Mining Operations Plan Amendment A (MOP) that was submitted to the Resources Regulator within the Department of Planning and Environment (the Department) on 18 January 2019 (Department Reference: SF19/10769) is approved for the period from the date of this approval until 30 July 2020 and subject to the following.

The Regulator considers that the MOP is prepared in accordance with the ESG3 Guideline, however the following gaps have been identified:

1. Comments from the consultation process were not incorporated into the MOP prior to submission to Resources Regulator. The next MOP shall incorporate the comments as per the Department of Planning and Environment Resource Assessments (Melissa Anderson - email 25 February 2019).
2. The MOP is a stand-alone document and Management Plans cannot be simply referenced if they are relevant to the MOP. If the topic relates specifically to rehabilitation / final landuse, that section of Management Plan (ie Biodiversity Management Plan) needs to be extracted and included in the MOP.
3. Further work is required to identify suitable representative ecosystems for the successful development of Specific, Measurable, Achievable, Realistic and Timely (SMART) Completion Criteria and further refinement of the Trigger Action Response Plan (TARP) to be successfully implemented across HVO.

Resources Regulator

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4. Resources Regulator identifies that following the initial rehabilitation assessment of the 12 rehabilitation lots identified in the s240 (refer MOP Appendix C – Common Appendix) there may be additional risks with the trajectory of rehabilitation success for other sites across HVO. HVO are to complete a review to identify the stages and success of rehabilitation, risks to rehabilitation, recommendations to bring back onto trajectory and proposed maintenance and future programs. Formal correspondence relating to this review will be issued to HVO following the March site inspection.

Note the approval date of this MOP is restricted to 30 July 2020 to allow for the submission of the above information. HVO is encouraged to review the opportunity to combine the HVO North and South MOP's into the one MOP to increase efficiency and reduce administrative burden.

It is the responsibility of the Authorisation Holder to ensure that all mining and mining related operations described in this MOP are as approved within the relevant Project Approval or Development Consent and all necessary approvals, consents or permits required under the relevant NSW or Commonwealth regulations have been obtained prior to carrying out the operations.

It is the responsibility of the Authorisation Holder to fulfil their obligations and commitments to the rehabilitation outcomes and performance standards as approved by the relevant consent authority to ensure the rehabilitation outcomes identified are achieved.

ASSESSED DEPOSIT

Approval of this MOP has triggered a review of the assessment of the security deposit required to secure funding for the fulfilment of rehabilitation obligations under Consolidated Coal Lease (CCL) 714, Coal Lease (CL) 327, CL 398 (1973), Mining Lease (ML) 1465, ML 1634 and ML 1734, ML 1682 (1992)

Notice of the change in the security deposit condition related to this MOP approval will be provided separately.

DEFINITIONS

In this letter, words have the meaning given to those terms in the *Mining Act 1992*, unless otherwise specified below.

Department means the Resources Regulator within the NSW Department of Planning and Environment.

Authorisation Holder means the holder of the relevant authorisation(s).

Mining Operations Plan means the project, mining and mining related operations described in the "Hunter Valley Operations South – Mining Operations Plan" prepared by Hunter Valley Operations and dated 15 January 2019, as amended by:

- (a) Hunter Valley Operations South MOP – Amendment A

If you have any questions about this Notice, please contact Matthew Quinn directly on 02 4063 6630.

Yours sincerely,



MONIQUE MEYER
Manager and Principal Inspector Environment
Compliance Operations
Resources Regulator
NSW Department of Planning and Environment

Signed under delegation from the Minister for Resources

Signed under delegation from the Secretary of the NSW Department of Planning and Environment

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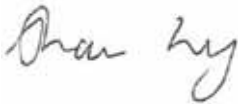
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In accordance with condition Schedule 3 Condition 36 of Project Approval 06_0261, this Hunter Valley Operations (HVO) South Mining Operations Plan has been prepared by a suitably qualified person with expertise in rehabilitation ecology.

Michael Lloyd is an environmental scientist with over 20 years' experience in undertaking impact assessments and preparing management plans. This MOP is based on the extensive body of work undertaken across previous approved MOPs for HVO that have been reported against in the Annual Environmental Reviews.

HVO's mining engineers provided a significant input with the contribution of the mine plans and the corresponding material production schedule estimates, disturbance rates and planned rehabilitation estimates.

HVO SOUTH	
Mining Operations Plan	
Name of Mine	Hunter Valley Operations South
MOP Commencement Date	20 June 2018
MOP Completion Date	20 June 2023
Mining Authorisations (Lease / Licence No.)	CCL714, CL327, CL398, ML1465, ML1634, ML1682, ML1734, ML1753
Name of Authorisation / Title Holder(s)	<div> <div>CCL 714</div> <div>CL 327</div> <div>CL 398</div> <div>ML1465</div> <div>ML 1634</div> <div>ML 1682</div> <div>ML 1734</div> <div>ML 1753</div> </div> <div>Jointly held by Coal and Allied Operations Pty Ltd & HVO Resources Pty Ltd</div>
Name of Mine Operator (if different)	Hunter Valley Operations
Name and Contact Details of the Mine Manager (or equivalent)	Tony Galvin General Manager Hunter Valley Operations PO Box 315 SINGLETON NSW 2330 Ph: 02 6570 0228 Email: Tony.Galvin@glencore.com.au
Name and Contact Details of Environmental Representative	Andrew Speechly Manager Environment and Community Hunter Valley Operations PO Box 315 SINGLETON NSW 2330 Ph: 02 6570 0497 Email: andrew.speechly@hvo.com.au
Name of Representative(s) of the Authorisation Holder(s)	Shaun Leary
Title	Manager Technical Services
Signature	
Date	10/07/2018 15 January 2019

1.0 Introduction

This Mining Operations Plan (MOP) ~~has been~~ prepared in response to the approval of the Hunter Valley Operations (HVO) South Modification 5 (~~Mod 5~~) that was determined by the Planning and Assessment Commission on 28 February 2018. The determination permits Cheshunt Pit to continue mining through the Riverview Pit, extracting the deeper Bayswater Seam below the Vaux Seam, and mining down to the base of the Vaux Seam below the Bowfield Seam in South Lemington Pit 2.

The mining of these deeper seams will occur within the existing State-approved disturbance footprint. In restricting the operation to the existing disturbance footprint, an increase in the height of the overburden emplacement in some areas by an additional 80m is required to accommodate the additional overburden material.

This MOP has also been developed to satisfy Project Approval (PA 06_0261) (28 February 2018) Schedule 3 Condition 33A and 36 which relates to the development of the Biodiversity Management Plan (~~BMP~~) and the Rehabilitation Management Plan.

~~Hunter Valley Operations HVO~~ is located in the upper Hunter Valley of New South Wales (~~NSW~~) approximately 24 km north west of Singleton (refer to **Map 1A**). The Hunter River geographically divides HVO into HVO North and HVO South. The two sites are, however, operated as a fully integrated operation with personnel, equipment and materials utilised as required.

This MOP applies to HVO South, which includes Cheshunt Pit, Riverview Pit (North and South) and Lemington South Pit No. 1 and 2. An aerial image showing the main “components” of HVO South is presented in **Map 1B** and **1C**. Mining operations in HVO South have been conducted in accordance with the previous HVO South MOP as approved by ~~the Department of Planning and Environment – Resources Regulator (RR) Division of Resources and Geoscience (DRG)~~ on 17 December 2015.

1.1 History of Operations

The mining complex at HVO has grown through a process of expansion and acquisitions since Coal & Allied, a subsidiary of Rio Tinto Coal Australia (RTCA), commenced mining at Hunter Valley No. 1 (now part of HVO North) in 1979. Mining activities in HVO South commenced at Lemington Mine in 1971, while owned by ExxonMobil. Coal & Allied purchased Lemington Mine from ExxonMobil in December 2000. Yancoal Australia subsequently purchased Coal & Allied from RTCA on 1 September 2017 and became the major shareholder of HVO as of that date. As of 4 May 2018, HVO operates as a joint venture arrangement, with Glencore becoming the operator of HVO. A brief history of operations for these pits is outlined in the following sections.

1.1.1 Cheshunt and Riverview Pits

Cheshunt and Riverview Pits were consented for mining as Hunter Valley No. 2 mine in 1986. Since the original approval, the area south of the Hunter River has undergone a number of name changes. It has been referred to previously as Hunter Valley No. 1 South Pit, Hunter Valley No. 2 Mine and South Pit.

A brief history of development, mining and associated approvals for the Cheshunt and Riverview pits is outlined in **Table 1** below.

Table 1 Cheshunt and Riverview Development, Mining and Associated Approvals

Year	Details
1986	Approval gained for development of Hunter Valley No. 2 Mine, including: transport of 4.5 Mt Run Of Mine (ROM) coal from south of the Hunter River to Hunter Valley Coal Preparation Plant (HVCPP), Liddell coal preparation plant or Hunter Valley Loading Point (HVLN); and short and long term re-alignments of Jerrys Plains Road to the south.
1990	Approval granted for Western out of pit emplacement of overburden in conjunction with development of Hunter Valley No. 2 Mine; rescheduling of mining of Riverview Pit; and permanent re-alignment of Jerrys Plains Road.
1997	Approval granted for small extension (56 ha) to the south west of South Mine (formerly Hunter Valley No. 2 Mine) to re-orientate mining strips to increase mining efficiency.
2000	Approval granted to increase rate of mining to 8 Mtpa and development of the Cheshunt Pit with mining to progress south west through Riverview Pit; out of pit emplacement of overburden on

Year	Details
	the Lemington Mine site; and overland conveyor from HVO South to HVCPP (not yet commenced).
2001	Modification to approval to allow change in mining schedule to seven day operations from year one rather than year nine.
2002	Approval granted for altered mine plan including concurrent mining at Cheshunt and Riverview Pits; operation of dragline at Riverview Pit; and haulage of coal from Cheshunt and Riverview Pits to either or both the Lemington Coal Preparation Plant (LCPP) or the HVCPP.
2006	Approval granted for extension of open cut coal mining from the Cheshunt Pit through the Barry Property enabling the extraction of approximately 8 Mtpa of ROM coal; and extension of open cut coal mining to the south west of the Riverview Pit.
2009	<p>Approval PA 06_0261 granted to replace all existing HVO South approvals and to allow:</p> <ul style="list-style-type: none"> extension of open cut and highwall mining (increasing the approved mining surface disturbance footprint by 250 hectares); mining of all coal seams within HVO South to unlimited depth; mining up to 16 Mtpa ROM coal by a combination of draglines, shovels, excavators and associated haul trucks; modification, upgrades and / or reconstruction of existing infrastructure including increase of processing capacity of the Lemington Coal Preparation Plant to 16 Mtpa, additional stockpiles and new coal loading infrastructure; and relocation of Comleroi Road and other infrastructure across HVO South; infrastructure to facilitate transfer of product coal to the Wambo rail spur via either a rail spur and loop, overland conveyor (OLC) or trucks, or any combination; the full integration of operations at HVO South related to new activities as well as upgrades and modifications to approved operations, mining and processing rates, equipment use and relocation, water, reject and tailings disposal and coal handling; relocation or reconfiguration of the Hunter Valley Gliding Club (HVGC) airstrip and facilities (if agreed with the Club), to accommodate the integration of the Riverview Pit with South Lemington Pit 2. <p>Subsequent modification to approval to allow raising of Lake James Dam.</p>
2012	Modification to approval to allow transfer of biodiversity offset for HVO South from Archerfield to Goulburn River Biodiversity Area.
2016	Commonwealth approval EPBC 2016/7640 granted for vegetation clearing in areas with previous State approvals.
2018	<p>Modification to the State development consent to enable:</p> <ul style="list-style-type: none"> Cheshunt Pit to progress and extract the Bayswater Seam below Riverview Pit by open cut methods; amendment to the approved overburden emplacement strategy to enable an 80m increase in height in some areas up to a maximum height of 240m Australian Height Datum AHD; increase the rate of extraction to 20 Mtpa ROM coal; and update the Statement of Commitments within PA 06_0261 to remove redundant commitments and conditions or those inconsistent with measures prescribed in the approved management plans.

1.1.2 Lemington South Pit

Mining in South Lemington Pit 1 was suspended in 2001 and the remaining void is currently used for temporary storage of mine water from both HVO and the adjacent Mount Thorley Warkworth (MTW) operation.

A brief history of development, mining and associated approvals for the Cheshunt and Riverview pits is outlined in **Table 2** below.

Table 2 Lemington South Pit Development, Mining and Associated Approvals

Year	Details
1971	Approval gained to establish open cut mine and No. 1 underground mining complex with 1 Mtpa ROM coal limit; and construct LCPP No. 1
1976	Approval granted to extend mining into No. 2 underground mining complex area and increase ROM coal to 2 Mtpa; and construct second LCPP rated at 440 tph of ROM coal.
1980	Approval granted to extend open cut and underground mining operations within Buchanan-Lemington Colliery; construct haul road from South Lemington to Lemington across Wollombi Brook; and increase capacity of LCPP No. 2 to 660 tph ROM coal.
1981	Approval gained to increase product coal production to 3 Mtpa.
1985	Approval gained to allow northern extension of open cut mining within Buchanan-Lemington Colliery Holding; and north west extension of Lemington Mine.
1987	LCPP No. 1 closed and decommissioned
1993	Approval granted to install a coarse reject transport conveyor to facilitate filling and progressive rehabilitation of underground mine No. 2 portal using coarse reject from LCPP (over 4-5 years).
1998	Approval granted to establish mining in South Lemington – two open cut pits, a scraper slot and trench, supplemented by highwall mining operations to 0.6 Mtpa product; total combined product limit of 3 Mtpa; and removal of 82 ha of Warkworth Sands Woodland (not listed under the former Threatened Species Conservation Act (TSC Act) at that time). South Lemington Pit 2, scraper slot and trench and highwall mining have not yet commenced.
1999	Approval gained to increase production to 3.5 Mtpa of product coal (North Lemington to 2.9 Mtpa and South Lemington to 0.6 Mtpa).
2001	Approval gained to increase saleable production to 4.4 Mtpa (North Lemington to 3.2 Mtpa and South Lemington to 1.2 Mtpa). Mining in South Lemington Pit 1 suspended. Approval granted for temporary crossings of Wollombi Brook to allow dragline and electric shovel relocation.
2003	Coal processing at LCPP No. 2 suspended and plant placed into care and maintenance.
2011	Infrastructure removal and site decontamination completed for LCPP No. 2.
2018	Modification to the State development consent to enable: <ul style="list-style-type: none"> South Lemington Pit 2 to mine to the base of the Vaux Seam below the Bowfield Seam.

1.2 Consents, Authorisations and Licences

This MOP has been prepared in accordance with the ~~Project Approval~~ (PA) 06_0261 that was modified on 28 February 2018 and its associated conditions. A copy of the project approval can found on the ~~Hunter Valley Operations HVO~~ website and in **Appendix A**. This MOP provides information regarding the projected mining and associated activities for HVO South for the period of 2018 - 2023 with operational, environmental and socio-economic objectives and obligations. This MOP has also been prepared in consideration of the document *ESG3: Mining Operations Plan (MOP) Guidelines* published by NSW Trade & Investment (September 2013).

~~Hunter Valley Operations HVO~~ received PA 06_0261 under Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act) from the Minister for Planning for the HVO South Coal Project which replaced 25 separate development consents and 10 associated modifications granted by both the former Department of Planning (DoP) and Singleton Council (SC). PA 06_0261 is supported by the HVO South Environmental Assessment (ERM, 2008), Raising of Lake James Dam Environmental Assessment (Coal and Allied 2009); Proposed Modification to HVO South Project Environmental Assessment (EMGA Mitchell McLennan 2010); HVO South Project Approval – Administrative Omissions and Clarifications Environmental Assessment (Coal and Allied 2012a); HVO South Project Approval – Dedication of Lands for Offsets Environmental Assessment (Coal and Allied 2012b); and the Hunter Valley Operations South - Modification 5 Environmental Assessment (Coal and Allied 2017).

HVO South operates under a number of different approvals which include:

- Development Consents and approvals issued by the Department of Planning and Environment (DPE), ~~Singleton Council (SC)~~ and Muswellbrook Shire Council (MSC);
- Commonwealth approvals under *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act);
- Mining tenements issued by the ~~Department of Planning and Environment, Division of Resources and Geoscience (DRG)~~ RR;
- Mining Operations Plans (MOP) approved by ~~DRG~~ RR;
- Environment Protection Licence (EPL) issued by the NSW ~~Office of Environment and Heritage (OEHL)~~ Environment Protection Authority (EPA);
- Dangerous Goods Licences issued by ~~WorkCover~~ SafeWork NSW;
- Water Licences issued by ~~NSW Office of Water (NOW)~~ WaterNSW; and
- Aboriginal Heritage Impact Permits issued by the NSW Office of Environment and Heritage (OEHL).

Current approvals, tenements and MOPs for HVO South are summarised in **Table 3**. Current licenses are summarised in **Table 4**, except water licenses which are summarised in **Table 5**. Section 90 Permits under the *National Parks and Wildlife Act 1974* (~~NSW~~) are summarised in **Table 6**.

Table 3 HVO South Approvals, Tenements and MOPs

Reference	Description	Issue Date	Expiry Date
Planning Approvals			
PA 06_0261	HVO South Operations	24/03/2009	24/03/2030
PA 06_0261	HVO South Operations – Modification 1	17/12/2009	24/03/2030
PA 06_0261	HVO South Operations – Modification 2	3/02/2012	24/03/2030
PA 06_0261	HVO South Operations – Modification 3	31/10/2012	24/03/2030
PA 06_0261	HVO South Operations – Modification 4	31/02/2012	24/03/2030
PA 06_0261	HVO South Operations – Modification 5	28/2/2018	24/03/2030
Commonwealth Approvals			
EPBC 2016/7640	HVO mine complex	10/10/2016	31/12/2030
Mining Tenements			
CCL 714	Cheshunt and South Lemington (Maison Dieu, Keys land, Stapleton Land, Glider Club, United land, Kannar & MTW land near Redbank, Warkworth Village)	23/05/1990	30/08/2030
CL 327	Riverview Pit (United land and glider club land)	06/03/1989	05/03/2031
CL 398	Riverview Pit (Wambo land)	4/06/1992	3/06/2034
ML1465	Cheshunt Pit	21/02/2000	21/02/2021
ML 1634	Cheshunt, Riverview and South Lemington	31/07/2009	30/07/2030
ML 1682	Cheshunt (Lake James)	16/12/2012	15/12/2033
ML 1734	Lemington South (Ex Kannar)	6/04/2016	5/04/2037
ML 1753	Riverview Pit mining purposes	19/04/2017	18/04/2038
Mining Operations Plans			
Hunter Valley Operations South		25/07/2018	30/07/2023

Table 4 HVO South Licences

Licence / Permit No.	Description	Authority	Expiry Date
EPL 640	Environmental Protection Licence	EPA	1 April (anniversary date) 12 June 2020 (review due date)
RML5085293	Radiation Management Licence	EPA	14 November 201 89
RR12709	Licence to Store Dangerous Good/Explosives	Workcover-SafeWork NSW	6 July 2022
538338	Road Occupancy Licences– Golden Highway	Roads and Maritime Service (RMS)	29 June 201 89
	Road Closure Approval - Lemington Road	Singleton Council-SC	30 June 201 89

Table 5 HVO South Water Licences

Licence No.	Purpose	Legislation	Location / Description	Expiry
WAL 969	Water Access	Water Management Act 2000 (WM Act)	Former Riverview pump	Perpetuity
WAL 970	Water Access	WM Act 2000	LCPP river pump	Perpetuity
WAL 1006	Water Access	WM Act 2000	LCPP river pump	Perpetuity
WAL 1070	Water Access	WM Act 2000	LCPP river pump	Perpetuity
20BL166637, 20BL170496, 20BL170497, 20BL170498, 20BL171423, 20BL171424, 20BL171425, 20BL171426, 20BL171427, 20BL171428, 20BL171429, 20BL171430, 20BL171431, 20BL171432, 20BL171433, 20BL171434, 20BL171435, 20BL171436, 20BL171437, 20BL171439, 20BL171492, 20BL171681, 20BL171725, 20BL171726, 20BL171727, 20BL171728, 20BL171762, 20BL171851, 20BL171857, 20BL173065, 20BL173062, 20BL173063, 20BL173064, 20BL173069	Monitoring Bore	Water Act 1912	HVO South monitoring bores	Perpetuity
20BL030566	Bore – Well	Water Act 1912	East Open Cut	Perpetuity
20BL170010- replaced by WAL 40466	Excavation - mining	Water Act 1912	Cheshunt/ Riverview extended excavation	Continuing
20BL173392- replaced by WAL 39798	Production Bore	Water Act 1912	LUG bore	Continuing
20BL173847 - replaced completely by WAL40462	Dewatering Bore	Water Act 1912	WB15HVO01	Continuing
20CW802603 replaced by 20FW213277	Controlled Work - Levee	Water Act 1912	Hobden Gully Levee	21/09/2027
20CW802613- replaced by 20FW213281	Controlled Work - Levee	Water Act 1912	Barry Levee	21/09/2027
20WA201257	Diversion Works	WM Act 2000	LCPP river pump	Perpetuity
20WA201338	Diversion Works	WM Act 2000	LCPP river pump	Perpetuity
20WA201501	Diversion Works	WM Act 2000	LCPP river pump	Perpetuity

Table 6 HVO South Section 90 Permits

Permit No.	Location Description	Authority	Expiry Date
C0001890	Care Agreement	OEH	3 June 2036
C0002193	Aboriginal Heritage Impact Permit	OEH	6 December 2026

1.3 Land Ownership

The Leaseholder owns a majority of the lands within the existing leases area, with the exception of small pockets of land owned by the Crown, Hunter Valley Gliding Club, Wambo, Glencore, Construction, Forestry, Mining and Energy Union (CFMEU) and private owners. The Leaseholder does, however, own all land subject to this MOP application. A schedule of land ownership on and adjacent to HVO South Coal Leases (CL) is contained in Appendix 1 of the ~~development consent project approval~~ and shown on **Map 1C**.

1.4 Stakeholder Consultation

External relations programmes and policies that incorporate both HVO North and HVO South are undertaken by the Leaseholder. Regional/broader community relations programmes such as HVO's Community Investment Programme (which includes corporate partnerships and site donations), media liaison and stakeholder consultation are managed by the Leaseholder's Environment and Community team. The objectives of the external relations strategy are to:

- Have a robust relationship with our communities of interest;
- Effectively contribute to the community's long term sustainability; and
- Ensure "reputation capital" is valued and integrated into business processes and decision making.

As a component of this community strategy, HVO maintains a Near Neighbour Community Relations Strategy. The purpose of this Strategy is to identify stakeholders, issues and appropriate management activities to maintain relations between HVO and the local community. The main objectives are to:

- Endeavour HVO to consistently build upon its credibility within the region through a process of engagement and transparency within the neighbouring community;
- Be proactive and focus on an honest and open approach rather than community issues management;
- Build awareness and provide information on current and future plans;
- Establish a working relationship with all stakeholders and keep them well informed;
- Address any concerns held by residents and other stakeholders;
- Minimise any disruption and inconvenience to residents and operations; and
- Reduce the number of community concerns caused by the business.

1.4.1 Community Consultative Committee

~~Hunter Valley Operation's~~ HVO's Community Consultative Committee (CCC) monitors compliance with conditions of consent and provides a forum for important community discussion. Community representatives act as the point of contact to provide feedback between the mines and the community. Community representatives are asked to relay information from these meetings to their community and in turn, through their representative, the community can raise issues they would like addressed. This CCC is comprised of members from the community and representatives from HVO and SC. The ~~Resource Regulator RR, NSW Planning & Environment DPE~~ and OEH attend as available.

~~Hunter Valley Operations~~ HVO has a 24-hour Environmental Hotline for community issues relating to any of its mines, including HVO South. Though the CCC and public advertisements, community members have been informed that they may contact HVO at any time to lodge concerns or enquiries regarding its mining operations. A system has been established to ensure an appropriate HVO representative responds to any complaint lodged.

1.4.2 Statutory Authorities

During the compilation of the HVO South EA, consultation was undertaken with representatives of relevant government departments and agencies. Consultation methods included formal briefings, presentations and the provision of ongoing information to ensure that the EA met the requirements of key regulatory bodies. Meetings were held with the ~~RR DPE, the Division of Resources and Geoscience, the Department of Primary Industries - Division of Lands and Water, Singleton Shire Council~~ SC and the Commonwealth.

Draft documents of the MOP were reviewed by the DPE, ~~Singleton Council~~ SC and the Department of ~~Primary Industries - Division of~~ Lands and Water, in accordance with Condition 36 of ~~Project Approval PA 06_0261 for the Hunter Valley Operations~~ HVO South Coal Project. Comments received following the consultation are presented in **Appendix B** and the accompanying table. Note that consultation with the Department of ~~Primary Industries - Division of~~ Lands and Water occurred on 12 June 2018 at their office with a detailed summary provided on the 13 June 2018. ~~No response to the draft MOP has been received.~~

The original MOP was approved by the RR on 25 July 2018, citing gaps in information relating to rehabilitation. These are addressed in **Appendix B**.

Statutory authorities also have the opportunity for ongoing involvement in HVO South operations through their representation on the CCC.

1.4.3 Aboriginal Groups

~~Hunter Valley Operations~~ HVO works closely with local Aboriginal people through professional engagement and consultation on cultural heritage management. Company employees also undergo training in Aboriginal cultural awareness.

The upper Hunter Valley Cultural Heritage Working Group (CHWG) comprises HVO representatives and representatives from Upper Hunter Valley Aboriginal Community (UHVAC) groups, corporations and individuals. The CHWG was established in September 2005 so that HVO and the Aboriginal community could develop and implement a new cultural heritage consultation and management process in the upper Hunter Valley. Through this working group, HVO now has an ongoing consultation process with the Aboriginal community, a regular forum for discussions on all matters pertaining to cultural heritage associated with HVO owned lands, projects and operations.

The CHWG works with HVO to develop cultural heritage processes including community consultation procedures, project work Terms of Reference template, cultural heritage investigations methodologies, and a process for the selection and engagement of Aboriginal corporate entities for project management and administrative coordination. Moreover, the CHWG developed an agreed process for the selection of cultural heritage field officers and technical advisors to conduct the cultural heritage investigations.

1.5 Rehabilitation and Post-Mining Land Use

Provisions for the rehabilitation of mined areas are attached to Mining Leases in accordance with the *Mining Act 1992* as administered by the ~~RR DRG~~. A general requirement of the DPE is that after rehabilitation, land should have the same land use capability as before mining. Rehabilitation plans and reports are prepared to satisfy the requirements of both ~~RR DRG~~ and DPE, and other relevant stakeholders. All rehabilitation will be undertaken in consultation with the ~~RR DRG~~ and other relevant agencies.

Security deposits usually in the form of a bank guarantee are lodged with the ~~RR DRG~~ to enable rehabilitation costs to be met. These deposits are progressively reviewed as areas are rehabilitated.

Rehabilitation objectives are integrated into early mine planning to ensure compatibility with site constraints, mining operations, conservation objectives, community expectations, pre-mining land use, final land use, drainage, stability, soils, erosion control and visual compatibility.

Rehabilitation designs for the final landform in HVO South have been designed to follow the principles and strategies outlined in the *Synoptic Plan: Integrated Landscapes for Coal Mine Rehabilitation in the Hunter Valley of New South Wales* (Department of Mineral Resources 1999) which aims to integrate biodiversity enhancement with sustainable agricultural practices.

Further detail regarding the processes, mitigation measures and rehabilitation that will be implemented in operational areas can be found in sections of this MOP as well as the Integrated ~~Biodiversity Management Plan (BMP)~~ that is a requirement of Condition 33A of the ~~Project Approval PA 06_0621~~.

This MOP provides detail relating to the various operational domains found at HVO South and their rehabilitation as well as the monitoring and reporting. The BMP extends on this and considers biodiversity matters on both operational and non-operational lands, which includes the approved offsets. Detail regarding the background to these offsets are outlined in **Section 4.2.5** of this MOP.

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intentionally.

2.0 Project Description and Proposed Mining Activities

The operations approved under ~~the HVO South Modification 5 Environmental Assessment~~ Mod 5 will not increase the disturbance footprint. The mining approved under Mod 5 will allow Cheshunt Pit to continue mining through the Riverview Pit extracting the deeper Bayswater Seam, and for South Lemington Pit 2 to mine deeper to the base of the Vaux Seam.

The approved mine plan will avoid any direct impacts on aspects such as biodiversity and Aboriginal heritage.

The increased depth of mining within the existing disturbance footprint will, however, require an increase in the height of the overburden emplacement in some areas to accommodate the additional overburden material.

This MOP is for the first five years of the approved mining and hence only considers the extension of Cheshunt Pit through Riverview Pit.

2.1 Asset Register

The main assets split by domain for HVO South are listed in **Table 7**. Areas detailed in **Table 7** represent a snapshot of the current disturbance.

Table 7 Main Assets Split by Domain for HVO South

Domain	Size (ha)	Major Assets	Comment
Final Void*	199.2	150.1	0 ha of Final Void rehabilitated.
Water Management Area	75	59.9 ha	0 ha of Water Management Area rehabilitated.
Infrastructure Area	185.3	135.3 ha HVO South Facilities: Workshop, Mining Office, Fuel Farm, Bath House Lemington Facilities: Workshop, Light Vehicle Workshop, Shutdown Maintenance Pad, Workshop Offices	Disconnect and terminate all services i.e. power, water and sewer; contaminated soil treatment from workshops and fuel farm areas; remove carbonaceous material from stockpile areas.
Tailings Storage Facility	196.2	108 ha Lemington No. 1 Tailings Storage Facility (TSF) (Cell A and B) Lemington No. 2 TSF Lemington No. 3 TSF Lemington No. 4 TSF (Cell A and B) Lemington No. 5 TSF	All previous Tailings Storage Facilities capped and closed. A number are within the active mining or emplacement path.
Overburden Emplacement	2366.3	1220.8 ha of active emplacement	1091.6 ha of Overburden Emplacement under rehabilitation.
Total Disturbance Area	3022		

* Note that the final void reflects the existing void as at the start of the MOP period. This is not the final location and the void will be developed as mining progresses beyond this MOP period.

2.2 Material Production Schedule

2.2.1 Material Production Schedule

The proposed provisional material production schedule for HVO South for the period covered by this MOP is shown in **Table 8**.

Table 8 Material production schedule during the term of the MOP

Material	Unit	Year 1	Year 2	Year 3	Year 4	Year 5
		2018	2019	2020	2021	2022
Topsoil Stripping	kbcm	405	186	117	57	70
Waste Rock	Mbcm	68.3	76.2	83.1	75.8	66.7
Ore (ROM Coal)	Mt	12.1	12.5	11.6	11.4	13.1
Processing Waste (Coarse Reject)	Mt	1.7	1.8	1.4	1.4	1.8
Processing Waste (Fine Reject)	Mt	1.1	1.1	1.1	1.0	1.2
Processing Waste (Total)	Mt	2.8	2.9	2.5	2.4	3.0
Product Coal	Mt	9.3	9.6	9.1	8.9	10.1

Further details on the various components of this Schedule are provided in the following sections of the MOP.

2.3 Exploration

2.3.1 Past and Proposed Exploration

Pre-production and exploration drilling is regularly conducted at HVO as part of a continuing programme to update the geological models with new structural and coal quality data within the existing mining lease. Drilling routinely includes open-hole drilling, cored-hole drilling and groundwater drilling to install piezometers. All cored and open holes have been geophysically logged.

All exploration drilling activities are reviewed prior to commencement as part of the Ground Disturbance Permit (GDP) process. Planned borehole locations and access tracks are assessed for environmental, cultural heritage, approval and mining title issues with constraints and conditions placed on drilling locations and activities for each borehole as required.

All boreholes are surveyed and, if not required for monitoring purposes, are cement sealed on completion. All casing is removed where practicable. However, in isolated holes, this may not be possible requiring the casing to be cut off below ground level. Borehole sites are then rehabilitated to an appropriate standard, as dictated by the GDP and the guidelines prepared by the **RR DRG**.

Cheshunt Pits

Both exploration and pre-production drilling has been undertaken in Cheshunt Pit 1 and Pit 2, with a mix of open, and core holes. This phase of exploration was designed to increase the structural, lithological, geophysical, geotechnical and coal quality knowledge of the area. Some drilling also focused on further defining structural anomalies within the pits. Drilling focused on the Cheshunt Pit 1, Cheshunt Pit 2 and Cheshunt Pit 1 Extension.

Proposed exploration activities will involve the continuation of pre-production open and fully cored drilling, targeting structural, lithological, geophysical, geotechnical and coal quality characteristics in Cheshunt Pit 1, Cheshunt Pit 2 and Cheshunt Pit 1 Extension.

Riverview Pits

Both pre-production and exploration drilling has been undertaken in the Riverview Pits, with a mix of open, core, and limit of oxidation holes. This phase of exploration was designed to increase the structural, lithological, geophysical, geotechnical and coal quality knowledge of the area. Drilling focused on the Riverview Central Pit, Riverview West North Pit, Riverview West South Pit and the Glider Pit.

Proposed exploration activities will involve the continuation of pre-production open and fully cored drilling, targeting structural, lithological, geophysical, geotechnical and coal quality characteristics in the Riverview West South Pit and Glider Pit.

2.3.2 Estimated Mine Life

As of 31 December 2016, the JORC compliant ROM reserves totalled 871 million tonnes, of which 665 million tonnes is proved and 206 million tonnes are probable reserves.

The development consent for HVO South is valid until 2030. The following life expectancies for each pit are based on current approved rates of production:

- Cheshunt Pit reserves extending south and west will allow continued production to 2024;
- Riverview Pit is expected to produce coal beyond 2030. This will occur in two stages: firstly as Riverview in its current form until 2023; and secondly as an extension from the Cheshunt Pit. The extension of Cheshunt Pit will involve mining through the Riverview spoil to uncover the remaining Bowfield to Bayswater Coal Seam sequence within the current development consent; and
- Mining within South Lemington Pit 1 and 2 is planned to be completed prior to 2030, however, no mining in these pits is planned during this MOP period.

2.4 Land Preparation

2.4.1 Removal of Vegetation

All vegetation clearing is undertaken as a staged operation immediately in advance of mining operations. Vegetation clearing is avoided during the breeding season of identified threatened fauna species.

Pre-clearing surveys are undertaken prior to vegetation removal to identify reusable timber and important habitats. Where present, suitable microhabitats such as trees with hollows, fallen logs and bat roosts are identified and relocated for use in rehabilitation. Habitat trees are also surveyed and marked to determine if fauna are using them. Any marked trees that show signs of current or recent use are reserved for latest possible removal to encourage fauna to abandon the area of their own accord.

Following the removal of useable timber for fence posts and stag trees, as well as collection of viable seed for use in rehabilitation, the remaining smaller vegetation is generally mulched and incorporated into the topsoil, or may be cleared by bulldozers, broken up and placed on areas of post mining rehabilitation to form fauna habitat or dumped in pit. Suitable logs may also be supplied to river restoration projects within the Hunter Valley for the construction of in-stream structures.

Vegetation clearing ahead of mine workings will be kept to a minimum, consistent with the space requirements of the pre-stripping fleet, which is usually about one mining strip (approximately 100 m). Clearing also allows for the establishment of mine infrastructure ahead of the mining operations and may include clearing for haul roads and access tracks, power lines, pipelines, transformers and drainage control structures.

A Vegetation Clearance Plan (VCP) was approved by Department of the Environment and Energy on 24 October 2016 in accordance with Condition 2 of the federal government approval referred to as HVO State Approved Mining Project (EPBC 2016/7640). Measures implemented from the VCP provide for the effective management of Central Hunter Valley Eucalypt Forest (CHVEF), Regent Honeyeater, Swift Parrot, and Green and Golden Bell Frog during the vegetation clearance for extension areas in West Pit, Cheshunt Pit, Carrington Pit and Riverview Pit.

The areas scheduled for disturbance during the term of this MOP are shown in **Table 9**. Disturbance areas are shown for new disturbance as well as disturbance of rehabilitated areas.

Table 9 Disturbance Rates and Rehabilitation 2018-2022

Year	Disturbance (ha)*	Rehabilitation Disturbance (ha)	Total Disturbance (ha)	New Rehabilitation (ha)
2018	24.1	110.7	1641	85.4
2019	17.4	98.4	1712	66.4
2020	2.3	30	1685	59.8
2021	0	15.3	1626	74.9
2022	0	23.3	1574	75.3
Total	43.8	277.7		361.8

* New disturbance only

2.4.2 Topsoil Management

Topsoil must be stripped and salvaged correctly to maximise its value for re-use in rehabilitation. Where possible, the topsoil is directly transported from stripping to rehabilitation areas. This is discussed further below.

2.4.2.1 Soil Types

Soil assessments have been undertaken as part of previous environmental assessments for the South Lemington open cut mine area (SKM, 1997), the Hunter Valley No. 1 Mine South Pit area (ERM, 1998) and the HVO South Coal Project area (ERM, 2008). The dominant soil types present within Cheshunt, Riverview and South Lemington areas are presented in **Table 10** and **Table 11** below.

2.4.2.2 Topsoil Suitability for Rehabilitation

Previous assessments have characterised the quality, quantity and types of topsoil at HVO South, as well as its suitability for use in rehabilitation. Structural and textural properties of soils have been found to be the most significant limiting factors.

Table 10 Summary of soil characteristics (assessments prior to 2008)

Soil Type	Location	Description	Erosion potential	Topsoil stripping depth (cm)
Cheshunt / Riverview				
Clay soils	1,103 ha covering most of the Cheshunt and Riverview Pit areas	Moderately structured thin, porous, acid topsoils	Stable	0-10
		Tough, dense, alkaline subsoils	Moderate to high dispersive rating	
Gravelly Soils	Two small pockets (5 ha) in the Cheshunt Pit and north east of the WOOP dump	Very stony, acid, crumbly porous topsoils	Stable	0-10
		Less stony, tough, dense subsoils	Stable	
Alluvial Soils	61 ha within Cheshunt Pit	Weakly to strongly structured friable clay loam topsoil	Moderately dispersive rating	0-50
		Crumbly, porous, sandy clay or light clay	Material at depth has a moderate to high dispersive rating	
Sandy Soils	111 ha adjacent to the Hunter River	Weakly structured, crumbly, porous, sandy topsoils	Stable	0-10

Soil Type	Location	Description	Erosion potential	Topsoil stripping depth (cm)
		Light medium clay or sandy clay subsoils	Stable	
South Lemington				
Duplex	All other areas of South Lemington lease area	Sand to clay loam topsoils	Stable	0-10
		Red clayey subsoils	Slightly dispersible	
Siliceous sands	Under Wollombi Brook	Acidic sand topsoil	Stable	0-10
		Hard sandy clay subsoils	Slightly dispersible	

Source - adapted from SKM 1997 and ERM 1998.

Table 11 Summary of soil characteristics in HVO South Coal Project extension area

Soil Type	Location	Topsoil stripping depth (cm)
Yellow Duplex	262 ha in Deep Cheshunt, Riverview Pit South East, South Lemington Pit 1, and Riverview Pit South West.	0-10
Red Duplex	49 ha in Riverview Pit South West	0-10
Siliceous Sands	294 ha within Deep Cheshunt and South Lemington Pit 1	Not suitable for topdressing unless mixed with clay
Alluvial Soils	28 ha within northern margins of Deep Cheshunt	0-50
Shallow Rocky Lithosols	12.3 ha within Riverview Pit South south-west	Not suitable for topdressing

Source - adapted from ERM 2008.

2.4.2.3 Soil Stripping

Soil testing will be undertaken to determine what soil amelioration is required prior to re-use for rehabilitation activities. Areas that are planned to be disturbed will be stripped of soil prior to disturbance. Advance clearing and soil removal is kept to a minimum to reduce dust generation and potential impacts on fauna species. Soil will be stripped using appropriately sized earthmoving equipment, preferably bull dozers. Where practicable, soil will be stripped when moist, but not saturated; and no stripping will occur in excessively dry or wet conditions. Prior to stripping of soil, appropriate controls such as sediment controls will be put in place to prevent off-site loss of soil sediments.

2.4.2.4 Soil Handling and Management

Stripped topsoil and subsoil needs to be managed to prevent erosion and weed infestation, and to retain maximum soil reserves for reuse during rehabilitation works.

Where possible, soil will be transferred directly from stripping to re-spreading operations, eliminating the need for storage. However in some cases, mining operations dictate that soil storage will be necessary for extended periods. Where stockpiling is required, the following procedures will be adopted:

- Stockpiles will be located away from trafficable or mine areas, trees or watercourses and placed on areas of flat topography or along the contour to prevent erosion;
- Good quality topsoil, marginal topsoil and subsoils will be stockpiled separately and recorded as such;
- Soil stockpiles and volumes will be identified and monitored for weed control;
- Where possible, stockpiles will be limited to a maximum height of three metres and windrowed to increase surface area; and
- Stockpiles will generally be sown with a multi-species cover crop, including deep rooting, nitrogen-fixing species such as Lucerne, to help maintain topsoil viability and minimise erosion and weed infestation if not being reused for prolonged periods.

2.4.2.5 Soil Budgeting

Due to the shallow nature of the in situ duplex topsoils there is a potential for significant topsoil loss. However, with the use of marginal material, mulch, compost and adequate controls sufficient topsoil is available for rehabilitation.

Priority areas for the redeployment of topsoil will be on areas planned to be returned to pastures and areas with potentially hostile spoil properties that make it difficult to establish vegetation. For the purposes of topsoil budgeting, it is assumed that:

- The primary objective of the mine rehabilitation programme is to create a structurally stable landform;
- A secondary objective is to maximise post-mine land capability and restore a productive land use (primarily pastoral use);
- The total area projected as being disturbed over mine life is the area to be rehabilitated;
- The area to be rehabilitated excludes the final voids and areas already rehabilitated; and
- Topsoil is only available from mining areas and rehabilitated areas to be stripped over the mine life.

The area to be rehabilitated over this MOP application period is estimated to be approximately 361.8 ha. Based on an average thickness of ten cm of topsoil, it is expected that there will be sufficient suitable topsoil to provide for the area of rehabilitation. The expected annual topsoil recovery for the period covered by this MOP is provided in **Table 8**. For areas being returned to native vegetation, mine spoil improved with ameliorants such as municipal waste composts or timber mulch will be utilised as a suitable growth medium. Previous trials have shown the use of municipal waste composts reduce weed germination within the rehabilitation area.

2.5 Mining

2.5.1 Criteria

The design of mining operations in HVO South was influenced by various factors including maximising resource recovery, geology, economics, lease boundaries, proximity of the Hunter River, rehabilitation requirements, Coal Preparation Plant (CPP) capacities and environmental and ecological factors. Proposed future operations during the period of this MOP represent a continuation of the existing criteria.

2.5.2 Mine Layout

HVO South ~~Operations~~ is made up of several discrete mining and ancillary mining areas, those being;

- Cheshunt;
- Riverview Pit;
- South Lemington Pit 1 and 2; and
- Lemington Coal Preparation Plant and associated ancillary mining infrastructure.

Cheshunt and Riverview Pits are surrounded by the Golden Highway to the South and the Hunter River to the North. Cheshunt Pit sits to the North-East of the operation with the pit advancing in a south-west direction. Riverview Pit is located to the west of the operation and is split into three sections; west, central and east. The central area of Riverview has reached its final limits against the golden highway and has since become a water storage location. Riverview west has two advancing faces moving away from each in north and south directions; towards the Hunter River and Golden Highway respectively. Riverview east is also known as the Glider Pit and surrounds the Hunter Valley Gliding Club to the north east and south west. The pit limits for Cheshunt and Riverview are defined by the Hunter River to the north, the Golden Highway to the south and mining consent limits to the west and east. Cheshunt Pit has approval to continue through Riverview Pit extracting the deeper Bayswater Seam below the Vaux Seam, which is the base seam for mining within Riverview Pit.

South Lemington Pit 1 is an existing void that sits south and east of Wollombi Brook and north of the Golden Highway. South Lemington Pit 2 is currently unmined but is located with the Golden Highway to the west, Comleroi Road to the north and Wollombi Brook to the south east. HVO South Mod 5 obtained approval for South Lemington Pit 2 to be mined to the base of the Vaux Seam within the existing approved disturbance footprint. Pit 2 does not, however, have approval from the Commonwealth to disturb the listed vegetation community and hence no disturbance that will affect Matters of National Environmental Significance (MNES) will occur within South

Lemington Pit 2. It is possible that exploration may occur where MNES will not be affected, hence the disturbance boundary is shown to encompass the South Lemington Pit 2 footprint. There is currently no plan to resume mining in either of the South Lemington pits within this MOP period.

The ~~Lemington Coal Preparation Plant (LCPP)~~ was decommissioned. The Leaseholder does, however, retain the right to rebuild, within an infrastructure envelope, the LCPP as well as the approved ancillary mining infrastructure to take the coal to the Wambo rail spur. There are no plans within this MOP period to construct the LCPP or the infrastructure, however, the option has been retained.

2.5.3 Mining Method

Mining will continue in accordance with current operational practices utilising the existing HVO equipment fleets. Mining is currently carried out by a dragline (Riverview Pit only), electric shovels and excavators, supported by loaders, dozers, graders, water trucks and a fleet of dump trucks.

Overburden and interburden is either free dug or drilled and blasted, removed using a combination of shovel/excavator/front end loaders and placed in trucks for haulage to out of pit emplacements or refill areas in the pit.

Coal seams thinner than two metres are ripped by dozers, while seams thicker than two metres are drilled and blasted. Coal is then placed into trucks by front-end loaders and delivered to the ROM coal stockpile facilities.

The mine operates 24 hours a day, seven days a week.

The application of two different highwall mining techniques was included in the HVO South EA; Continuous Highwall Mining and Auger Highwall Mining. The specific areas approved are highlighted in the EA. No highwall mining is proposed to take place during the period of this MOP, but changed economic or geological conditions may require an amendment to the MOP to approve highwall mining techniques as addressed in the EA.

All coal mined within the extension areas approved in the HVO South EA is anticipated to be extracted generally in accordance with the methods outlined above.

2.5.4 Resource Sterilisation

In general, all economic coal within the approved Development Consent boundary will be removed as part of the mining process, and the proposal will not involve the sterilisation of any economic reserves.

2.5.5 Mining Equipment Fleet

All operations at HVO are fully integrated, permitting sharing of mining equipment. Typical equipment for use in mining operations will vary according to mining operations but would include those listed below:

- Dragline.
- Electric shovels.
- Dump trucks.
- Excavators.
- Graders.
- Dozers.
- Pumps / Lighting plants.
- Front-end loaders.
- Drills.
- Scrapers.
- Water trucks.
- Fuel trucks.
- Various light vehicles and service vehicles.
- Mobile crib facilities.

As earthmoving technology develops in the future, new equipment may be introduced to the site as required.

2.6 Mineral Processing

ROM coal from HVO South is trucked via purpose built internal haul roads to the ~~Hunter Valley Coal Preparation Plant~~ HVCPP. The current approval under the HVO South EA allows for the extraction of up to 20 Mtpa ROM coal and for the processing of 20 Mtpa ROM coal extracted from HVO South across the HVO coal processing plants. At present, while the development consent for HVO North permits the HVCPP to process this volume, the Plant is limited to receiving 16 Mtpa of coal from mining operations south of the Hunter River and hence the HVO North development consent is to be modified before the 20 Mtpa ROM coal transported from HVO South can be achieved.

The current approval also allows for the replacement of the decommissioned LCPP, but the replacement of this facility is not forecast within this MOP period.

2.6.1 HVCPP

The HVCPP is located to the north-east of the mine surface facilities. It receives ROM coal from Carrington/West Pit (HVO North) and Cheshunt/Riverview Pit (HVO South). The CPP has a current capacity of 13.5 Mtpa Product.

~~Hunter Valley Coal Preparation Plant~~ HVCPP has two ROM coal stockpiles with capacity totalling 176,000t. Prior to washing the ROM coal is crushed using rotary breakers and roller crusher sizers. The processing plant is made up of six identical modules each consisting of dense media separation, cyclone and spirals classification and centrifuge dewatering. Coarse reject is disposed of in the active mine dumps and “mixed” with normal waste dumping of the mining operations. Tailings are treated in three thickener tanks and then disposed within tailings storage facilities (refer to **Section 0** and **2.7.3.2**).

Product coal is transported via a 7.4km overland conveyor to the HVLP or to Newdell **Loading Point (NLP)** via a second overland conveyor for rail transport to the export port of Newcastle. HVLP has two product stockpiles with capacity totalling 148,000t and **Newdell-NLP** has a product stockpile capacity of 450,000t. Coal is allocated between the HVLP and ~~Newdell Loading Point~~ NLP to maximise the utilisation of the loading facilities as required.

2.7 Waste Management

2.7.1 Mining Overburden

All overburden and interburden material generated from mining operations at HVO South is either road hauled to, or directly emplaced by the dragline on current emplacement areas behind the active mining operation. As part of the integration of operations at HVO, mining waste may be transported to any HVO pit for emplacement to achieve the final approved landform.

All mining waste emplacements shall be reshaped as required. The actual method and height of emplacement areas shall be in accordance with the final approved landforms and is dependent on the competency of the overburden material. The approximate maximum heights of emplacement at HVO South will be in accordance with the proposed final landform levels and as shown on **Map 4**.

2.7.2 Coarse Rejects

Coarse reject consists predominantly of fine-grained sedimentary rock types with minimal quantities of carbonaceous material. The reject is of no current commercial use and has little propensity for spontaneous combustion. This material has similar properties to overburden in contact with coal seams and is generally saline and alkaline.

~~Hunter Valley Coal Preparation Plant~~ HVCPP currently generates approximately 3.6 Mtpa of coarse washery rejects. Residue materials generated by the preparation plant are not expected to contain any toxic materials.

Coarse rejects are transported by truck and buried at least five metres below the final surface level in overburden emplacements as part of the final landform design.

2.7.3 Fine Rejects

Fine reject (tailings) is thickened into a solid's density of approximately 20 percent to 30 percent by weight and is predominantly fine rock and clay with some coal and flocculent. The tailings are wet with moderate conductivity.

Hunter Valley Coal Preparation Plant currently generates approximately 1.7 Mtpa of fine washery rejects. Residue materials generated by the preparation plants are not expected to contain any toxic materials.

2.7.3.1 Disposal

There are currently seven tailings emplacements within the HVO South area, all of these have been rehabilitated. These are:

- No.1 TSF Cell A, rehabilitated;
- No.1 TSF Cell B, rehabilitated;
- No.2 TSF, rehabilitated;
- No.3 TSF, rehabilitated;
- No.4 TSF Cell A, rehabilitated;
- No.4 TSF Cell B, rehabilitated;

- No.5 TSF, rehabilitated.

Tailings from HVCPP is currently pumped via pipeline to the North Void ~~Tailings Storage Facility (TSF)~~, located in ~~the~~ HVO North ~~area~~. No tailings are expected to be pumped to ~~the~~ HVO South ~~area~~ within this MOP period.

2.7.3.2 Tailings Storage Facilities Management

A Life of Mine Fine Reject Management Strategy was prepared for HVO and submitted to DPE and ~~RR DRG~~ in June 2015. A revised version was submitted in February 2016 to address issues raised by DPE and ~~RR DRG~~.

~~Current estimates show North Void TSF reaching its capacity in 2021. The rate of tailings deposition into North Void TSF will be reduced in 2018 to facilitate better tailings consolidation in the top layers and reduce anticipated closure times. The Carrington in-pit TSF is planned to take over from the North Void TSF as the Primary TSF for deposition of tailings from HVCPP in 2018. The Carrington in-pit TSF will take over from the North Pit TSF as the primary TSF for deposition of tailings from HVCPP in 2019. Tailings from the HCPP will be deposited into Dam 6W and Cumnock Void (via agreement with Glencore) until 2022. Section 6.2 provides information on the plans for rehabilitation of TSF's during the period of this MOP.~~

There is no plan for tailings to be pumped to the HVO South area within this MOP period.

2.7.4 Sewage Waste

Sewage from in-pit mobile facilities is periodically pumped out by licensed contractor and disposed off-site. Permanent site facilities are periodically pumped out prior to onsite treatment by aerated treatment plants. The treated effluent is spray irrigated onto evaporation areas. Sewage from the Cheshunt bathhouse passes through an extended aeration package treatment plant and the purified effluent is disinfected and directed to mine water storage dams where it is recycled.

2.7.5 Oil and Grease

A specialised oil and grease storage facility exists at all active service areas, which is collected for recycling by HVO's approved waste disposal contractor. The bulk oils and grease storage facilities are part of the fuel storage facility and meet Australian Standards. All waste hydrocarbons are recycled via a licensed waste hydrocarbon disposal company.

2.7.6 Waste Management System

Management of all industrial and putrescible waste generated on site is undertaken in accordance with the HVO's waste management system, local ordinances and within existing regulatory guidelines. Waste segregation and recycling is encouraged through providing appropriate recycling facilities. Co-mingle recyclable wastes are removed by licensed contractor to a Materials Recycling Facility where wastes are sorted for further recycling. All waste management contractors working at HVO are licensed by ~~QEH~~ EPA.

Waste not suitable for recycling is removed by contractors and disposed of at the ~~Singleton Council-SC~~ landfill. As there is no market for recycling of waste haul truck tyres, these are buried beneath the emplacement area in a site that will not cause environmental harm. The burial location and number of tyres are recorded in a tyre management database. This does not apply to light vehicle tyres which are taken off site for recycling.

The waste management system allows for the tracking of wastes by type, weight and cost. The system is automated, with a parallel docketed system remaining in use to meet compliance obligations. Waste statistics at HVO are reported annually in the Annual Environmental Report (AER). The information is used by HVO to identify areas of improvements and track performance against targets.

2.8 Other Infrastructure

2.8.1 Existing Infrastructure

Existing infrastructure at HVO South consists of two different sets of surface facilities; Lemington Facilities and Southern Facilities located directly south and east of Cheshunt Pit respectively. Offsite access to both sets of facilities is via Comleroi Road.

Key infrastructure within the Lemington facilities include, the Lemington bathhouse, light and heavy vehicle workshops, light vehicle washing station, laydown yards and major shutdown pad. The Lemington facilities also include the remaining LCPP facilities. The preparation plant has been dismantled, and coal stockpile areas are currently utilised for storage of various materials, including spare parts and compost. Current project approval,

does allow for a replacement ~~Coal Preparation Plant~~ CPP to be built, but there are no current plans to replace the LCPP facility within this MOP period.

Key Infrastructure within the southern facilities include the south bathhouse, workshop, vehicle washing facilities, bulk oil and fuel storage and administration buildings.

Mobile crib and amenity facilities are also provided to employees in all open cut areas.

Haul roads are used for the movement of coal and other approved materials and provide connections between all pits, CPPs and the NLP. A bridge and connecting haul road currently link the North Pit to HVO South ~~operations~~. These haul roads will be maintained for the duration of this MOP. Other mine haul roads are established/extended to service mining operations as required. Additionally, a private road runs from the ~~Hunter Valley CHPP~~ HVCPP to the HVLP adjacent to the overland conveyor.

Electricity is supplied from existing 66 Kilo Volts (kV) transmission lines to mining equipment, workshops, administration facilities, employee amenities, CPPs and coal handling facilities at each of the pits.

There are a number of water management structures located throughout the lease area as part of the mine water management system, including sedimentation dams, tailings dams, stock water dams, mine water dams and various diversion banks and pipelines for the management of clean and dirty waters.

Existing stock proof fencing and is located in rehabilitated mining areas and on grazing lands on the edges of the mining operations.

2.8.2 Construction

There are no major construction works proposed in the HVO South Area within this MOP period. Small construction works proposed construction during MOP term will include:

- Relocation of In Pit Crib Hut, Fuelling and Park Up Facilities;
- Relocation and upgrades to in-pit Water Fill Points;
- Construction & relocation of internal haul roads to access active pits and the Lemington southern facilities;
- Relocation of communication towers and pipelines, as required;
- Relocation of Power Lines and Sub Stations within mining footprints.

All construction activities will be undertaken in accordance with the development consent and relevant legislation, as applicable. Any vegetation disturbance required to facilitate the construction will be in accordance with the HVO South approvals, and State and Commonwealth legislation.

3.0 Forecast Rehabilitation Activities

The West Pit **development consent** (DA 450-10-2003) approves the movement of overburden material between mining areas and facilities across HVO North and South. PA 06_0261 enhances this capability to further the integration of the whole HVO site through the allowance for the transfer and movement of overburden and topsoil materials between HVO North and South.

Rehabilitation activities at HVO South will be conducted in accordance with the following documents:

- *Conceptual Landscape and Rehabilitation Management Strategy (CLRMS)* (June 2007);
- DMR's *Synoptic Plan: integrated landscapes for coal mine rehabilitation in the Hunter Valley of NSW* (1999);
- *Development of Rehabilitation Completion Criteria for Native Ecosystem Establishment on the Coal Mines in the Hunter Valley* (ACARP, Nichols, 2005);
- HVO South Modification 5 Environmental Assessment (2017); and
- This MOP.

The rehabilitation plan for HVO South incorporates considerations such as conservation objectives, community expectations, pre-mining land use, final land use, drainage, stability, soils, erosion control and visual compatibility. The shaping of emplacements and rehabilitation will follow the active mining areas, within Riverview and Cheshunt minimising the area of disturbance at any point in time

The aim of the rehabilitation at HVO South will be to:

- Maximise long term landform stability and minimise erosion;
- Construct a final landform that is compatible with surrounding landforms;
- Develop a final land use that is compatible with surrounding land uses;
- Restore ~~50~~-60-70 percent of mined land to a sustainable and productive grazing use;
- Restore ~~30~~-40-~~50~~ percent of mined land to sustainable native vegetation comprising local species; and
- Create native vegetation corridors that connect to existing remnants areas of forest or woodland to provide opportunities for wildlife habitat and migration.

The revegetation strategy in areas rehabilitated for agriculture and grazing will incorporate a variety of native and introduced pasture species.

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4.0 Environmental Issues Management

4.1 Risk Assessment

The key risks associated with the proposed mining activities at HVO South during the term of this MOP have been assessed using the likelihood ratings, maximum reasonable consequence ratings, risk matrix and classifications listed in **Table 12**, **Table 13**, **Table 14** and **Table 15** respectively.

Table 12 Likelihood Ratings

Class	Likelihood	Likelihood Description	Frequency
A	Almost certain	Recurring event during the life – time of the operation / project	Occurs more than twice per year
B	Likely	Event that may occur frequently during the life – time of an operation / project	Typically occurs once or twice per year
C	Possible	Event that may occur during the life – time of an operation / project	Typically occurs in 1-10 years
D	Unlikely	Event that is unlikely to occur during the life – time of an operation / project	Typically occurs in 1-100 years
E	Rare	Event that is very unlikely to occur during the life – time of an operation / project	Greater than 100 year event

Table 13 Maximum Reasonable Consequence Ratings

Class	Consequence	Consequence Description
1	Minor	Near-source confined and promptly reversible impact on-site, with little or no off-site impact expected
2	Medium	Near-source confined and short-term reversible impact on-site, with little and promptly reversible off-site impact
3	Serious	Near-source confined and medium-term recovery impact on-site, with near-source confined and short-term reversible off-site impact
4	Major	Impact that is unconfined and requiring long-term recovery, leaving residual damage on-site with near-source confined and medium-term recovery of off-site impacts
5	Catastrophic	Impact that is widespread (or unconfined) and requiring long-term recovery, leaving major residual damage on-site with off-site impacts that are unconfined and requiring long-term recovery and leaving residual damage

Table 14 Risk Matrix

Likelihood	Consequence				
	1 - Minor	2 - Medium	3 - Serious	4 - Major	5 - Catastrophic
A – Almost Certain	Moderate	High	Critical	Critical	Critical
B – Likely	Moderate	High	High	Critical	Critical
C – Possible	Low	Moderate	High	Critical	Critical
D – Unlikely	Low	Low	Moderate	High	Critical
E – Rare	Low	Low	Moderate	High	High

Table 15 Risk Classification

Risk Class	Risk Management Response
Critical	Risks that significantly exceed the risk acceptance threshold and need urgent and effective attention.
High	Risks that exceed the risk acceptance threshold and require proactive management. While proactive actions are undertaken, further risk reduction is impracticable suggesting a need for compensatory measures
Moderate	Risks that lie on the risk acceptance threshold and require active monitoring. The implementation of specific safeguards could be used to reduce risks further
Low	Risks that are very unlikely and of low consequence, and do not require active management. Nevertheless, some potential for certain risks to occur remains and could require specific monitoring

Table 16 outlines the key identified risks and associated risk ratings. The ratings assume that the risks are untreated i.e. have not been addressed by specific risk mitigation measures other than routine design and operational practices.

Table 16 Key risks associated with activities undertaken over the MOP term

ISSUE	Exploration	Mine development and mining	Waste rock emplacement	Use/maintenance of roads, tracks and equipment	Mineral processing facilities and infrastructure	Ore/product stockpiling and handling	Construction activities incl. earthworks	Tailings impoundment management	Land preparation, vegetation and topsoil	Water management, incl. storm event	Hazardous material & fuel handling	Sewerage	Rubbish removal	Rehabilitation	Rehabilitated lands and remaining features
Air pollution, dust	H	H	L	H	M	H	M	L	H	-	-	L	H	H	-
Erosion and sedimentation	M	M	M	M	M	-	L	-	M	H	-	-	-	H	H
Surface water	L	H	H	H	-	-	M	M	H	-	-	L	-	H	-
Groundwater	L	H	-	-	-	-	M	M	-	-	-	-	L	-	-
Contaminated land	L	H	-	-	-	-	M	-	L	-	M	L	L	-	-
Hazardous substance contamination	M	M	H	H	L	L	M	-	H	H	H	-	-	H	-
Acid mine drainage	-	L	L	-	-	-	-	-	-	-	-	-	-	-	-
Flora and fauna	M	H	-	-	-	-	H	-	H	-	-	-	-	L	L
Weeds and vertebrate pests	-	M	-	-	-	-	-	-	M	-	-	-	-	H	H
Blasting	-	H	-	-	-	-	-	-	-	-	-	-	-	-	-
Operational noise	L	H	H	H	M	-	H	-	L	-	-	-	-	-	-
Visual amenity and lighting	-	H	-	-	-	-	M	L	-	-	-	-	-	-	-
Aboriginal heritage	H	H	-	-	-	-	H	-	H	-	-	-	-	L	L
European heritage	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Spontaneous combustion	-	-	L	-	-	L	-	-	-	-	-	-	-	-	L
Bushfire	M	L	-	L	-	-	L	-	M	-	-	-	-	-	M
Geo-chemical soil instability	-	-	-	-	-	-	-	-	L	-	-	-	-	M	M
Mine subsidence	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Methane drainage / venting	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Public safety	L	M	-	-	-	-	-	M	-	L	L	L	-	-	L

4.1.1 Hunter Valley Operations Environmental Management Strategy

The current HVO Environmental Management Strategy (EMS) has been developed to meet the relevant approval conditions to provide a strategic framework for environmental management at HVO. The HVO EMS was first approved by the (then) DoP on 13 April 2005. It was last reviewed and updated in 2016.

The EMS is designed so that HVO can:

- Efficiently manage its environmental issues;
- Comply with regulatory requirements;
- Continually improve its environmental performance; and
- Satisfy the expectations of stakeholders and the local community.

4.1.1.1 Environmental Management Documents

All EMS documents are kept on the HVO Site Document Register so they are electronically distributed and readily accessible across the organisation.

Management Strategies, Plans and Monitoring Programmes are prepared as required by development consent/project approval conditions. The Management Strategies and Plans have been developed with an understanding of the environmental areas that need to be managed and the results of the Environmental Assessments (EA).

Procedures have been established, documented and maintained for all mining related activities that have a potentially significant impact on the environment. Procedures provide details of operation and maintenance of facilities, equipment and machinery where required.

4.1.2 Environmental Management Plans

In addition to the standards and procedures listed above, Environmental Management Plans (EMPs) are prepared as required by the development consent. Where applicable, the management strategies within the EMPs apply across both HVO North and HVO South. These management plans are approved by DPE and any relevant agencies, and are reviewed as necessary to ensure they remain relevant.

A specific example is the BMP. While this MOP relates to the rehabilitation of the various domains at HVO South, the BMP outlines the management of both operational and non-operational domains.

4.1.3 Hunter Valley Operations Environmental Services

~~Hunter Valley Operations~~ HVO have a team of environmental specialists to establish, implement and audit the requirements of the EMS and EMPs. This team is able to provide a comprehensive coverage of HVO's mining operations.

The GDP system is also managed by HVO's Environment and Community team. Prior to any ground disturbance, a GDP is prepared by the proponent and distributed internally for review for any potential issues regarding approvals matters, flora and fauna, rehabilitation, cultural heritage or water issues. This assists HVO to operate in accordance within the various licences, approvals and commitments as well as the applicable State and Commonwealth legislation.

4.1.4 Auditing and Inspections

HVO's Environment and Community team routinely conduct a number of audits and inspections, including internal environmental and compliance audits and other less routine audits. Site based environmental personnel also conduct regular inspections of all work areas.

4.1.5 Environmental Reporting

An Annual Environmental Review is produced for HVO to fulfil the reporting requirements of SC, OEH, ~~RR DRG~~ and DPE. This report provides a statement of compliance to approval conditions and compiles monitoring results and discusses trends, system changes and responses to any potential issues identified during monitoring. Targets and future initiatives are also identified. Other environmental related reports include regular reporting to EPA, OEH, CCC and DPE.

4.2 Risk Management

HVO maintains an Environmental Management System (EMS) as a means to facilitate compliance with environmental standards and requirements. The EMS provides a framework for managing all environmental and community aspects, impacts and performance of the mining operations. The HVO EMS has been developed generally in accordance with ISO 14001.

As part of the EMS, management plans, procedures and standards have been developed to meet statutory requirements, manage activities on site to minimise risk to the environment and to continually improve the performance of operations. The following management plans are in place for HVO:

- *Environmental Management Strategy;*
- *Pollution Incident Response Management Plan;*
- *Water Management Plan (including a Surface Water Management Plan, Surface Water Monitoring Program, Groundwater Management Plan and Groundwater Monitoring Program);*
- *Air Quality and Greenhouse Gas Management Plan;*
- *Noise Management Plan;*
- *Blast Management Plan;*
- *HVO South Aboriginal Cultural Heritage Management Plan;*
- *Integrated Biodiversity Management Plan;*
- *Biodiversity Offset Strategy;*
- *Landscape and Rehabilitation Management Strategy;*
- *River Red Gum Rehabilitation and Restoration Strategy;*
- *Bushfire Management Plan;* and
- *HVO's series of Spontaneous Combustion Management Plans.*

These management plans will be updated as required with the approval of the DPE. Copies of the current versions of these management plans are available on the HVO website (<https://insite.hvo.com.au>). Future revisions to any environmental management plan will be reported in the Annual Review.

4.2.1 Operational Noise

Operational noise is managed in accordance with the HVO Noise Management Plan (NMP), ~~approved by the DPE on 25 August 2015~~. The NMP describes the following in detail:

- Noise related legal and other requirements relevant to ~~Hunter Valley Operations~~ HVO;
- The measures (both proactive and reactive) to be implemented to maintain noise emissions below consented noise limits;
- All aspects of HVO's noise monitoring programme including monitoring locations, frequency of assessment, the use of real time monitoring systems, and a protocol for determining compliance with the noise criteria;
- Processes in place to provide regular updates to the DPE and local community regarding the outcomes of the noise monitoring programme;
- Processes for receiving and responding to community complaints; and
- Processes for periodic review of the NMP.

4.2.2 Blasting

Blasting is managed in accordance with the HVO Blast Management Plan, and HVO Post-Blast Fume Mitigation and Management Plan, ~~approved by the DPE on 4 April 2014~~. The Plans describe the following in detail:

- Blasting related legal and other requirements relevant to ~~Hunter Valley Operations~~ HVO;

- The measures (both proactive and reactive) to be implemented to minimise the blasting related impacts on near neighbours and the surrounding environment, and to maintain compliance with consented airblast overpressure/ground vibration limits;
- Description of known causal factors which contribute to the generation of post-blast fume;
- Details of measures to be implemented to minimise the likelihood of post-blast fume generation, and processes to respond to any instances of post-blast fume generation;
- All aspects of HVO's Blast monitoring programme including monitoring locations, and a protocol for determining compliance with the blasting criteria;
- Processes in place to provide regular updates to the DPE and local community regarding the outcomes of the blast monitoring programme;
- Processes for receiving and responding to community complaints; and
- Processes for periodic review of the Plans.

4.2.3 Air Quality

Air quality is managed through the ~~Hunter Valley Operations HVO~~ Air Quality & Greenhouse Gas Management Plan (AQMP). ~~Approved for implementation on 12 February 2014;~~ The AQMP describes the following in detail:

- Air quality related legal and other requirements relevant to ~~Hunter Valley Operations HVO~~;
- The measures (both proactive and reactive) to be implemented to minimise air quality impacts on near neighbours and the surrounding environment, and to maintain compliance with consented air quality criteria;
- All aspects of HVO's air quality monitoring programme including monitoring locations, frequency of assessment, the use of real time monitoring systems, and a protocol for determining compliance with the air quality criteria;
- Processes in place to provide regular updates to the DPE and local community regarding the outcomes of the air quality monitoring programme;
- Processes for receiving and responding to community complaints; and
- Processes for periodic review of the Plan.

4.2.4 Water

Water is managed through the site Water Management Plan (WMP) ~~as approved on 10 July 2015 and subsequently updated on 4 May 2016.~~

The purpose of the WMP is to provide reasonable and feasible measures to address potential water impacts of the Project as identified in the Approvals and satisfy the relevant conditions of the Approvals. The WMP describes procedures required to maintain compliance with conditions of the Approvals relating to potential water impacts. This WMP also provides a mechanism for assessing water quality and quantity monitoring results.

~~Hunter Valley Operations HVO~~ manages water according to three main objectives:

- Fresh water usage is minimised;
- Impacts on the environment and HVO neighbours are minimised; and
- Interference to mining production is minimal.

This is achieved by:

- Minimising freshwater use from the Hunter River;
- Preferentially using mine water for coal preparation and dust suppression;
- An emphasis on control of water quality and quantity at the source;
- Segregating waters of different quality where practical;
- Recycling on-site water;
- Ongoing maintenance and review of the system; and

- Disposing of water to the environment in accordance with statutes and regulations.

4.2.4.1 Water Management System

The HVO water management system consists of a network of infrastructure (i.e. dams, pipelines, contour banks) to control the movement of water around the site. Water is managed according to type. Water type is determined by catchment source, quality and use. The main types of water managed at HVO include:

- Mine Water;
- Runoff Water; and
- River Water.

Water used in coal production at HVO is predominantly saline due to interaction with saline groundwater within coal seams and contact with saline mine spoils. Saline water cannot be released from site except for opportunistic discharges as regulated by the Hunter River Salinity Trading Scheme (HRSTS). The majority of saline mine water is directed to two out of pit storages – Dam 15S (Lake James) and the Riverview Void. Water is pumped between HVO South and HVO North via pipelines across the Hunter River haul road bridge. Large mine-water dams have sufficient free-board capacity maintained to prevent overtopping during heavy rainfall events.

4.2.4.2 External Water Supply

~~Hunter Valley Operations~~ HVO seeks to use non-potable sources of water preferentially prior to accessing water from the Hunter River under the Water Sharing Plan. Typically excess water is stored on site, however piping infrastructure is in place to transfer water to/from MTW via Dam 27S (Lemington Void). Additional sources of poor quality water are also available from the Lemington Underground Bore and under a water transfer agreement in place with the Peabody Wambo mine.

~~Hunter Valley Operations~~ HVO holds both High and General Security Water Access Licences to withdraw water from the Hunter River. Should HVO require more water, entitlements can be traded to this licence in accordance with the WMA to increase output through the scheme. The volume of the surface water access licences held by HVO total 5,144 ML/a, based on a 100 percent Available Water Determination.

4.2.4.3 Water Discharge

Excess mine water can be released via licensed discharge points into the Hunter River. Licensed discharge points are located on: Parnells Dam (9W), Dam 11N and Lake James (Dam 15S). Discharges are only allowed during high and flood flow periods in the Hunter River as determined by State Water and the NOW. Discharges are regulated by conditions in the site EPL 640 and by the *Protection of the Environment Operations (Hunter River Salinity Trading Scheme) Regulation 2002*.

4.2.4.4 Surface Water Management

4.2.4.4.1 Surface Water Monitoring

~~Hunter Valley Operations~~ HVO maintains a network of surface water monitoring sites located on mine site dams and surrounding natural watercourses. The Hunter River is sampled at seven sites both upstream and downstream of mining operations to monitor the potential impact of mining on the river. On site dams are monitored to identify the quality of mine water. Results of the surface water quality monitoring at HVO are reported to the CCC and in the **AER Annual Review**.

4.2.4.4.2 Clean Water diversions

Clean water diversion structures are employed to divert clean water away from the active pits. Prior to release from site this water is managed to minimise sediment load. Sediment control structures are implemented generally in accordance with *Managing Urban Stormwater Volume: 2E Mines and Quarries*.

4.2.4.4.3 Erosion and Sediment Control

A GDP is required for all disturbance activities. Prior to disturbance, appropriate erosion and sediment controls consistent with current best practice standards will be established. Where ground conditions allow, erosion and sediment controls will be designed generally in accordance with *the 'Blue Book': Managing Urban Stormwater: soils and construction* (Volume 1 and 2E – Mines and Quarries) (**Blue Book**).

Sediment mobilisation and erosion will be minimised by:

- Where practical, diverting runoff from undisturbed catchments around disturbed areas via diversion drains and banks to discharge into natural watercourses;
- Retaining runoff from disturbed areas in sediment dams to settle out suspended sediment with possible treatment prior to discharge back to the natural system;
- Return water back to the mine water system if water quality is not suitable for release;
- Installing appropriate erosion and sediment controls prior to disturbance of any land;
- Limiting the extent of disturbance to the practical minimum and maintaining groundcover;
- Reducing the flow rate of water across the ground on disturbed surfaces;
- Progressively stripping and stockpiling topsoil for later use in rehabilitation and stabilisation;
- Stabilising topsoil stockpiles to minimise erosion;
- Progressively rehabilitating disturbed land to increase ground cover, increase infiltration and reduce erosion potential;
- Constructing drainage controls such as scour protection to improve stability in concentrated flow areas; and
- Restricting access to rehabilitation and non-disturbed areas.

4.2.4.5 Groundwater Management

An integrated management approach is employed at HVO to mitigate the potential impacts of mining on the groundwater environment and other groundwater users, including dependent ecosystems.

The key groundwater management measures are:

- Physical water management;
- Groundwater monitoring, data management and reporting;
- Groundwater model revisions and verification of predictions;
- Salinity trading and water sharing; and
- Direct compensation measures.

The groundwater management measures are intended to complement the groundwater monitoring programme detailed in the WMP. Results of the groundwater monitoring at HVO are reported to the CCC and in the AER.

4.2.5 Flora and Fauna

Wollombi Brook and Hunter River River Red Gum (RRG) stands occurring within the HVO South Project Approval boundary are managed in accordance with the *River Red Gum Rehabilitation and Restoration Strategy* (RRGRRS), ~~submitted to DP&I in March 2010~~. The management of the Carrington Billabong RRG stands, located within HVO North, is also covered in this strategy. A *Landscape and Rehabilitation Management Strategy* has also been prepared as per DA requirement, and was submitted to DPE for approval in June 2007. This document outlines how the rehabilitation strategy integrates with existing and planned corridors of native vegetation in areas surrounding the development.

The HVO South ~~Coal~~ Project Approval granted permission to clear 48 ha of remnant native vegetation and 92 ha of regrowth. To offset this impact 140 ha of Narrow-leaved Ironbark Woodland is to be protected in perpetuity. The offset area to satisfy this condition is located within the Goulburn River Biodiversity Area. The *Regional Offset Management Plan - Warkworth Mine, NSW Hunter Valley Operations, NSW (June 2014)* has been prepared to guide the long term protection and management of the Goulburn River and Bowditch Biodiversity Areas. The regional offset management plan will be replaced by a site specific offset management plan for Goulburn River Biodiversity Area.

HVO was granted approval for the continuation of open cut coal mining in areas that were previously approved by the State after the commencement of the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) within the mine complex. The approval was granted on the 10 October 2016 and granted permission to clear 61 ha of the ~~Central Hunter Valley Eucalypt Forest~~ CHVEF and woodland. The conditions of the approval required the preparation and approval of an offset strategy that specified the development of an offset package. The offset package included the protection in perpetuity of land at the Wandewoi Biodiversity Area which included

the reinstatement of the key characteristics of the CHVEF within the grassland area of the Wandewoi Biodiversity Area. To compensate for other residual significant impacts, additional offsets have been purchased and will be secured in perpetuity as per the approval conditions.

Site specific offset management plans have been prepared for each offset Biodiversity Area which details the protection and management measures to be implemented.

4.2.5.1 Weeds and Vertebrate Pest Species

The management and control of weeds at HVO South is underpinned by the Annual Works Schedule (AWS), which lists Weeds of National Significance, noxious and environmental weeds species as identified at HVO South, and provides a framework to allow for structured weed management and control across operational and non-operational areas of HVO South. Assessment of the impact of weeds across the HVO South site is ongoing with the results of the regular monitoring programmes used to update the AWS. Additionally, a Working Weed Action Plan (WWAP) was developed in 2011, which outlines the weed species surveyed across site, advisable control methods and timings, and priority ranked areas for weed control. Weed treatment control is conducted annually and at other times as determined by seasonal conditions that may promote excessive weed growth, and is reported in the Annual Review.

The management of weeds across the MOP disturbance area is undertaken in accordance with advice from the Upper Hunter Weeds Authority. This represents a low environmental risk associated with the proposed activities that can be managed with an ongoing inspection and maintenance programme.

The management of vertebrate pests follows the *Vertebrate Pest Action Plan*, which is updated seasonally based on recommendations from the quarterly Vertebrate Pest Control Reports. This approach allows maximum flexibility to react to sightings, monitoring results, or particular pest infestations and allow customisation of the programme to effectively address these infestations. The data presented in the quarterly Vertebrate Pest Control Reports provide a sound basis for all decision making on vertebrate pest control on the site.

Vertebrate Pest species control is undertaken quarterly and includes trapping, baiting and shooting. Performance of vertebrate pest species control is reported annually in the Annual Review.

4.2.6 Aboriginal Heritage

HVO manages Aboriginal cultural heritage through the Cultural Heritage Management System (CHMS), which has been developed to ensure that all activities and ground disturbances associated with the company's operations comply with all relevant legislation and statutory regulations governing the management of Aboriginal cultural heritage.

At HVO South, Aboriginal cultural heritage is managed in accordance with the Aboriginal Cultural Heritage Management Plan (ACHMP) required under PA 06_0261, which was approved by the DP&I in February 2010. This Project Approval contains detailed conditions for the management of Aboriginal cultural heritage at HVO South (including the programmes and policies to be included in the HMPs). Annual reports are prepared on its progress against, and compliance with, these conditions and are reported in the Annual Review. HVO works closely with the local Aboriginal community on all aspects of cultural heritage management. The HVO Upper Hunter Valley Aboriginal CHWG is the primary forum for Aboriginal community consultation on matters pertaining to cultural heritage. The CHWG is comprised of representatives from HVO and Registered Aboriginal Parties/stakeholders from Upper Hunter Valley Aboriginal community groups, corporations and individuals. On request, the local Aboriginal community is provided access to Aboriginal sites located on HVO land.

HVO has also constructed and maintain Cultural Heritage Databases and Geographical Information System (GIS) to better manage and protect sites. These include cultural heritage spatial and other data, such as site location, description, assessments, date recorded, associated reports, management provisions and various other details to assist with the management of sites.

A GDP system is utilised at HVO. This permit must be authorised by cultural heritage staff and must be completed prior to any disturbance of HVO land outside current mining operations. During this process, the location of archaeological and cultural heritage sites is conveyed to employees operating in the vicinity and unintentional disturbance of sites is avoided.

There are a number of Aboriginal heritage sites present within the MOP proposed disturbance area. These sites will be managed or salvaged in accordance with development consent and ACHMP conditions, and all relevant CHMS procedures and legislative requirements.

4.2.7 European Heritage

HVO maintains a Historic Heritage Inventory to record significant items of European heritage. A Community Heritage Advisory Group was established in 2012 to advise on the management and protection of heritage items.

There are no listed items of European Heritage within the HVO South Coal Project area, therefore no management measures need to be considered in this MOP.

4.2.8 Visual Amenity and Lighting

General measures to minimise potential impacts on visual amenity include:

- Progressive rehabilitation with grasses and woodland;
- Screen plantings to provide a visual screen from the Lemington Road;
- Appropriate placement and use of natural colours for all significant infrastructure; and
- Overburden heights and land shaping will be consistent with the development consent and Environmental Impact Statement (EIS) requirements.

In relation to lighting, measures are implemented to direct mine lighting appropriately. Control measures include:

- Fixed and mobile floodlights will not be directed towards surrounding residence unless there is significant intervening topography;
- Day and night dumps may be created to assist with reducing lighting impacts; and
- All external lighting complies with *Australian Standard AS4282 (INT) 1995 – Control of Obtrusive Effects of Outdoor Lighting*.

A visual impact mitigation assessment for the HVO South Coal project was conducted 2010. Tree screening along sections of Lemington Road have been installed in line with the report recommendations.

4.2.9 Hazardous Substances Contamination

HVO manages hazardous material through the ChemAlert system whereby all chemicals used on site are registered through a central database. The central database contains all information contained in the **Material Safety Data Sheets (MSDS)** and an inventory of chemicals held onsite. The information can be accessed at any computer terminal within the operation and provide guidance on storage, use and disposal.

Hazardous and explosive materials are transported and stored on site in accordance with the *NSW Work Health and Safety (Mines and Petroleum Sites) Act 2013* and supporting *Work Health and Safety (Mines and Petroleum Sites) Regulation 2014* as well as the *NSW Explosives Act 2003* and supporting *Explosives Regulation 2013*.

The procedures and controls in place minimise the potential for land and water contamination from the handling, storage and disposal of hazardous substances. These controls include storage within properly sealed containers and controlled areas, banded for medium to long-term storage requirements. These storage and waste receipt areas are isolated from clean water catchments to minimise the risk of land or water pollution should an unplanned spill occur.

Small amounts of contaminated material are treated in the bioremediation site and returned to the spoil dump once reported as appropriately decontaminated.

The response to any accidental spills or ground contamination will be assessed on a case-by-case basis and remediated using biodegradable spill absorbent. The comprehensive site spill response trailer and emergency response procedure for HVO would also be called upon as required. This work will be carried out in accordance with the relevant HVO Environmental Procedures. Hydrocarbon or chemical spills will also be reported in the mine site incident reporting and management system with corrective and preventative measures taken as appropriate.

4.2.10 Spontaneous Combustion

~~HVO has procedures for the management of Spontaneous combustion. Spontaneous combustion is managed through HVO's Spontaneous Combustion Management Plans.~~ Spontaneous combustion issues have historically occurred within NLP rail loop.

The objectives of the Management Plans and Environmental Procedure are to:

- Minimise outbreaks of spontaneous combustion;

- Identify potential areas that may be prone to spontaneous combustion before an outbreak occurs;
- Place all carbonaceous material in such a manner that reduces the possible occurrence of spontaneous combustion;
- Where longer term spontaneous combustion problems occur, instigate a management plan to deal with these; and
- Maintain final rehabilitation free from spontaneous combustion.

4.2.11 Acid Mine Drainage

Mineral wastes may pose an environmental risk because of acid drainage, however the potential for acid mine drainage is low at HVO South.

4.2.12 Contaminated Land

In contaminated or polluted land, the contaminated soil/material is removed to the designated bioremediation area, which is maintained and monitored. Stringent planning and management of this mining operation will avoid any contamination or pollution of the land being mined. A Contaminated Sites Register is used to record and follow up of any contamination that occurs on site.

Prior to the cessation of mining activities in the MOP disturbance area, an assessment will be undertaken to determine whether potential contamination issues exist and remediation is required.

4.2.13 Bushfire

Bushfire management is undertaken in accordance with the HVO Bushfire Management Plan. The Bushfire Management Plan was ~~last updated in June 2017~~ in consultation with ~~Singleton Council SC~~ and the NSW Rural Fire Services (RFS).

The following controls may be implemented to control the risk associated with bushfire:

- controls, including mowing, slashing, ploughing, flailing and manual removal as required to reduce fuel loads and fire risk in peak seasons;
- grazing licences have been established to allow strategic grazing in rehabilitation areas and other on-site areas to reduce fuel loads;
- fuel reduction requirements will be assessed in consultation with the NSW RFS;
- establishment and maintenance of fire breaks, including around critical infrastructure;
- maintenance of rescue truck and water carts to be available in the event of fires; and
- periodic review, testing and training of relevant personnel in the site Emergency Response Procedure.

4.2.14 Mine Subsidence

No subsidence impacts will occur as a result of the operations, as all current and proposed mining operations at HVO South are open cut.

4.2.15 Methane Drainage / Venting

Not applicable to HVO South, which only includes open cut operations.

4.2.16 Public Safety

Public safety at HVO is managed primarily through the implementation of appropriate safety standards and daily security inspections. Fencing, signposting, restricted access areas, and locked external gates form part of the safety measures to protect the public. These measures are implemented according to the mines safety standards and procedures and include audit, inspection, testing and reporting systems.

There is no public access from the mine entrance to pit areas, as part of the restraints to public access, and measures of public safety. It is standard procedure that no blasting occurs within 500 m of any public road, unless it is temporarily closed to public access and that should visibility or traffic safety on any public road be compromised by dust, that mining in the area would cease until safe to resume.

A private security contractor is also engaged to conduct nightly inspections of the mining lease area to maintain the safety of all persons in the mine vicinity, and to ensure there are no breaches of security. Inspections are also undertaken during daylight hours on public holidays.

All visitors and inducted contractors are required to undertake a visitors induction at the time of sign-in prior to entering the mine site and where necessary will be accompanied by an inducted mine employee.

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5.0 Post Mining Land Use

5.1 Regulatory Requirements

The regulatory requirements specific to post mining land-use and rehabilitation outcomes at HVO South are summarised in **Table 17** and **Table 18**.

Table 17 Regulatory Requirements – Planning Approvals

Condition	Requirement	Document/ Section
PA 06_0261		
Schedule 3 Condition 29	Biodiversity Offset Strategy The Proponent must implement the biodiversity offset strategy described in the Warkworth Mine EIS, summarised in Table 15 below and shown conceptually in Appendix 5, to the satisfaction of the Secretary.	Regional Offset Management Plan (OMP) - Warkworth Mine, NSW Hunter Valley Operations, NSW (June 2014)
Schedule 3 Condition 29A	Long Term Security of Offset By the end of June 2018, unless the Secretary agrees otherwise, the Proponent must secure the offset area identified in condition 29 under an in perpetuity conservation mechanism to the satisfaction of the Secretary, such as a Conservation Agreement under the <i>National Parks and Wildlife Act 1974</i> , BioBanking Agreement under the <i>Threatened Species Conservation Act 1995</i> , Biobanking Stewardship Agreement or Conservation Agreement under the <i>Biodiversity Conservation Act 2016</i> or by incorporating the land into the Goulburn River National Park (if agreed by NPWS). This conservation mechanism may be combined with any similar mechanism required for Warkworth Mine.	Regional OMP Section 1.2
Schedule 3 Condition 29B	Offsets for Warkworth Mine The Proponent must not undertake any mining operations or development within the Southern Biodiversity Area or Northern Biodiversity Area as indicated on the plan in Appendix 10, other than any conservation-related activity under an approved Biodiversity Management Plan under either this approval or similar plan required for Warkworth Mine.	Local Offset Management Plan – Warkworth Mine, NSW
Schedule 3 Condition 30	River Red Gum Restoration Strategy Within 12 months of the date of this approval, or otherwise agreed by the Direct-General, the proponent shall review, revise and provide a timetable for the implementation the HVO River Red Gum Strategy for the Hunter River and Wollombi Brook river red gum populations (as shown in Appendix 8), in consultation with CLWD and OEH, and to the satisfaction of the Secretary. This strategy must be prepared by suitably qualified expert/s, and must include: <ul style="list-style-type: none"> a) the conservation and restoration objectives for the river red gum population; b) a description of the short, medium and long term measures that would be implemented to conserve and restore the river red gum populations (including measures to address matters which affect the long term health and sustainability of the river red gums such as surface and ground water supply, and controlling weeds, livestock and feral animals); and c) detailed assessment and completion criteria for the conservation and restoration of the river red gum 	Hunter Valley Operations South River Red Gum Rehabilitation and Restoration Strategy

Condition	Requirement	Document/ Section
	populations.	
Schedule 3 Condition 31	Hunter Lowland Red Gum Forest The Proponent must protect all stands of the Hunter Lowland Red Gum Forest (also identified as Hunter Floodplain Red Gum Woodland Complex in the EA) endangered ecological community within the site, and adjacent lands under the control of the Proponent, as shown in Appendix 8, to the satisfaction of the Secretary.	Hunter Valley Operations South River Red Gum Rehabilitation and Restoration Strategy
Schedule 3 Condition 33A	Biodiversity Management Plan The Proponent must prepare a Biodiversity Management Plan to the satisfaction of the Secretary. This plan must: <ul style="list-style-type: none"> (a) be submitted to the Secretary for approval within 3 months of the determination of Modification 5, unless otherwise agreed by the Secretary; (b) be prepared in consultation with the OEH by a suitably qualified and experienced person/s; (c) describe the short, medium, and long term measures to be undertaken to manage the remnant vegetation and fauna habitat on the site and implement the Biodiversity Offset Strategy (see condition 29); (d) describe the measures to be undertaken to avoid the Southern Biodiversity Area or Northern Biodiversity Area located within the site (see condition 29B); (e) incorporate the River Red Gum Strategy (see condition 30); (f) describe the measures to be undertaken to protect the Hunter Lowland Red Gum Forest endangered ecological community (see condition 31); (g) include detailed performance and completion criteria for evaluating the performance of the Biodiversity Offset Strategy and include triggers for remedial action, where these performance or completion criteria are not met; (h) include a detailed description of the measures to be implemented on the site and in the biodiversity area/s for: <ul style="list-style-type: none"> • protecting vegetation and fauna habitat outside the approved disturbance area on the site; • enhancing the quality of existing vegetation, vegetation connectivity and fauna habitat on the site and in the offset areas; • minimising clearing and avoid unnecessary disturbance; • maximising the salvage of resources within the approved disturbance area for beneficial reuse; • collecting and propagate seed; • utilising vegetation for visual screening of the site; • minimising the impacts on fauna on site, including undertaking pre-clearance surveys; • managing salinity; • controlling weeds and feral pests; • controlling erosion; • managing grazing and agriculture on the site; • controlling access; and • manage bushfire hazards; (i) be integrated with rehabilitation for the site; (j) include a seasonally-based program to monitor and report on 	Regional Offset Management Plan Section 1.3.3, Section 3, Section 4 and Section 5. HVO South MOP

Condition	Requirement	Document/ Section								
	<p>the effectiveness of the above measures, progress against the detailed performance and completion criteria, and any progressive improvements that could be implemented to improve biodiversity outcomes;</p> <p>(k) monitor and report on the impacts of the project on groundwater dependent ecosystems and riparian vegetation consistent with the Groundwater Monitoring Program, and identify trigger levels for the remediation of any material impacts to these ecosystems;</p> <p>(l) identify the potential risks to the successful implementation of the Biodiversity Offset Strategy, and include a description of the contingency measures to be implemented to mitigate against these risks; and</p> <p>(m) include details of who would be responsible for monitoring, reviewing, and implementing the plan.</p> <p>The Proponent must implement the Biodiversity Management Plan as approved by the Secretary.</p> <p><i>Note: Management measures relating to the Biodiversity Offset Strategy may be addressed via equivalent measures required as part of the long term security arrangement under condition 29A.</i></p>									
Schedule 3 Condition 34	<p>Progressive Rehabilitation</p> <p>The Proponent must rehabilitate the site progressively, that is, as soon as reasonably practicable following disturbance. All reasonable steps must be taken to minimise the total area exposed at any time. Interim stabilisation and temporary vegetation strategies must be employed when areas prone to dust generation, soil erosion and weed incursion cannot be permanently rehabilitated</p>	HVO South MOP								
Schedule 3 Condition 35	<p>Rehabilitation Objectives</p> <p>The Proponent must rehabilitate the site to the satisfaction of the Secretary responsible for DRG. This rehabilitation must be generally consistent with the proposed rehabilitation activities described in the documents listed in condition 2 of Schedule 2 (and shown conceptually in the figure in Appendix 6), and comply with the objectives in Table 16.</p> <p><i>Table 16: Rehabilitation Objectives</i></p> <table><tr><th>Feature</th><th>Objective</th></tr><tr><td>All areas of the site affected by the project</td><td><ul style="list-style-type: none">• Safe, stable and non-polluting• Fit for the intended post-mining land use/s</td></tr><tr><td>Areas proposed for native ecosystem re-establishment</td><td><ul style="list-style-type: none">• Establish self-sustaining native woodland ecosystems characteristic of vegetation communities found in the local area</td></tr><tr><td>Areas proposed for agricultural land</td><td><ul style="list-style-type: none">• Establish/restore grassland areas to support sustainable agricultural activities• Achieve the nominated land capability classification</td></tr></table>	Feature	Objective	All areas of the site affected by the project	<ul style="list-style-type: none">• Safe, stable and non-polluting• Fit for the intended post-mining land use/s	Areas proposed for native ecosystem re-establishment	<ul style="list-style-type: none">• Establish self-sustaining native woodland ecosystems characteristic of vegetation communities found in the local area	Areas proposed for agricultural land	<ul style="list-style-type: none">• Establish/restore grassland areas to support sustainable agricultural activities• Achieve the nominated land capability classification	HVO South MOP
Feature	Objective									
All areas of the site affected by the project	<ul style="list-style-type: none">• Safe, stable and non-polluting• Fit for the intended post-mining land use/s									
Areas proposed for native ecosystem re-establishment	<ul style="list-style-type: none">• Establish self-sustaining native woodland ecosystems characteristic of vegetation communities found in the local area									
Areas proposed for agricultural land	<ul style="list-style-type: none">• Establish/restore grassland areas to support sustainable agricultural activities• Achieve the nominated land capability classification									

Final Landform	<ul style="list-style-type: none"> • Stable and sustainable for the intended post-mining land use/s • Integrated with surrounding natural landforms • Incorporate micro-relief and drainage lines that are consistent with surrounding topography, to the greatest extent practicable • Maximise surface water drainage to the natural environment (excluding final void catchment) • Protect and maintain, to the greatest extent practicable, existing views of the Wollemi National Park and associated escarpments for residences of Maison Dieu
Final Void	<ul style="list-style-type: none"> • Designed as long term groundwater sink to maximise ground water flows across backfilled pits to the final void • Minimise to the greatest extent practicable: <ul style="list-style-type: none"> - the size and depth of final voids; - the drainage catchment of final voids; - any high wall instability risk; and - the risk of flood interaction
Surface infrastructure of the project	<ul style="list-style-type: none"> • Decommissioned and removed, unless DRG agrees otherwise
Rehabilitation materials	<ul style="list-style-type: none"> • Materials from areas disturbed under this approval (including topsoils, substrates and seeds) are to be recovered, managed and used as rehabilitation resources, to the greatest extent practicable
Water quality	<ul style="list-style-type: none"> • Water retained on the site is fit for the intended post-mining land use/s • Water discharged from the site is suitable for receiving waters and fit for aquatic ecology and riparian vegetation
Community	<ul style="list-style-type: none"> • Maintain public safety • Minimise adverse socio-economic effects associated with mine closure

Note: The rehabilitation objectives detailed in Table 16 apply to the entire site; however, they do not require any additional earthmoving works to be undertaken to landforms that have been constructed under previous approvals or prior to the approval of Modification 5.

Schedule 3 Condition 36	<p>Rehabilitation Management Plan</p> <p>The Proponent must prepare a Rehabilitation Management Plan for the project to the satisfaction of the DRG. This plan must:</p> <ul style="list-style-type: none"> (a) be prepared by suitably qualified expert/s; (b) be prepared in consultation with the Department, CLWD, and Council by a suitably qualified and experienced person/s; (c) be submitted for approval within 3 months of the determination of Modification 5, unless otherwise approved by the Secretary; (d) be prepared in accordance with any relevant DRG Guideline; (e) describe how the rehabilitation of the site would achieve the objectives identified in Table 16 and be integrated with the measures in the Biodiversity Management Plan; (f) include detailed performance and completion criteria for evaluating the performance of progressive and final rehabilitation and include triggers for remedial action, where these performance or completion criteria are not met; (g) describe the measures to be implemented to meet the performance and completion criteria, to ensure compliance with the relevant conditions of this approval and to address all aspects of rehabilitation including mine closure, final landform (including the final void), final land use/s, and water management in the final landform; (g) include procedures for the use of interim stabilisation and temporary vegetation strategies, where reasonable to minimise exposed areas; (h) include a program to monitor, independently audit and report on the effectiveness of the rehabilitation measures, and progress against the performance and completion criteria; (i) identify the potential risks to the successful implementation of rehabilitation, and include a description of the contingency measures to be implemented to mitigate against these risks; and (j) include details of who would be responsible for monitoring, reviewing, and implementing the plan. <p>The Proponent must implement the Rehabilitation Management Plan as approved by the Secretary.</p>	HVO South MOP
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Table 18 Regulatory Requirements – Tenements

Condition	Requirement
Coal and Mining Leases	
CCL714 Condition 2 CL327 Condition 2 CL398 Condition 2 ML1465 Condition 2 ML1634 Condition 2 ML1682 Condition 2 ML1734 Condition 2 ML1753 Condition 2	<p>Rehabilitation</p> <p>Any disturbance resulting from the activities carried out under this mining lease must be rehabilitated to the satisfaction of the Minister.</p>

5.2 Post Mining Land Use Goal

The objective of the post-mining land use is to be compatible with surrounding land uses and provide environmental and community benefits. This includes maximising the biodiversity and connectivity within landscape, through improved management of existing remnants and the establishment of a network of vegetation corridors.

The objective of the post mining land use is to be compatible with surrounding land uses and provide environmental and community benefits.

The final land uses across the site will include grazing and land set aside for native vegetation and fauna habitat. A conceptual final rehabilitation plan which details land uses is shown in **Map 4**.

Mining infrastructure within the project disturbance area would be removed if no longer required and the affected lands rehabilitated. This rehabilitation would be consistent with adjacent vegetation communities.

5.3 Project Rehabilitation Objectives

~~The objective of the post mining land use is to be compatible with surrounding land uses and provide environmental and community benefits. This includes maximising the biodiversity and connectivity within landscape, through improved management of existing remnants and the establishment of a network of vegetation corridors.~~

~~The final land uses across the site will include grazing and land set aside for native vegetation and fauna habitat. A conceptual final rehabilitation plan which details land uses is shown in **Map 4**.~~

~~Mining infrastructure within the project disturbance area would be removed if no longer required and the affected lands rehabilitated. This rehabilitation would be consistent with adjacent vegetation communities.~~

~~The final landform will be shaped to minimise the surface water catchment draining to the void. The low wall is graded to enable a useable area within the final void as the pit lake develops with the rising groundwater.~~

~~To avoid additional disturbance, the existing rehabilitation will remain unchanged, however, as the rehabilitation progresses, micro-relief will be incorporated into the new rehabilitation areas to better replicate and assimilate with the natural landscape in the area.~~

~~A Mine Closure Plan for HVO South will be prepared at least five years prior to completion of mining to:~~

- ~~• Investigate options for the future use of the site, including the final void; and~~
- ~~• Investigate ways to minimise the adverse socio-economic effects associated with mine closure, including reduction in local employment levels.~~

The rehabilitation objectives of this MOP are detailed below in **Table 19** and are aligned to the Landscape and Rehabilitation Objectives as defined in Table 19.1 of the Environmental Assessment Report (ERM Jan 2008) and discussed in the HVO South Mod 5 EA.

Table 19 Rehabilitation Objectives

Feature	Objective
All areas of the site affected by the project	• Safe, stable and non-polluting
	• Fit for the intended post-mining land use/s
Areas proposed for native ecosystem re-establishment	• Establish self-sustaining native woodland ecosystems characteristic of vegetation communities found in the local area
Areas proposed for agricultural land	• Establish/restore grassland areas to support sustainable agricultural activities
	• Achieve the nominated land capability classification
Final landform	• Stable and sustainable for the intended post-mining land use/s
	• Integrated with surrounding natural landforms
	• Incorporate micro-relief and drainage lines that are consistent with surrounding topography, to the greatest extent practicable

Feature	Objective
	<ul style="list-style-type: none"> • Maximise surface water drainage to the natural environment (excluding final void catchment) • Protect and maintain, to the greatest extent practicable, existing views of the Wollemi National Park and associated escarpments for residences of Maison Dieu
	<ul style="list-style-type: none"> • Designed as long term groundwater sink to maximise ground water flows across backfilled pits to the final void
Final void	<ul style="list-style-type: none"> • Minimise to the greatest extent practicable: <ul style="list-style-type: none"> - the size and depth of final voids; - the drainage catchment of final voids; - any high wall instability risk; and - the risk of flood interaction
Surface infrastructure of the project	<ul style="list-style-type: none"> • Decommissioned and removed, unless DRG agrees otherwise
Rehabilitation materials	<ul style="list-style-type: none"> • Materials from areas disturbed under this approval (including topsoils, substrates and seeds) are to be recovered, managed and used as rehabilitation resources, to the greatest extent practicable
Water quality	<ul style="list-style-type: none"> • Water retained on the site is fit for the intended post-mining land use/s
	<ul style="list-style-type: none"> • Water discharged from the site is suitable for receiving waters and fit for aquatic ecology and riparian vegetation
Community	<ul style="list-style-type: none"> • Maintain public safety
	<ul style="list-style-type: none"> • Minimise adverse socio-economic effects associated with mine closure

5.4 Proposed Post Mining Landform

The final landform and land use has been illustrated on **Map 4**.

The final landform will be shaped to minimise the surface water catchment draining to the void. The low wall is graded to enable a useable area within the final void as the pit lake develops with the rising groundwater.

Drainage lines from the final landforms will be compatible with the surrounding drainage network. This will be achieved using a combination of controls such as graded banks, designed channels and where necessary, water course reinforcement.

To avoid additional disturbance, the existing rehabilitation will remain unchanged, however, as the rehabilitation progresses, micro-relief will be incorporated into the new rehabilitation areas to better replicate and assimilate with the natural landscape in the area.

5.5 Detailed Mine Closure Planning

HVO South will commence the detailed mine closure planning process at least 5 years prior to the anticipated mine closure date (i.e. the planned cessation of mining). Based upon current approvals mining will continue until 2030.

The detailed mine closure plan will include:

- A review and finalisation of the final landform prior to the planned closure date with a detailed assessment of predicted water quality and void recharge undertaken as part of this process;
- Groundwater impact assessments associated with detailed planning for mine closure will be undertaken prior to planned closure of the mine to assist with refinement of the final landform to minimise long term impacts associated with mine closure;
- A social impact assessment will be undertaken leading up to the development of a detailed mine closure plan (e.g. within five years of life of mine);

- A detailed mine closure plan will be developed at least two years prior to the anticipated mine closure date. During the development of the mine closure plan, consultation will be undertaken with relevant government agencies and the local community; and
- A final void management plan will be developed and included in the mine closure plan. The final closure plan will be submitted to the appropriate regulatory agencies for approval two years prior to cessation of mining.

6.0 Rehabilitation Planning and Management

6.1 Scope

The scope of this MOP in terms of rehabilitation planning only covers those lands located within the MOP's disturbance area. The management of Biodiversity Areas will be undertaken under specific Offset Management Plans, and is excluded from the scope of this MOP.

6.2 Domain Selection

Primary domains can be defined as land management units within the mine site, usually with unique operational and functional purpose and therefore similar geophysical characteristics. Secondary domains are land management units characterised by a similar post mining land use objective.

It is likely that most domains will require a different rehabilitation methodology to achieve the intended post-mining land use. Domains for HVO have been determined in consideration of the specific requirements of the mining location and local environment. The key domains for HVO, as shown in **Map 2**, are outlined in **Table 20**.

Table 20 HVO South Primary and Secondary Domains

Primary Domains	Code	Secondary Domains	Code
Final Void	1	Final Void	A
Water Management Area	2	Water Management Area	B
Infrastructure Area	3	Rehabilitation Area – Pasture	C
Tailings Storage Facility	4	Rehabilitation Area – Woodland	D
Overburden Emplacements	5		

Further information on these domains and the key issues that pertain to their management is provided in the following sections.

6.2.1 Infrastructure Area

Existing and proposed infrastructure at HVO South are detailed in **Section 2.8**. HVO South contains two sets of surface facilities. There are currently no CPP or coal stockpile areas located within HVO South.

6.2.2 Tailing Storage Facility

Tailing Storage Facilities are dams or voids to which fine coal rejects from the CPP's are disposed of for settlement and decantation. There are currently seven tailings emplacements within the HVO South area all of which have been rehabilitated.

Refer to **Section 2.7.3.1** for further details.

6.2.3 Water Management Area

Water Management Areas include the network of dams that comprise the HVO water management system and that is in place to control the movement of water around the site. These include sedimentation, diversion, mine water and water supply dams but exclude tailings storage facilities.

6.2.4 Overburden Emplacements

Overburden is produced and disposed of within mined out sections of the open cut to create a final landform or designated out of pit emplacement areas. The placement of overburden occurs with the mine plans for the various HVO South pits. As part of the integration of operations at HVO, mining waste may be transported to any HVO pit for emplacement to achieve the final approved landform. Refer to **Section 2.7** for further details.

6.2.5 Final Void

A final void is the remnant open pit left at mine closure. The mining plan for HVO South will result in a single final void remaining in place at completion of mining in Riverview Pit. The surface area of the final void, when

measured at a natural surface level of approximately 70 mAHD, is approximately 512 ha. The low wall will have a gentle slope of less than or equal to 10 degrees to maximise the area of useable land. This useable area will gradually decrease as the evaporative basin develops within the void over time.

6.2.6 Rehabilitation Areas

The rehabilitation programme aims to focus on the progressive rehabilitation of pastures and woodlands on the major overburden emplacements. The rehabilitated lands are divided into:

- Rehabilitation Area – Pasture, restoration of native or introduced pasture crops; and
- Rehabilitation Area – Woodland, restoration of woodlands that provide potential habitat or vegetation corridors for resident or transient fauna populations in and around HVO.

Areas of HVO South rehabilitated to date include the following:

- The eastern extents of Cheshunt Pit;
- The northern extents of the Riverview Pit; and
- The northern extents of the Lemington South Pit.

6.3 Domain Rehabilitation Objectives

The rehabilitation objectives for the domains identified in **Section 6.2** are defined in **Table 21**.

Table 21 Domain Rehabilitation Objectives

Domain	Rehabilitation Objective
Primary Domains	
Final Void	<p>Final voids will be used for water storage post-mining. The objective is for the final voids to be safe, stable and non-polluting.</p> <p>So far as is reasonable and feasible, final voids will be designed and constructed to:</p> <ul style="list-style-type: none"> • minimise the size and depth of final voids; • maximise the useable land within the low wall; • minimise the drainage catchment of final voids; • minimise high wall instability risk; and • minimise risk of flood interaction for all flood events up to and including the Probable Maximum Flood.
Water Management Area	<p>The drainage pattern of the final landform will be designed to integrate with the surrounding catchments and will be revegetated to achieve long term stability and erosion control and will be integrated into the final landform and revegetation strategy.</p> <p>Water quality leaving site is to be in accordance with the EPL water quality criteria.</p> <p>The objective is for water management areas to be safe, stable and non-polluting.</p>
Infrastructure Area	<p>Mining infrastructure within the identified disturbance area will be removed if no longer required and the affected lands rehabilitated.</p> <p>The objective is for infrastructure areas to be safe, stable and non-polluting.</p>
Tailing Storage Facility	<p>Rehabilitated TSFs will be integrated into the final landform and revegetation strategy. Noting that where a woodland community will be established, species used will be shallow rooted (<600 mm root depth) to ensure cap integrity.</p> <p>The objective is for tailings storage facility areas to be safe, stable and non-polluting.</p>

Overburden Emplacement	Rehabilitated overburden emplacements will be undulating, free draining landforms. Final landform will be developed with recognition of the pre-mining landform features and will incorporate the existing rehabilitated landforms to ultimately be consistent with the surrounding landscape features. The objective is for the overburden emplacement areas to be safe, stable and non-polluting.
Secondary Domains	
Final Void	As per Primary Domain.
Water Management Area	As per Primary Domain.
Rehabilitation Area – Pasture	Return 50 -60-70% of disturbed mining areas to grazing land.
Rehabilitation Area – Woodland	Return 30-40- 50 % of disturbed mining areas to native woodland areas, but not necessarily conforming to any particular vegetation community. Establish native vegetation areas creating corridors to link surrounding native vegetation.

6.4 Performance Criteria, Measures and Indicators

The performance criteria, measures and associated indicators have been developed in accordance with the range of project related documentation i.e. EA (ERM, 2008), Director General's Report and the Project Approval. The performance or completion criteria are objective target levels or values that can be measured to quantitatively demonstrate the progress and ultimate success of a biophysical process. These criteria have been developed for each phase of the rehabilitation so that the rehabilitation success can be quantitatively tracked throughout the life of the mine.

The performance measures quantify the rehabilitation and land management programme in terms of efficiency or effectiveness and establish the indicative timeframes for completion. The performance indicators are used to define and evaluate the programme, typically in terms of making progress towards the development of sustainable ecosystems whilst also providing a framework for the implementation of key activities. These indicators provide the basis for the procedural context of the site work practices. The performance indicators are attributes of the biophysical environment e.g. pH, slope; that can be used to approximate the progression of a biophysical process and can be measured to demonstrate and track the progress of an aspect of rehabilitation towards a desired completion criteria (NSW Trade & Investment September 2013).

The criteria, measures and indicators which provide the framework for this MOP are underpinned by a range of documents which relate to land management. These include industry standards and ~~Hunter Valley Operations~~ HVO Procedures. The ongoing development of these documents will provide the basis for the review of this MOP with resultant amendments being recorded in documents such as the HVO Annual Review.

There is an element of risk attached to the development of completion or performance criteria, in that it is impossible to predict all of the variables that might influence the recovery or otherwise of those lands which are rehabilitated post mining. Many variables operate at catchment or regional scales, such as river flows and pest outbreaks. Other factors that operate at continental or even global scales, such as climatic influences (including droughts or floods brought about by La Niña and El Niño events), could significantly influence the long-term sustainability of the vegetated lands at HVO. To this end, the performance measures and associated indicators have been designed to provide an appropriate benchmark or guide against which to assess the management of project lands and the resulting improvements.

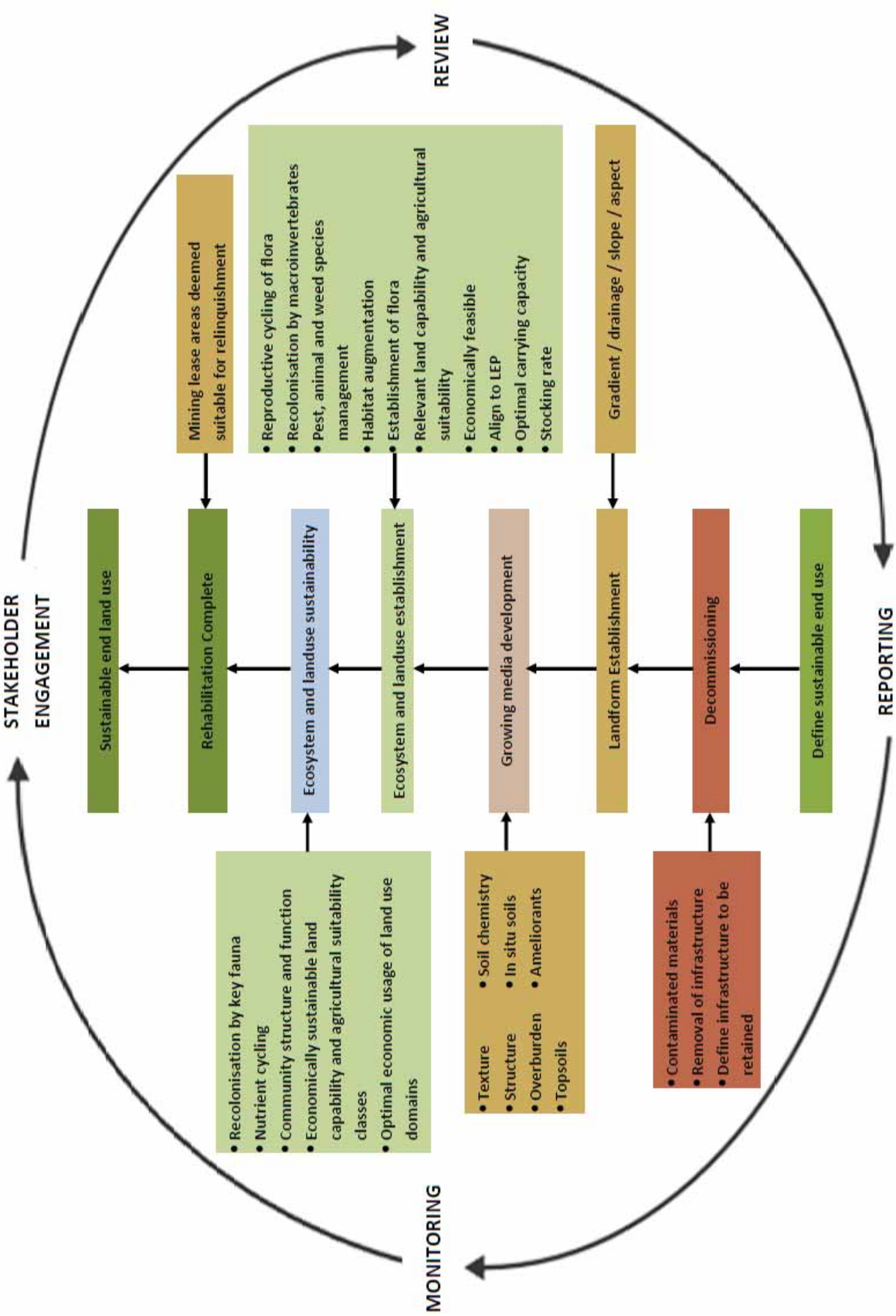
Woodland rehabilitation criteria associated with the 11 July 2018 to 30 July 2023 HVO South MOP were developed based upon monitoring within the Central Hunter Grey Box-Ironbark Woodland and Central Hunter Ironbark-Spotted Gum-Grey Box Forest Endangered Ecological Communities (EECs). The monitoring program was collectively established for HVO North, HVO South and Mount Thorley Warkworth mines, to reflect the requirement of HVO North and Mount Thorley Warkworth to rehabilitate 2,118 ha to a vegetation community consistent with the EECs. This is not a requirement of the HVO South consent, accordingly new woodland rehabilitation criteria need to be established for HVO South. In 2019 HVO South will implement a new rehabilitation monitoring program that will capture data for suitable reference sites in a commensurate woodland vegetation community. The woodland rehabilitation criteria outlined within this MOP will continue to be refined during the MOP term as suitable data becomes available (refer **Sections 6.5.1 – 6.5.5**). Additional detail regarding the proposed rehabilitation monitoring program is provided in **Section 8**.

6.5 Rehabilitation Phases

The ultimate rehabilitation objective for HVO South is the development of sustainable ecosystems across the site and in connection with the surrounding landscape. This will be achieved through a series of conceptual stages which are shown diagrammatically in **Figure 1** and described as:

- Stage 1 – Decommissioning – removal of hard stand areas, buildings, contaminated materials, hazardous materials;
- Stage 2 – Landform Establishment – incorporates gradient, slope, aspect, drainage, substrate material characterisation and morphology;
- Stage 3 – Growing Media Development – incorporates physical, chemical and biological components of the growing media and ameliorants that are using to optimise the potential of the media in terms of the preferred vegetative cover;
- Stage 4 – Ecosystem and Land Use Establishment – incorporates revegetated lands and habitat augmentation; species selection, species presence and growth together with weed and pest animal control / management and establishment of flora;
- Stage 5 – Ecosystem and Land Use Sustainability – incorporates components of floristic structure, nutrient cycling recruitment and recovery, community structure and function which are the key elements of a sustainable landscape; and
- Stage 6 – Rehabilitation Complete – land use and landscape is deemed as suitable to be relinquished from the Mining Lease.

Figure 1 Conceptual Stages of Sustainable Ecosystem Development



6.5.1 Decommissioning

In the context of this MOP, decommissioning is the formal process to remove some facet of the mining operation from its active status. The objectives, performance indicators and criteria together with the justification source for this data as it relates to the decommissioning stage are provided in **Table 22**.

It should be noted that this phase will particularly apply to those domains where the risk of hazardous materials may exist and as such may not apply to some of the domains.

Table 22 Decommissioning

Domain Objective	Performance Indicator	Completion Criteria	Justification / Source	Complete (Yes/No)	TARP Element	Progress at Start of MOP
All Domains						
Final landforms are safe, stable, non-polluting and free-draining	Landform Stability	Any final void and associated highwall has been assessed by a qualified geotechnical engineer to validate that it is stable and does not pose any safety risk.	This MOP. Consistent with other Glencore operations.	No	Yes	Not commenced
	Site Security	Potential hazards (i.e. electrical, mechanical etc.) have been effectively isolated The structural integrity of the infrastructure has been inspected by a suitable qualified engineer and determined to be suitable and safe as part of the intended final land use		No	N/A	Not commenced
Public Safety	Site Security	A public safety risk assessment to be completed with all identified actions implemented and closed out. Appropriate security measures (e.g. adequate fencing) has been implemented (where required) prior to commencing decommissioning and demolition works		No	N/A	Not commenced
Infrastructure						
All infrastructure that is not to be utilised as part of the future intended land use is removed to make the site safe and free of hazardous materials.	Removal of infrastructure	Removal of infrastructure at closure unless there is a written agreement with the DPE or RR for infrastructure to remain in situ.	This MOP. Consistent with other Glencore operations.	No	N/A	Not commenced
		All surface infrastructure, including offices and workshops, and services which do not have a potential future use associated with any post mining land use will be removed, unless such removal has a greater environmental impact than rehabilitating the area with the infrastructure remaining in place.		No	N/A	Not commenced
	Demolition of infrastructure	All demolition work has been carried out in accordance with AS2601-2001: The Demolition of Structures or its latest version.	PA 06_0261 Schedule 2, Condition 11	No	N/A	Not commenced

Domain Objective	Performance Indicator	Completion Criteria	Justification / Source	Complete (Yes/No)	TARP Element	Progress at Start of MOP
	Disconnect Services	All site services have been removed (electricity, telecommunications etc.). Where services are buried (i.e. pipelines, cables etc.) and their retrieval may lead to further disturbance, the infrastructure may be left in situ provided that they don't pose constraints to the post mining land use. In this situation, the location of the services will be surveyed and marked on the record tracings and a suitable caveat developed to provide that they are readily identifiable for future land holders.	This MOP. Consistent with other Glencore Operations.	No	N/A	Not commenced
	Removal of exploration infrastructure	All drill holes, excavations, and groundwater monitoring bores are decommissioned and sealed in accordance with RR requirements, excluding those being retained for monitoring purposes.	ESG5: Assessment Requirements for Exploration Activities	No	N/A	Not commenced
	Hazardous materials	Hazardous materials are identified and removed from site including hydrocarbons, chemicals, explosive products, asbestos containing materials (ACMs), lead paints, synthetic mineral fibres (SMFs) and polychlorinated biphenyls (PCBs) (verified by Certificates of disposal).	This MOP. Consistent with other Glencore Operations.	No	N/A	Not commenced
All infrastructure that is to remain as part of the future land use is safe and does not pose any hazard to the community.	Remaining infrastructure safe and suitable	The structural integrity of the infrastructure has been inspected by a suitably qualified engineer and determined to be suitable and safe as part of the intended final land use.		No	N/A	Not commenced
		Appropriate security measures have been implemented to minimise the potential for unauthorised access during the period that the site is transitioned to the intended final land use.		No	N/A	Not commenced
		All potential hazards (i.e. electrical, mechanical etc.) have been effectively isolated.		No	N/A	Not commenced
There is no residual soil contamination on site that is incompatible with intended land use or that poses a threat of environmental harm.	Remediation of contaminated soils.	All contaminated soils removed from site or remediated to acceptable contamination levels.		No	N/A	Ongoing
	Carbonaceous Material	Where practical, exposed carbonaceous material will be removed and co-disposed within the mining voids or suitably capped <i>in situ</i> .		No	N/A	Ongoing

Domain Objective	Performance Indicator	Completion Criteria	Justification / Source	Complete (Yes/No)	TARP Element	Progress at Start of MOP
There is no residual soil contamination on site that is incompatible with intended land use or that poses a threat of environmental harm.	Removal of hazardous materials	Contamination will be appropriately remediated so that appropriate guidelines for land use are met, e.g. Health Investigation Level of the National Environment Protection (Assessment of Site Contamination) Measure (1999).	This MOP . Consistent with other Glencore Operations.	No	N/A	Ongoing
Active Mining						
Public safety is maintained	Public safety	A safety berm and/or security fence is constructed at the void crest (highwalls and endwalls) that provides an adequate engineered barrier for vehicles.	This MOP. Consistent with other Glencore Operations.	No	N/A	Yes
Final voids will be constructed in accordance with an approved Final Void Management Plan	Final Void Management Plan	A <i>Final Void Management Plan</i> and Final Void Design has been developed in consultation with stakeholders and approved by the RR (or contemporary equivalent) at least 5 years prior to closure.		No	N/A	Not commenced
	Exposed Coal Seams	Exposed coal seams will be capped with at least 3 m benign material where required to prevent spontaneous combustion, supported by survey.		No	N/A	Ongoing
Overburden Emplacement Area						
No proposed decommissioning activities within this domain.						
Tailings Disposal Facility						
All tailings pumping infrastructure will be decommissioned and removed.	Tailings infrastructure	All tailings infrastructure (pipelines, pumps and related infrastructure) is decommissioned and removed.	This MOP. Consistent with other Glencore Operations.	No	N/A	Not commenced
	Tailings Storage Facility Capping Design	A Detailed Tailings Capping Design has been developed and approved by the RR (or contemporary equivalent) prior to closure.		No	N/A	Not commenced
Water Management Area						
Mine water dams and sediment dams are dewatered and desilted prior to being converted to clean water farm dams.	Pumping Infrastructure	All pumps and associated infrastructure is decommissioned and removed from site.	This MOP. Consistent with other Glencore Operations.	No	N/A	Ongoing
	Removal of hazardous materials	All dams, drains and banks not required in the final landform have been demolished and accumulated sediment removed and disposed in the final void.		No	N/A	Ongoing
	Obsolete water management structures	All dams, drains and banks not required in the final landform have been demolished and accumulated sediment removed and disposed in the final void.		No	N/A	Ongoing

Domain Objective	Performance Indicator	Completion Criteria	Justification / Source	Complete (Yes/No)	TARP Element	Progress at Start of MOP
	Removal of excess sediment.	Removal of excess sediment from the surface dams for future use by the subsequent land owner or alternatively filling the dams if they are no longer required.	Mine Rehabilitation Handbook (Australian Mining Industry Council 1990) Mine Rehabilitation (Hannan 1995)	No	N/A	Ongoing
Rehabilitation Pasture						
No proposed decommissioning activities within this domain.						
Rehabilitation Woodland						
No proposed decommissioning activities within this domain.						
Offset Areas						
No proposed decommissioning activities within this domain.						

Objective	Performance Indicator	Performance Criteria	Justification/ Source	Link to TARP	Progress at Start of MOP
Infrastructure Areas					
Mining infrastructure within the identified disturbance area will be removed if no longer required and the affected lands rehabilitated. The objective is for the infrastructure areas to be safe, stable and non-polluting.	Removal of infrastructure	All buildings, fixed plant and other infrastructure that is not required as part of the post closure land use will be demolished and removed from the site.	HVO Mining Operations Plan HVO Contaminated Sites Management Work Instruction		Still in use
	Disconnect and terminate services	All redundant services disconnected and terminated.			Still in use
	Remediation of contaminated soils.	All contaminated soils removed from site or remediated to acceptable contamination levels.			Ongoing
Tailing Storage Facility					
The objective is for the tailings storage facility areas to be safe, stable and non-polluting.	Removal of pipelines and pumps and related tailings infrastructure.	All pipelines and pumps and related tailings infrastructure removed from the site.	HVO Mining Operations Plan HVO Contaminated Sites Management	Item 7	Still in use
	Remediation of contaminated	All contaminated soils removed from site			Ongoing

Objective	Performance Indicator	Performance Criteria	Justification/ Source	Link to TARP	Progress at Start of MOP	
	soils.	or remediated to acceptable contamination levels.	Work Instruction			
Water Management Area						
The drainage pattern of the final landform will be designed to integrate with the surrounding catchments and will be revegetated to achieve long term stability and erosion control and will be integrated into the final landform and revegetation strategy. Water quality leaving site to be in accordance with the EPL water quality criteria. The objective is for the water management areas to be safe, stable and non-polluting.	Removal of excess sediment.	Removal of excess sediment from the surface dams for future use by the subsequent land owner or alternatively filling the dams if they are no longer required.	Hunter Valley Operations Water Management Plan	Item 4	Not yet required	
	Dam reshaping as required.	Re-shaping dams (where required) in accordance with their intended use, this may involve re-sizing, facilitating cattle access or reshaping to enhance habitat functionality for specific fauna species.				
	Retained water management.	Where dams are to be retained, design drainage structures to capture runoff from sufficient catchment area so that the dam can be utilised for its intended use.				
	Erosion and sediment controls installed	The installation of appropriate sediment and erosion control measures.			Ongoing	
Final Void						
The objective is for the final voids to be safe, stable and non-polluting.	Removal of pipelines and pumps and related pit infrastructure.	All pipelines and pumps and related pit infrastructure removed from the site.	HVO Mining Operations Plan HVO Contaminated Sites Management Work Instruction	Item 4	Not yet required	
	Remediation of contaminated soils.	All contaminated soils removed from site or remediated to acceptable contamination levels.				

6.5.2 Landform Establishment

In the context of this MOP, Landform Establishment are the processes involved to achieve stable landforms including slopes, erosion controls, and drainage lines with integrated landscape features, which are compatible with surrounding landforms, whilst ensuring that the rehabilitated areas of native vegetation link with undisturbed native vegetation.

The objectives, performance indicators and criteria, together with the justification source which describe structures and method for this data, as they relate to the Landform Establishment Stage, are provided in **Table 23** and address:

- Stabilising landforms;
- Minimising erosion;
- Preventing water pollution;
- Preventing access to open pits or other hazardous locations;
- Enhancing visual amenity; and
- Site user, stock and fauna safety.

The final landform and rehabilitation domain types for HVO during the life of the MOP are shown on **Map 4**.

Table 23 Landform Establishment

Domain Objective	Performance Indicator	Completion Criteria	Justification / Source	Complete (Yes/No)	TARP Element	Progress at Start of MOP
All Primary Domains						
Landform suitable for final land use and compatible with surrounding landscape as sustainable native ecosystem.	Slopes	Landform is generally compatible within the context of the local topography. Overburden emplacement external slopes will generally be reggraded to less than 10°. Internal slopes may be steepened to grades up to 18°. “Note, localised steepening of slopes will occur due to contour bank construction etc.” Avoidance of straight lines and angular corners in profiles of final landforms. Class IV and V lands have slopes of <20%. Avoidance of straight lines and angular corners in profiles of final landforms.	Previous HVO South MOP	No	Yes	Ongoing
	As built survey	Landform survey verifies constructed landform is generally in accordance with the approved landform design, including heights detailed in the EIS.	This MOP. Consistent with other Glencore Operations.	No	N/A	Ongoing
	Erosion	There is no evidence of slumping or uncontrolled erosion that would cause a safety issue or compromise the land capability.		No	Yes	Ongoing
	Stability	Monitoring verifies there are no gully or tunnel erosion features, or rill erosion >300 mm deep; as supported by site record form and monitoring.		No	Yes	Ongoing
		Drainage structures (including drainage lines established in the final landform) are stable and there is no evidence of overtopping or significant scouring as a result of runoff. Landforms are assessed to be geotechnically stable and free draining to local watercourses.		No	Yes	Ongoing
Infrastructure						
All hazardous and/or contaminated materials will be removed or remediated in-situ such that the land is suitable for the intended post mining land use.	Carbonaceous Material	ROM and product stockpiles coal bedding layers are capped with inert material and shaped to a free draining landform.	This MOP. Consistent with other Glencore Operations.	No	N/A	Ongoing
Active Mining						

Domain Objective	Performance Indicator	Completion Criteria	Justification / Source	Complete (Yes/No)	TARP Element	Progress at Start of MOP
Final landforms are safe, stable, non-polluting and free-draining.	Exposed coal seams will be covered	Exposed coal seams will be covered with five metres of inert materials to prevent spontaneous combustion where practical.	Mine Rehabilitation (Hannan 1995)	No	N/A	Ongoing
	Safety	Any final void and associated highwall has been assessed by a qualified geotechnical engineer to validate that it is stable and does not pose a safety risk.		No	N/A	Ongoing
Overburden Emplacement Area						
Overburden areas are geotechnically stable and blend in with the surrounding landscape	Inert Capping	Net acid generating and carbonaceous materials will be capped by a minimum of 5 m of benign material where practical.	This MOP. Consistent with other Glencore Operations.	No	Yes	Ongoing
	Final Landform Survey	Final landform survey is generally in accordance with the approved final landform design.		No	Yes	Ongoing
		Undulating Profiles	Newly established overburden emplacements will be shaped to include informal undulations, supported by survey.	This MOP. Consistent with other Glencore Operations.	No	N/A
Tailings Disposal Facility						
Final landforms are safe, stable, non-polluting and free-draining.	TSF capping design to allow for settlement of tailings surface to occur. TSF design and management to allow for initial overfilling of the covering material to compensate for expected settlement.	TSF capping design to allow for settlement of tailings surface. Capping thickness to be >2m, or as per design by expert tailings consultant.	Previous HVO South MOP Schedule 3, High Risk Activities, Part 5, Clause 27 Emplacement Areas. <i>Work Health and Safety (Mines and Petroleum Sites) Regulations 2014</i>	Yes	Yes	All TSFs within HVO South have been capped and rehabilitated

Domain Objective	Performance Indicator	Completion Criteria	Justification / Source	Complete (Yes/No)	TARP Element	Progress at Start of MOP
	Free Draining	Capped tailings storage facilities are confirmed by survey to be free draining following the expected settlement period.	Part 2 Division 4 Subdivision 1 Clause 33 (Notification of High Risk Activities) <i>Work Health and Safety (Mines and Petroleum Sites) Regulations 2014</i>	No	Yes	Ongoing
	Spontaneous Combustion	Monitoring records verify that there is no evidence of spontaneous combustion.	This MOP. Consistent with other Glencore Operations.	No	N/A	Ongoing
	AMD	Capped tailings monitoring and analysis indicates there is no evidence of AMD generation outside of the facility or exposed material, as indicated by triggers set in the monitoring program.		No	N/A	Ongoing
	Water Management Area					
Final landform drainage will integrate with surrounding catchments and will achieve long term geomorphic stability and minimise erosion.	Final landform drainage design	Final landform drainage structures including drains, banks, drop structures and dams have been designed and constructed in accordance with an approved detailed drainage design and the Blue Book.	Blue Book, relevant engineering design standards and site specific requirements.	No	Yes	Ongoing
	Geomorphic stability	Monitoring verifies that drainage structures stable with no active gully heads, tunnel erosion or bank failure.		No	Yes	Ongoing
			Creek Diversions are assessed to be 'stable' as defined by the CSIRO Ephemeral Stream Assessment.	CSIRO 2008	No	Yes
Rehabilitation Pasture						
Pasture rehabilitation areas will be capable of sustainable grazing.	Surface rock density	Rehabilitation records verify that surface spoils and soils are rock raked (where required) to remove rocks and produce a friable surface.	This MOP. Consistent with other Glencore Operations.	No	N/A	Ongoing

- Note: all designs for water management areas will be undertaken with consideration of the standards outlined in Table 6.1 in DECC (2008) Managing Urban Stormwater, Soil and Construction. Volume 2E: Mines and Quarries.

Objective	Performance Indicator	Performance Criteria	Justification / Source	Link to TARP	Progress at Start of MOP
Infrastructure Area, Water Management Area, Overburden Emplacement *					
The final landforms, batter slopes, drainage and benching will be designed to ensure the long term stability of the landform.	Sedimentation dams installed.	Sedimentation dams are incorporated into the final landform to collect runoff from rehabilitated areas and the dam capacity is designed to allow time for suspended sediment to settle out.	HVO-10 EWI site—E9— 019 work instruction HVO-10 EWI site—E2— 011 work instruction		Not yet required
	Soils for landform construction will be geochemically stable.	Geochemically stable soils will be utilised for the construction of final landforms and drainage pathways.		TARP Item 6	Ongoing
	Drainage paths and contour drains installed.	Drainage paths and contour drains to be constructed to suitable design standard (see Note).		TARP Item 1	Ongoing
	Minimisation of constructed slopes greater than 10 degrees—low walls, ramps and drainage structures.	Landform is generally compatible within the context of the local topography. The landform is to be shaped to ensure overall slopes are 10 degrees or less unless otherwise agreed. Avoidance of straight lines and angular corners in profiles of final landforms. Approvals in place for slopes >18 degrees.		TARP Item 2, 3 and 4	Ongoing
Minimise risk of spontaneous combustion.	Minimise risk of spontaneous combustion.	Absence of carbonaceous material on the surface of the rehabilitation and no active spontaneous combustion areas.		TARP Item 8 and 9	Ongoing
Final Void					
The final landforms, batter slopes, drainage and benching will be designed to ensure the long term stability of the	Exposed coal seams will be covered	Exposed coal seams will be covered with five metres of inert materials to prevent spontaneous combustion where practical.	HVO-10 EWI site—E2— 011 work instruction	TARP Item 8	Not yet required

Objective	Performance Indicator	Performance Criteria	Justification / Source	Link to TARP	Progress at Start of MOP
landform.	Long term stability of final void batter slopes.	The final void batter slopes and benching will be designed to ensure the long term stability of the landform.		TARP Item 4	Not yet required
Overburden Emplacement					
Encapsulation	Problematic materials will be capped.	Net acid generating materials and coarse rejects will be disposed amongst non-carbonaceous overburden materials and covered with 5 metres of inert materials.	HVO-10 EWI site—E3—024 work instruction HVO-10 EWI site—E8—009 work instruction	TARP Item 9	Ongoing
Surface rocks	Surface rock removed from rehabilitated land surface	Rocks > 200mm are removed from the surface of rehabilitated lands.	HVO-10 EWI site—E9—007 work instruction		Ongoing
Tailings Storage Facility					
Operation of TSF.	Tailings storage facilities are capped with overburden and rehabilitated after consolidation of tailings.	Decommissioning and capping of tailings storage facilities in accordance with approval granted under the <i>Work Health and Safety (Mines and Petroleum Sites) Act 2013</i>	HVO-10 EWI site—E8—009 work instruction	TARP item 5	All TSFs within HVO South have been capped and rehabilitated
The potential subsidence of materials deposited into the TSF will also be taken into account when designing the final landform.	TSF capping design to allow for settlement of tailings surface to occur. TSF design and management to allow for initial overfilling of the covering material to compensate for expected settlement.	TSF capping design to allow for settlement of tailings surface. Capping thickness to be >2m, or as per design by expert tailings consultant.		TARP Item 5	All TSFs within HVO South have been capped and rehabilitated

6.5.3 Growing Media Development

In the context of this MOP Growing Media Development incorporates the processes involved to achieve a soil which is capable of supporting a sustainable plant community. It includes consideration of the chemical, physical and biological properties of the media and takes into account issues such as the specialist requirements, e.g. soil ameliorants aligned to the revegetation of the disturbed areas, whilst also incorporating consideration of land use that may deviate from the traditional post mining land use.

The criteria, performance measures and indicators together with the justification source which describe structures and method for this data as relate to the growing media development stage is provided in **Table 24**.

Overburden Characterisation

At HVO South, overburden material varies in physical and geochemical properties, in accordance with the geology of the area and the extent of exposure to weathering.

Chemical analyses of HVO spoil materials indicate that, in general, the overburden is slightly sodic and alkaline, but within acceptable ranges for use as a plant growth medium.

Soil Types and Suitability

Data derived from previous environmental assessments demonstrates the suitability of the soils at HVO South in terms of the suitability of these soils for use as top dressing and the stripping depth. Topsoil suitability for use as topsoil dressing and the stripping depth are discussed in **Section 2.4.2**.

Industry experience gained from the use of topsoil derived from pasture and returning to native plant communities has demonstrated the potential for these soils to incur land management issues such as erosion and weed incursions. To address these issues the areas returning to native plant communities will include “enhanced growing media”, the basis being overburden and appropriate ameliorants i.e. organic fertilisers, gypsum and organic matter.

Soil management is fundamental in successful rehabilitation management at HVO South. The key objectives for managing the soil landscape (in context of vegetative cover and soil stability) include:

- Minimising bare soil patches, which would be affected by wind and water movement and the introduction and transportation of resources into and out of the system; and
- Favourable nutrient, infiltration and stability characteristics.

Table 24 Growing Media Development

Domain Objective	Performance Indicator	Completion Criteria	Justification / Source	Complete (Yes/No)	TARP Element	Progress at Start of MOP
All Domains						
Growing media is capable of supporting sustainable vegetation growth	Growing media development	The rehabilitation surface is a suitable growing medium Soil pH to be in the range of analogue sites Monitoring demonstrates soil profile development in rehabilitated areas (e.g. development of organic layer, litter layer)	This MOP. Consistent with other Glencore Operations.	No	TARP item 11	Ongoing
Erosion is minimised	Temporary ESC	Rehabilitation records verify that temporary ESCs are installed prior to topsoil re-spreading. Rehabilitation records verify that topsoiled rehabilitation areas are sown with either the approved pasture mix or a non-persistent cover crop promptly following topsoil spreading.	Blue Book	No	TARP item 1	Ongoing
All Secondary Domains						
Growing media appropriate for the intended final land use is reinstated at all rehabilitation areas.	Topsoil depth	Topsoil or a suitable alternative has been spread uniformly at the depth of 100mm; as supported by site record form/site GIS.	This MOP. Consistent with other Glencore Operations.	No	TARP item 11	Ongoing
	Topsoil characterisation	Topsoil's and topsoil substitutes have been tested to assess suitability for post mining land use		No	TARP item 10	Ongoing
	Amelioration	Rehabilitation records verify that appropriate soil ameliorants (e.g. gypsum, fertilisers, mulch) have been applied (where required) in accordance with specifications.		No	TARP item 11	Ongoing
	Temporary ESC	Rehabilitation records verify that temporary ESCs are installed prior to topsoil re-spreading.		No	N/A	Ongoing
Erosion is minimised						

Objective	Performance Indicator	Performance Criteria	Justification / Source	Link to TARP	Progress-at start of MOP
Rehabilitation Areas					
Soil properties suitable for the establishment and maintenance of selected	pH of replaced topsoil to be broadly within the range suitable for targeted species growth.	Pasture – pH >5.5 and <8.5 Woodland – pH >6.5 and <8.5	HVO-10-EWI site – E9-007 work instruction Hunter Valley Operations	TARP Item 10	Ongoing

Objective	Performance Indicator	Performance Criteria	Justification / Source	Link to TARP	Progress at start of MOP
vegetation species:- — Returning 60-70% of disturbed mining areas to grazing land; — Returning 30 to 40% of disturbed mining areas to native woodland, but not necessarily conforming to any particular vegetation community.	Electrical Conductivity of replaced topsoil to be broadly within the range suitable for plant growth.	Pasture—Electrical Conductivity <2 dS/m Woodland—Electrical Conductivity <2 dS/m	Water Management Plan	TARP Item 10	Ongoing
	Runoff water quality to be broadly trending towards less than 1,000µS/cm after 5 years.	Runoff water quality less than 1,000µS/cm after 5 years.			Ongoing
	Soil Phosphorous levels (Colwell) to be trending towards the range suitable for plant growth.	Pasture—Phosphorous >40ppm Woodland—Phosphorous within levels in analogue sites by Year 5 Target: 1.2 to 13.0ppm		TARP Item 10	Ongoing
	Organic carbon levels are typical of that of the surrounding landscape, increasing or fall within desirable ranges provided by the agricultural industry.	Pasture—Organic Carbon >1.5% Woodland—Organic Carbon within levels in analogue sites by Year 5 Target: 1.6 to 8.7%		TARP Item 10	Ongoing
	Cation Exchange Capacity is typical of that of the surrounding landscape or fall within desirable ranges provided by the agricultural industry.	Pasture—Cation Exchange Capacity >12 Cmol+/kg Woodland—Cation Exchange Capacity within levels in analogue sites by Year 2 Target: 7.4 to 20.4 Cmol+/kg		TARP Item 10	Ongoing
	Exchangeable Sodium Percentage (a measure of sodicity) is typical of that of the surrounding landscape or fall within desirable ranges provided by the agricultural industry.	Pasture—Exchangeable Sodium Percentage <10% Woodland—Exchangeable Sodium Percentage within levels in analogue sites by Year 2 Target: 0.2 to 8.7%		TARP Item 10	Ongoing
	Calcium/Magnesium ratio is typical of that of the surrounding landscape or fall within desirable ranges provided by the agricultural industry.	Pasture—Calcium/magnesium ratio >1 and <10 Woodland—Calcium/magnesium ratio within levels in analogue sites by Year 2 Target: 0.7 to 2.1		TARP Item 10	Ongoing

Objective	Performance Indicator	Performance Criteria	Justification / Source	Link to TARP	Progress at start of MOP
	Topsoil is spread appropriately in a way that will ensure optimum ecosystem establishment.	Topsoil is re-spread directly onto reshaped landforms where possible. Topsoil is spread to an average depth of 10 cm. The location of areas where topsoil is respread is recorded on the site GIS.	HVO-10-EWI site—E9—007 work instruction	TARP Item 11	Ongoing
	Ameliorants applied appropriately in a way that will ensure optimum ecosystem establishment.	Soil ameliorants such as gypsum, wood and hay mulch, biosolids, municipal waste composts and other organic wastes are utilised based on soil testing and Waste Regulation 1996 guidelines. Soil ameliorants are incorporated into the growth medium. The location of areas where soil ameliorants are used is recorded on the site GIS.		TARP Item 11	Ongoing

6.5.4 Ecosystem and Land Use Establishment

In the context of the current MOP for HVO South, Ecosystem and Land Use Establishment incorporates the requirements for:

- The management and control of fire, weed and vertebrate pest species;
- Correct flora species selection in terms of the revegetation programmes;
- The development of systems to enhance opportunities for nutrient cycling;
- Development and enhancement of habitat for key fauna species; and
- The optimal use of onsite resources, e.g. woody debris, rock, mulch.

Rehabilitation at HVO South is generally divided into areas for biodiversity outcomes and areas of pasture. The framework for the development of the objectives, performance indicators and criteria for ecosystem and land use establishment are provided in **Table 25**. Monitoring information from analogue sites has been used to inform the target setting process for performance criteria in **Table 25**.

Table 25 Ecosystem and Land Use Establishment

Domain Objective	Performance Indicator	Completion Criteria	Justification / Source	Complete (Yes/No)	TARP Element	Progress at Start of MOP
All Domains (excluding Final Void and Water Management Area)						
Weeds and feral animal species do not present a risk to rehabilitation.	Weed presence	Monitoring verifies there are no significant weed infestations.	This MOP. Consistent with other Glencore Operations.	No	Yes	Ongoing
		Records indicate that noxious weeds are controlled in accordance with legislation and the MOP.		No	Yes	Ongoing
	Feral animal density	Records indicate that feral animal pests are controlled in accordance with legislation and the MOP.		No	N/A	Ongoing
Vegetation is managed to control fire for the establishment and maintenance of selected vegetation species.	Vegetation is managed to control fire.	Actions are implemented as per the <i>Bushfire Management Plan</i> .	<i>HVO Bushfire Management Plan Rural Fires Act 1997</i>	No	Yes	Ongoing
Soil fertility and soil structure is comparable between rehabilitation areas and reference sites	EC	Testing verifies that EC of surface soils is below 1,000 mS/cm at Year 5.	Tongway & Hindley 1996	No	N/A	Ongoing
	Nutrients	Nitrogen, potassium and phosphorus are within 20% of analogue sites at Year 5.		No	N/A	Ongoing
	Soil carbon	Testing indicates that organic carbon levels are broadly trending toward 20% of levels at reference sites at Year 5.		No	N/A	Ongoing
Water Management Area						
Final landform drainage will integrate with surrounding catchments, achieve long term geomorphic stability and minimise erosion.	Discharge water quality	Records indicate that discharge water quality meets EPL requirements.	EPL	No	Yes	Ongoing
Rehabilitation Pasture						
Revegetation is progressing towards being sustainable in the long term.	Approximately 60-70% of mined land re-established as stable, productive pasture areas.	60-70% of disturbed mining areas returned to productive pasture areas.	Hunter Valley Operations South Coal Project Environmental Assessment Report (2008)	No	N/A	Ongoing
	Species suitable for agricultural land use.	Species used are compatible with agricultural outcomes.		No	N/A	Ongoing

Domain Objective	Performance Indicator	Completion Criteria	Justification / Source	Complete (Yes/No)	TARP Element	Progress at Start of MOP
	Land capability.	The site productivity, based on Potential Carrying Capacity, is comparable to that of analogue sites (Dry Sheep Equivalent).		No	N/A	Ongoing
Rehabilitation Woodland						
Establishment and germination of selected vegetation species: <ul style="list-style-type: none"> Approximately 60-70% of mined land re-established as stable, productive pasture areas; and Approximately 30-40% of mined land re-established as woodland areas. Revegetation is progressing towards being sustainable in the long term.	The vegetation is developing in structure and complexity comparable to that of the local remnant vegetation.	LFA Stability Index is comparable to or trending towards that of analogue sites (%).	Ecosystem Function Analysis (EFA) (Tongway 2004).	No	N/A	Ongoing
	Nesting structures (mammal and avian)	The Landscape Organisation Index is comparable to that of reference sites.	Rehabilitation Monitoring – Grasslands/Pasture Lands (AECOM 2015)	No	N/A	Ongoing
	Coarse Woody Debris and rocks	Species specific habitat and/or nesting features are incorporated where relevant in areas across the site.		No	N/A	Ongoing
	Approximately 30-40% of mined land re-established as woodland areas.	Coarse woody debris and / or rocks are placed to optimise inter connectivity across the landscape.		No	N/A	Ongoing
	Approximately 30-40% of mined land re-established as woodland areas.	Approximately 30-40% of mined land re-established as woodland areas.	Hunter Valley Operations South Coal Project Environmental Assessment Report (2008) This MOP.	No	N/A	Ongoing
	Species diversity	The number of tree species comprising the vegetation community is comparable to that of analogue sites (no. species/area).	Consistent with other Glencore Operations.	No	N/A	Ongoing
	Tree density	The number of grass species comprising the vegetation community is comparable to that of analogue sites (no. species/area).		No	N/A	Ongoing
	Species suitable for agricultural or native biodiversity land use.	The density of trees is comparable to that of analogue sites (no./area).		No	N/A	Ongoing
		Species used are compatible with native biodiversity conservation outcomes.		No	N/A	Ongoing

Objective	Performance Indicator	Performance Criteria	Justification/Source	Link to TARP	Status at start of MOP
All Domains					
Weeds are controlled to appropriate levels for the establishment and maintenance of selected vegetation species: — Returning 50-60% of disturbed mining areas to grazing land; — Returning 40 to 50% of disturbed mining areas to native woodland, but not necessarily conforming to any particular vegetation community.	Weeds are controlled to appropriate levels.	The amount of weeds present is comparable to reference sites of baseline survey.	HVO-10-EWI site—E9—007 work instruction	TARP Item 12	Ongoing
	Annual weed inspection.	Annual inspections of Mine lands are undertaken to identify areas requiring the implementation of weed management measures.	Biosecurity Act 2015 Australian and NSW Weed Strategies Biodiversity Conservation Act 2016—Key Threatening Processes	TARP Item 12	Ongoing
	Implementation of weed management measures.	Implementation of appropriate weed management measures which may include mechanical removal, application of approved herbicides and biological control.		TARP Item 12	Ongoing
	Weed control area records.	Recording of areas where weed control has been conducted in a GIS database which is regularly maintained.			Ongoing
	Assessment of weed control effectiveness through follow-up inspections.	Follow-up inspections to assess the effectiveness of the weed management measures implemented and the requirement for any additional management measures.		TARP Item 12	Ongoing
Pest animal control for any declared pest animal species known on the project lands to provide additional habitat for threatened species.	Pest animal control undertaken for any declared pest animal species known on the project lands.	Mandatory pest control for any declared pests known to occur on Mine owned land.	HVO-10-EWI Site E9-021 Local Land Services Act 2013 Biodiversity Conservation Act 2016	TARP Item 22	Ongoing
	Use of appropriate pest control measures.	Use of a range of appropriate pest control measures as determined (e.g. the destruction of habitat, trapping, targeted shooting programmes and baiting).		TARP Item 22	Ongoing

Objective	Performance Indicator	Performance Criteria	Justification/Source	Link to TARP	Status at start of MOP
	Assessment of pest animal control effectiveness through follow-up inspections.	Follow-up inspections to assess the effectiveness of control measures implemented and the requirement for any additional control measures.		TARP Item 22	Ongoing
Vegetation is managed to control fire for the establishment and maintenance of selected vegetation species: — Returning 50-60% of disturbed mining areas to grazing land; — Returning 40 to 50% of disturbed mining areas to native woodland, but not necessarily conforming to any particular vegetation community.	Vegetation is managed to control fire.	Implementation of actions as per the Bushfire Management Plan.	HVO Bushfire Management Plan <i>Rural Fires Act 1997</i>	TARP Item 13	Ongoing
Rehabilitation Area					
Establishment and germination of selected vegetation species: — Returning 50-60% of disturbed mining areas to grazing land; — Returning 40 to 50% of disturbed mining areas to native woodland, but not necessarily conforming to any particular vegetation	Appropriate provenance rules and planting methods for tube stock planting	Woodland/grassland seed and tubestock supply will preferentially be of local provenance. Seed and tubestock supplied from outside sources will be preferentially of Hunter provenance or from an area within NSW of similar climatic conditions to the Singleton area or as research defines. Tubestock is to be watered the day before and immediately prior to planting. Seedlings are hardened off before they are planted.	HVO-10-EWI-Site-E9-007 HVO-10-EWI-Site-E9-021 HVO South Modification 5 Environmental Assessment 2017 CSIRO Methodology for Ecosystem Function Analysis (EFA) (Tongway, 2004).		Ongoing
	Revegetation works	Warm season grasses are seeded late			Ongoing

Objective	Performance Indicator	Performance Criteria	Justification/Source	Link to TARP	Status-at start of MOP
community.	aligned to seasonality of rainfall, evaporation and temperature.	spring to autumn. Cool-season perennial grasses are planted late autumn-early spring. Tree planting to be undertaken in autumn and spring and after rains to provide adequate soil moisture.			
	The vegetation is developing in structure and complexity comparable to that of the local remnant vegetation	Based on key physical, biological and chemical characteristics the LFA Stability Index provides an indication of the site's stability and that it is comparable to or trending towards that of analogue sites (%). Pasture: 63.2% to 69.2%; Woodland: 53.9% to 81.8%.		TARP Item 23	Ongoing
		Based on key physical, biological and chemical characteristics the LFA Infiltration Index provides an indication of the site's infiltration capacity and that it is comparable to or trending towards that of analogue sites (%). Pasture: 29.4% to 37.3%; Woodland: 48.4% to 73.9%.		TARP Item 23	Ongoing
		Based on key physical, biological and chemical characteristics the LFA Nutrient Recycling Index provides an indication of the site's ability to recycle nutrients and that it is comparable to or trending towards that of analogue sites (%). Pasture: 24.1% to 30.7%; Woodland: 38.5% to 79.8%.		TARP Item 23	Ongoing
		The Landscape Organisation Index provides a measure of the ability of the site to retain resources and that it is comparable to or trending towards that of		TARP Item 23	Ongoing

Objective	Performance Indicator	Performance Criteria	Justification/Source	Link to TARP	Status at start of MOP
Minimise site impact in terms of compaction of soil, the spread of weeds and disturbance to vegetation		analogue sites (%). Pasture: 1.00; Woodland: 0.84 to 1.00.	HVO-10-EWI-Site-E9-022		
	Predation by herbivores	All plantings at risk of foraging by fauna (rabbits, hares, wallabies and kangaroos) are protected by the pre-planting application of deterrent spray, and/or tree guards and/or exclusionary fencing wherever practical.			Ongoing
	No uncontrolled entry of livestock or vehicles.	Vehicle access is restricted to defined access pathways for use by authorised vehicles. The main arterial tracks are maintained in good condition.		TARP Item 14	Ongoing
Habitat augmentation to provide additional habitat for threatened species.	Signage	Key habitat and rehabilitation areas will be fenced or signposted where appropriate to prevent the uncontrolled entry of livestock and to minimise vehicular traffic during the establishment phase.	HVO-10-EWI-Site-E9-007 HVO South Modification 5 Environmental Assessment 2017	TARP Item 14	Ongoing
	Coarse Woody Debris and rocks	Horizontal placement of hollow logs or small piles of timber and rocks are installed across the site creating cavities for habitat for small ground dwelling mammals and reptiles.			Ongoing
	Drainage depression (frog ponds) creation providing riparian and aquatic habitat	Habitat is developed using common native rushes /sedges in unshaded locations, free from predatory fish, nearby grassland and sheltering sites of vegetation and rocks.			Ponds constructed in rehab areas but habitat building not commenced
	Plant species selection.	Plant species are used which create suitable habitat for woodland birds e.g. flaky bark, production of small and large sized woody debris, diversity of flowering			Suitable species included in seed mixes.

Objective	Performance Indicator	Performance Criteria	Justification/Source	Link to TARP	Status at start of MOP
		time. Plant prickly species (e.g. Native Boxthorn) that provide critical habitat for certain species.			
	Provide diversity of habitats to improve biodiversity.	Create areas of open woodland where trees and shrubs are not planted too densely (create "patchiness") and provide relatively large patches of grassland with scattered trees. Create patchwork of dense thickets of shrubs.			Ongoing
Rehabilitation Areas – Pasture					
Returning 50-60% of disturbed mining areas to grazing land.	Returning 50-60% of disturbed mining areas to grazing land.	50-60% of disturbed mining areas returned to grazing land.	HVO-10-EWI-Site-E9-007		Ongoing
	Species used are compatible with agricultural outcomes.	Native species sown are based on the recommended species list from Table 28 —Species options, minimum number of species, and minimum number of genera for design of individual species mixes.	HVO-10-EWI-Site-E9-021		Ongoing
	The number of grass species comprising the vegetation community is comparable to that of analogue sites (no. species/area).	TBD		TARP Item 15	Criteria still to be determined
Rehabilitation Areas – Woodland					
Returning 40 to 50% of disturbed mining areas to native woodland, but not necessarily conforming to any particular vegetation community.	Returning 40 to 50% of disturbed mining areas to native woodland, but not necessarily conforming to any particular vegetation community.	40 to 50% of disturbed mining areas returned to native woodland	HVO-10-EWI-Site-E9-007 HVO-10-EWI-Site-E9-021		Ongoing

Objective	Performance Indicator	Performance Criteria	Justification/Source	Link to TARP	Status at start of MOP
	The number of tree species comprising the vegetation community is comparable to that of analogue sites (no. species/area).	1 to 4 species within a 20m x 20m quadrat.		TARP Item 16	Ongoing
	The number of grass species comprising the vegetation community is comparable to that of analogue sites (no. species/area).	4 to 9 species within a 20m x 20m quadrat.		TARP Item 15	Ongoing
	The density of trees is comparable to that of analogue sites (no./area).	250 to 3,150 stems per ha		TARP Item 17	Ongoing
	Species used are compatible with agricultural or native biodiversity conservation outcomes.	Species sown are based on those recommended species list from Table 28.			Ongoing

6.5.5 Ecosystem and Land Use Sustainability

In the context of this MOP, Ecosystem and Land Use Sustainability in HVO South incorporates the:

- Development of profiles in the growing media;
- Development of land usage which is consistent with surrounding areas;
- Vegetation communities capable of withstanding catastrophic events, e.g. bushfire and extensive drought;
- Nutrient cycling;
- Species diversity and abundance for both flora and fauna;
- Recolonisation of the sites by key indicator species; and
- Suitable Land Capability classes.

The criteria, performance measures and indicators together with the justification source which describe structures and method for this data as they relate to the Ecosystem and Land Use Sustainability Stage is provided in **Table 26**. Monitoring information from analogue sites has been used to inform the target setting process for Performance Criteria in **Table 26**.

Table 26 Ecosystem and Land Use Sustainability

Domain Objective	Performance Indicator	Completion Criteria	Justification / Source	Complete (Yes/No)	TARP Element	Progress at Start of MOP
Rehabilitation Pasture and Rehabilitation Woodland						
Weeds are controlled.	Weed presence	Rehabilitation monitoring verifies weed presence is broadly comparable to analogue sites and does not present a risk to rehabilitation.	This MOP. Consistent with other Glencore operations.	No	Yes	Ongoing
Feral animal pests are controlled on HVO lands.	Feral animal density	Records indicate that feral animal pests are controlled in accordance with legislation and the MOP.	<i>Integrated Biodiversity Management Plan</i>	No	N/A	Ongoing
Provide additional habitat for threatened species.	Fauna species	The number of native fauna species observed within the rehabilitation areas is similar to that of the local remnant vegetation.	This MOP. Consistent with other Glencore operations.	No	N/A	Ongoing
Management measures will be implemented to minimise bushfire risks in rehabilitation areas.	Bushfire risk management	Bushfire mitigation actions have been implemented including managing fuel loads, maintaining fire breaks and access roads.	<i>HVO Bushfire Management Plan</i>	No	Yes	Ongoing
	Access	Firefighting access is maintained across rehabilitation areas and to water storages (dams).		No	N/A	Ongoing
Monitoring demonstrates soils are self-sustaining	Soil Quality	Rehabilitation monitoring verifies soil characteristics (pH, EC and ESP, nitrogen and phosphorus) vary no more than 20% from relevant analogue site after 5 years.	This MOP. Consistent with other Glencore operations.	No	N/A	Ongoing
	Soil Quality	Soil testing indicates soil organic carbon is no less than 20% of levels in adjacent analogue site after 10 years.		No	N/A	Ongoing
	Surface cover	Rehabilitation monitoring verifies ground cover (vegetation, leaf litter, mulch) is in the range of analogue sites at Year 10.		No	Yes	Ongoing
Monitoring demonstrates soils are self-sustaining	Nutrient Recycling	Rehabilitation monitoring indicates evidence of nutrient recycling (e.g. presence of fungi).	Tongway & Hindley 1996	No	N/A	Ongoing
	Management Inputs	Rehabilitation records verify that management inputs (e.g. ameliorants, fertilizers) required to maintain vegetation health are comparable to analogue sites.		No	N/A	Ongoing

Domain Objective	Performance Indicator	Completion Criteria	Justification / Source	Complete (Yes/No)	TARP Element	Progress at Start of MOP
Final landforms are safe, stable, non-polluting and free-draining.	Landform Stability	Landforms are assessed to be stable and free draining to local watercourses.	operations.	No	Yes	Ongoing
	Erosion and sediment control	No significant erosion is present that constitutes a safety hazard or compromises the capability of the supporting the end land use.	Blue Book	No	Yes	Ongoing
Water Management Area						
Final landform drainage will integrate with surrounding catchments, achieve long term geomorphic stability and minimise erosion	Water Quality	Discharge water quality meets EPL requirements.	EPL	No	Yes	Ongoing
	Geomorphic stability	Drainage structures are assessed to be stable at Year 10.	Blue Book, relevant engineering design standards and site specific requirements.	No	Yes	Ongoing
Rehabilitation Pasture						
Revegetation is sustainable for the long term and only requires maintenance that is consistent with the intended final land use.	LFA Infiltration	LFA Infiltration index indicates that it is comparable to or trending towards that of analogue sites.	CSIRO Methodology for Landscape Function Analysis (Tongway 2004)	No	N/A	Ongoing
	LFA Nutrient Recycling	LFA nutrient recycling index indicates that it is comparable to or trending towards that of analogue sites.		No	N/A	Ongoing
	Total Groundcover	Total groundcover is the sum of protective ground cover components (dead and live plant material, rocks and logs) and is comparable to that of analogue sites (% Cover).		No	Yes	Ongoing
Revegetation is sustainable for the long term and only requires maintenance that is consistent with the intended final land use.	Species Abundance	The abundance of understorey species (non-weed) per square metre, averaged across the site, provides an indication of the heterogeneity of the site and that the number of non-weed species is comparable to analogue sites (no. species/m ²).	CSIRO Methodology for Landscape Function Analysis (Tongway 2004)	No	Yes	Ongoing
Rehabilitation Woodland						

Domain Objective	Performance Indicator	Completion Criteria	Justification / Source	Complete (Yes/No)	TARP Element	Progress at Start of MOP
Establishing a network of tree corridors to ensure connectivity of woodland community areas.	Vegetation communities in areas of rehabilitation have been designed to enhance connectivity across the site and to adjoining landscape.	Align vegetation communities on areas of rehabilitation to adjacent landscape. GIS data reflects connectivity of vegetation communities.	Hunter Valley Operations South Coal Project Environmental Assessment Report (2008)	No	N/A	Ongoing
	Connectivity	Woodland rehabilitation area features are considered compatible with adjacent operations rehabilitation objectives and the objectives of the "Synoptic Plan-Integrated Landscape for Coal Mine Rehabilitation in the Hunter Valley of NSW", to the satisfaction of the RR.	Andrews Neil Architects Planners 1999	No	N/A	Ongoing
Woodland Rehabilitation Areas will contribute to habitat linkage objectives of the 'Synoptic Plan'.	Approximately 30-40% of mined land re-established as woodland areas.	Approximately 30-40% of mined land re-established as woodland areas.	Hunter Valley Operations South Coal Project Environmental Assessment Report (2008) This MOP. Consistent with other Glencore Operations.	No	N/A	Ongoing
	Native fauna resources	Rehabilitation monitoring verifies that habitat resources for target species (e.g. food sources and shelter resources) are comparable to analogue sites.	This MOP. Consistent with other Glencore operations.	No	N/A	Ongoing
Revegetation is sustainable for the long term and only requires maintenance that is consistent with the intended final land use.	LFA Infiltration	LFA Infiltration index indicates that it is comparable to or trending towards that of analogue sites.	This MOP. Consistent with other Glencore operations.	No	N/A	Ongoing
	LFA Nutrient Recycling	LFA nutrient recycling index indicates that it is comparable to or trending towards that of analogue sites.		No	N/A	Ongoing
	Total Groundcover	Total groundcover is the sum of protective ground cover components (dead and live plant material, rocks and logs) and is comparable to that of analogue sites (% Cover).		No	Yes	Ongoing
	Native Understorey Abundance	The abundance of native species per square metre averaged across the site is within 70% of analogue sites.		No	Yes	Ongoing

Domain Objective	Performance Indicator	Completion Criteria	Justification / Source	Complete (Yes/No)	TARP Element	Progress at Start of MOP
Revegetation is sustainable for the long term and only requires maintenance that is consistent with the intended final land use.	Tree Diversity	The diversity of maturing trees and shrubs with a stem diameter greater than 5cm is comparable to that of analogue sites (no./area).		No	N/A	Ongoing
		The percentage of maturing trees and shrubs with a stem diameter greater than 5cm that are local endemic species is comparable to analogue sites.		No	N/A	Ongoing
	Tree Health	The percentage of the tree population which are in healthy condition and that the percentage is comparable to analogue sites.		No	N/A	Ongoing
		The percentage of the tree population which are in a medium health condition and that the percentage is comparable to analogue sites.		No	N/A	Ongoing
		The percentage of the tree population which are in a state of advance dieback and that the percentage is comparable to analogue sites.		No	N/A	Ongoing
		The presence of reproductive structures such as buds, flowers or fruit on trees and shrubs provides evidence that the ecosystem is maturing, capable of recruitment and can provide habitat resources and that the % population is comparable to that of analogue sites.		No	N/A	Ongoing
	Reproductive Structures			No	N/A	Ongoing

Objective	Performance Indicator	Performance Criteria	Justification/Source	Link to TARP	Status at start of MOP
Rehabilitation Areas					
Provide additional habitat for threatened species.	Monitoring of the placement and utilisation of habitat features and artificial roosting/nesting boxes.	Nest boxes will be installed to supplement arboreal habitat. Data on the location and species specificity of each nest box is collected and collated via Geographical Information System (GIS). Record utilisation of nest boxes.	HVO South Modification-5 Environmental Assessment 2017		Ongoing
Establishing a network of tree corridors to ensure connectivity of woodland community areas.	Vegetation communities in areas of rehabilitation have been designed to enhance connectivity across the site and to adjoining landscape.	Align vegetation communities on areas of rehabilitation to adjacent landscape. GIS data reflects connectivity of vegetation communities.			Ongoing
Rehabilitation Area – Pasture					
Returning 50-60% of disturbed mining areas to grazing land.	Weed plant cover (calculated as a percentage of total ground cover) is comparable to that of analogue sites. (% Cover)	TBD	CSIRO Methodology for Ecosystem Function Analysis (Tongway, 2004) HVO South Modification-5 Environmental Assessment 2017	TARP Item 11	Criteria still to be determined
	Total groundcover is the sum of protective ground cover components (dead and live plant material, rocks and logs) and is comparable to that of analogue sites (% Cover).	TBD		TARP Item 17	Criteria still to be determined
	The abundance of understorey species (non-weed) per square metre, averaged across the site, provides an indication of the heterogeneity of the site and that the number of non-weed species is comparable to analogue sites (no. species/m ²).	TBD			Criteria still to be determined

Objective	Performance Indicator	Performance Criteria	Justification/Source	Link to TARP	Status at start of MOP
Rehabilitation Area – Woodland					
Returning 40 to 50% of disturbed mining areas to native woodland, but not necessarily conforming to any particular vegetation community.	Weed plant cover (calculated as a percentage of total ground cover) is comparable to that of analogue sites. (% Cover)	Target: 5% to 33%	CSIRO Methodology for Ecosystem Function Analysis (Tongway, 2004) HVO South Modification 5 Environmental Assessment 2017	TARP Item 11	Ongoing
	Total groundcover is the sum of protective ground cover components (dead and live plant material, rocks and logs) and is comparable to that of analogue sites (% Cover).	Target: 32% to 74%		TARP Item 17	Ongoing
	The diversity of maturing trees and shrubs with a stem diameter greater than 5cm is comparable to that of analogue sites (no./area).	Target: 1 to 4 species within a 20m x 20m quadrat.		TARP Item 16	Ongoing
	The percentage of maturing trees and shrubs with a stem diameter greater than 5cm that are local endemic species is comparable to analogue sites.	Target: 90% to 100%		TARP Item 15	Ongoing
	The density of maturing trees and shrubs with a stem diameter greater than 5cm is comparable to analogue sites (no./area).	Target: 50 to 725 stems per ha		TARP Item 16	Ongoing
	Average trunk diameter (dbh) of the tree population provides a measure of age and growth rate and that it is trending towards that of analogue sites (cm).	Target: 10.8cm to 65cm		TARP Item 18	Ongoing
	The percentage of the tree population which are in healthy condition and that the percentage is comparable to analogue sites.	TBD		TARP Item 19	Criteria still to be determined

Objective	Performance Indicator	Performance Criteria	Justification/Source	Link to TARP	Status at start of MOP
	The percentage of the tree population which are in a medium health condition and that the percentage is comparable to analogue sites.	TBD		TARP Item 19	Criteria still to be determined
	The percentage of the tree population which are in a state of advance dieback and that the percentage is comparable to analogue sites.	TBD		TARP Item 19	Criteria still to be determined
	The presence of reproductive structures such as buds, flowers or fruit on trees and shrubs provides evidence that the ecosystem is maturing, capable of recruitment and can provide habitat resources and that the % population is comparable to that of analogue sites.	TBD		TARP Item 20	Criteria still to be determined
	The proportion of over-storey species occurring as regeneration is within 50-100% or exceeds that of analogue sites.	Target: 0.5 to 1.0		TARP Item 20	Ongoing

7.0 Rehabilitation Implementation

7.1 Rehabilitation Status at MOP Commencement

This section describes the status of each domain at the start of this MOP period. This information is also presented graphically in **Map 2**. For this section, the rehabilitation areas domains have been grouped into a single domain. The rehabilitation status of domains that are active, and subject to ongoing mining operations, is not described.

7.1.1 Infrastructure Areas

Domain is active.

7.1.2 Tailings Storage Facilities

All seven TSF's within HVO South have been capped and rehabilitated. Currently there are no active TSF's within HVO South. Riverview Void and Lemington South Void have both been identified as potential future TSF's however this is not planned within the period of this MOP.

7.1.3 Water Management Areas

Domain is active.

7.1.4 Overburden Emplacements

At the end of 2017, the total area of mined land at HVO South that was being prepared for rehabilitation or was under active rehabilitation was 2,915.9 ha.

Overburden is placed in active waste emplacement areas by the dragline, or hauled by trucks to emplacement locations behind the mining area for shovel strips. Existing active waste emplacement areas are defined as those that are currently unshaped. These emplacements are located adjacent to all active mining areas and dominate the central and south-western sections of the HVO South mine area.

Overburden is then shaped before rehabilitation activities can take place. In accordance with the progressive rehabilitation commitment, shaped overburden emplacements are generally located behind the unshaped spoil piles for each pit.

7.1.4.1 Landform design

Overburden is shaped to be compatible with adjacent land surfaces and final landform. The final landscape, as shown on **Map 4**, will consist of a series of hills, ridges and minor valley systems designed to be consistent with the pre-mining local and regional landscape. Final landform slopes vary according to erosion hazard, stability and drainage requirements. The final landform will be undulating, with slopes of generally 10 degrees for overburden emplacements and up to 18 degrees for internally draining sub domains. The slope on the low wall is proposed to be reduced to less than 10 degrees to increase the area of useable land available.

Drainage from the elevated rehabilitated overburden dumps will be achieved by the use of drainage routes at a slope of one to ten degrees. Drainage lines will be constructed to be compatible with the surrounding drainage network.

7.1.4.2 Surface shaping

Following truck dumping activities, the overburden piles are reshaped with the incorporation of micro-relief to form the final landscape. Dumps are generally developed in approximate 10-30 metre lifts over dragline spoil peaks by the truck and shovel operation, enabling good control over the final land shaping process. When dumping is completed in an area, the mine surveyor places batter pegs to guide the final land formation. Slopes are then bulldozed to the design slopes after which large rocks that have been exposed are removed.

No materials recovered through mining at HVO South are expected to be toxic. However, precautions are still taken to avoid potential hazards, with all unsuitable materials buried at least five metres below the surface in accordance with the EMS rehabilitation procedures.

7.1.4.3 Water Management

Drainage patterns on rehabilitated areas are designed to be compatible with the surrounding drainage network, in approximate location of the pre-mining flow lines. Drainage is generally divided into a number of small catchments that feed into a large channel. This is achieved using a combination of controls such as graded banks, designed channels and where necessary, water course reinforcement. Diversion drains to collect surface runoff are designed to cater for a one in ten year event with an approximate slope of up to two percent to minimise erosion.

In addition to the development of a more natural landscape, the incorporation of micro-relief into the emplacement is designed to reduce erosion compared to more traditional rehabilitation methods. The movement of the water from the emplacement will occur via a network of drainage channels and dry land attenuation areas appropriately designed with consideration of the approved final emplacement height and catchment areas.

Of the existing drop structures found in the Cheshunt Pit, two have been designated to cope with the potential runoff capacity likely to arise from the additional approved emplacement surface area. These features were designed following the submission of the HVO South Mod 5 Environmental Assessment. These drop structures are the only existing structures to be integrated into the management of surface runoff stemming from the increased emplacement height. Runoff from the proposed micro-relief areas will only be directed towards features that have been designed to effectively handle the applicable runoff capacity.

Sedimentation dams are incorporated into the final landform where considered appropriate to collect water runoff and allow time for any suspended sediment to settle out prior to the water leaving the site. Sedimentation dams will be designed to engineering standards sufficient to withstand floods of 1-in-20 year Average Recurrence Interval (ARI) and bypass spillways constructed to withstand floods of 1-in-100 year ARI.

Erosion control is primarily achieved through the establishment of productive vegetation cover on the rehabilitated slopes. Graded erosion banks are constructed as a temporary erosion control measure during the early stages of the revegetation process.

7.1.4.4 Surface Preparation

Following surface shaping, rehabilitation areas are contour-ripped and rock-raked prior to any further treatment. Topsoil generally spread at a nominal thickness of 100 mm. Soils are aerated or ripped to produce a rough surface to slow water movement and improve infiltration.

Whenever possible, topsoil will be transferred directly from stripping to re-spreading operations to reduce the possibility of structural damage and maintain biological activity and potential. Topsoil is typically spread using D6 sized dozers to minimise structural damage.

For higher value areas such as rehabilitation designated for native woodland development, topsoil may not be used if it arises from areas with high weed load. As an alternative, compost or green manure mixed with mine spoil may be utilised as the growth medium to encourage a reduced competition environment for the native seedlings.

7.1.4.5 Soil Treatment

Regular soil analysis is undertaken on re-contoured areas to determine suitable ameliorants for revegetation.

Soil modifiers, such as gypsum and compost are applied where required to improve topsoil condition. Gypsum and compost are initially spread and incorporated into the recovered topsoil. Revegetation will be undertaken progressively as the surface preparation of mine spoil is completed. The compost material generally provides enough nutrition for vegetation establishment at time of sowing. The addition of up to 400 kg/ha of "Starter 15", "Grower 11" or equivalent fertiliser may be required at the time of sowing for pasture revegetation areas in the absence of compost application.

7.1.4.6 Revegetation

HVO has rehabilitated its lands with a combination of pastures and woodlands. Pasture areas consist of a range of both native and introduced pasture species and are designed to sustain grazing pressures and improve animal productivity. Native vegetation areas utilise local native tree and shrub species and are designed to increase biodiversity values. Rehabilitation of shelter belts are designed to provide protection for stock and link native bush areas. Shelter belts can consist of a mixture of native and exotic species.

7.1.4.7 Progressive Rehabilitation

In areas returning to a grazing post mining land use, progressive rehabilitation will allow stock to graze new areas when pasture is considered stable. This assessment will be based on the data collected from defined monitoring programmes, which utilises data collected from analogue sites as a basis for comparison to post mined lands (refer **Section 8**). Stock water will be available from various sediment control dams and designated woodland and biodiversity areas will be protected by fencing.

7.1.4.7.1 Land Management

Land management activities include the following control programmes:

- Weeds will be controlled using appropriate management techniques, as the company is obliged to control weed growth on site under the *Biosecurity Act 2015*. If weeds occupy greater than twenty percent of ground cover area in rehabilitation, they will be sprayed or controlled by other methods.
- Regular feral animal control programmes include ongoing baiting to control the numbers of rabbits, hares, foxes, wild dogs and feral cats, culling of kangaroos in consultation with the National Parks and Wildlife Service (NPWS) and special releases of myxomatosis and/or calicivirus on site in conjunction with the Local Land Services (LLS) for rabbit control;
- Management procedures to minimise the potential for bushfire hazard include maintenance of grazing practices, to reduce fuel loads and maintain low grass levels in areas of high bushfire potential, provision of fire breaks and access trails, regular maintenance and grading of access trails and provision of sufficient on-site fire fighting equipment; and
- Stock grazing will not be commenced until the pasture is well established and area securely fenced. Stocking rates will be carefully monitored to ensure that the areas are not overgrazed. Vehicular traffic will be generally kept off revegetation areas and restricted to designated access tracks.

7.1.5 Final Void

Domain is inactive.

7.2 Proposed Rehabilitation Activities this MOP Period

For each rehabilitation stage discussed in **Section 6.0**, mining and rehabilitation activities over the term of this MOP are shown in **Map 3A** to **Map 3E**. Description of the proposed activities for each domain is provided in the following sections.

7.2.1 Infrastructure Areas

No rehabilitation activities is anticipated for this domain during the period covered by this MOP, as the existing infrastructure (as described in **Section 2.8.1**) will remain in place.

7.2.2 Tailings Storage Facilities

All TSF's are currently rehabilitated within HVO South.

7.2.3 Water Management Areas

Water Management Areas will continue to be managed as in the current situation with none to be rehabilitated during the period of this MOP.

7.2.4 Overburden Emplacements

Overburden materials will continue to be managed as in the current situation. Rehabilitation of Overburden Emplacement areas will follow the same process detailed in **Section 7.1.4** but will incorporate the refinements described below. Areas to be rehabilitated within the term of this MOP are located on spoil emplacements in the Riverview and Cheshunt pits, as shown on **Maps 3A** to **3E**.

7.2.4.1 Soil Treatment

Organics such as **green waste** or composted municipal waste materials may be used in place of chemical fertilisers to enhance soil nutrient and organic levels and improve soil structure. Suitable organic additives may also be used in accordance with industry lead practice and research findings to improve soils in areas to be returned to native vegetation.

7.2.4.2 Revegetation

Initial sacrificial cover crops may be used to provide quick stability to rehabilitation areas and provide additional opportunities for weed control prior to sowing to long term seed mixes. Cover crops will be selected to suit the season, i.e. millet for sowing in Spring/Summer and ryegrass, barley or triticale for sowing in Autumn/Winter.

In order to achieve diversity targets long-term seed mixes will contain a range of categories based on the following factors:

- Plant structure and form (e.g. tree vs. shrub).
- Floristics (i.e. spread over a range of plant genera).
- Life cycle (e.g. short lived primary coloniser vs. long lived understory shrubs).

7.2.4.2.1 Pasture Rehabilitation

Pasture will be sown in spring or autumn, depending on rainfall. This gives the best opportunity for seeds to germinate and successfully grow. Grass seeds are mixed with fertiliser and spread from a tractor-mounted broadcaster working along contour where possible for uniform seed distribution. Typical pasture species and rates of application are shown in **Table 27**. Scattered groups of native trees, shrubs and groundcovers will also be planted in pastures to give shade and shelter for livestock, to provide native forests for wildlife habitat and possible future commercial timber operations. Species will be selected from those listed in **Table 27**.

Table 27 Typical Pasture Species and Application Rates

Species		Autumn Sowing Rate (kg/ha)	Spring Sowing Rate (kg/ha)
Exotic Species			
Wimmera Rye		5	n/a
Siroso Phalaris		5	N/A
Lucerne		4	4
Sephi Medic		3	N/A
Haifa White Clover		3	N/A
Seaton White Clover		2	4
Kikuyu *		4	4
Setaria (Kazungula)		4	3
Woolly Pod Vetch		N/A	4
Couch (hulled)		N/A	1
Green Panic		N/A	3
Native Species		Grassy Mix kg / ha	
Grasses primary colonising	<i>Austrostipa densiflora</i> , <i>Austrostipa scabra</i> , <i>Bothriochloa macra</i> , <i>Chloris truncata</i> , <i>Digitaria brownii</i> , <i>Elymus scaber</i> , <i>Panicum effusum</i>	6	
Grasses long term understorey	<i>Aristida ramosa</i> , <i>Austrodanthonia fulva</i> , <i>Austrodanthonia setacea</i> , <i>Austrostipa ramosissima</i> , <i>Bothriochloa decipiens</i> , <i>Capillipedium spicigerum</i> , <i>Chloris ventricosa</i> , <i>Cymbopogon refractus</i> , <i>Dicanthium sericeum</i> , <i>Dichelachne crinita</i> , <i>Eragrostis leptostachya</i> , <i>Poa labillardieri</i> , <i>Sporobolus creber</i> , <i>Themeda triandra</i>	10.5	
Grasses long term understorey shade tolerant	<i>Austrostipa verticillata</i> , <i>Aristida vagans</i> , <i>Dichelachne micrantha</i> , <i>Echinopogon caespitosus</i> , <i>Echinopogon intermedius</i> , <i>Echinopogon ovatus</i> , <i>Entolasia stricta</i> , <i>Imperata cylindrica</i> , <i>Joycea pallida</i> , <i>Microleana stipoides</i> , <i>Oplismenus aemulus</i>	1.5	

* Mainly in drainage areas.

7.2.4.2.2 Woodland Rehabilitation

Native woodland rehabilitation within HVO South, aimed at enhancing biodiversity, will be promoted by:

- Using native endemic seeds (to match those already found on the subject site) where possible, for seeding and replanting programmes;
- Rehabilitate groundcover, understorey and canopy species by seeding and planting (planting understorey and tree species will be undertaken where grass competition restricts the use of direct seeding);
- Planting a variety of species as opposed to a monoculture, especially species that flower at different times of the year or that provide foraging resources for affected species;
- Creating a diversity of landforms and habitats such as woodland, regrowth and open forest on ridgetops and lower slopes;
- Placement of habitat features such as logs, rocks, and dams; and
- Linkage of areas rehabilitated with trees with adjacent remnant vegetation to promote regional corridors.

Woodland areas to be seeded during this MOP period will continue to include native understorey species with seed mixes being developed in accordance with **Table 28**. This table includes diversity targets for seed mixes with targets set for minimum number of species/genera to be included for the functional groups in each strata of the target vegetation community.

Table 28 lists the pool of about 130 species from which, any given mix of 40-60 species will be selected. The list is compiled from previous trials and studies undertaken for HVO, as well as the vegetation lists for ~~locally mapped communities Central Hunter Box-Ironbark Woodland and Central Hunter Ironbark-Spotted Gum-Gray Box Forest compiled by Peake (2006) and others.~~ It is not an exhaustive list of species recorded from these communities and will be further refined over time.

Table 28 Species options, minimum number of species, and minimum number of genera for design of individual species mixes

Category	Woodland Mix Min. no. species/ genera	Pasture/ Light Wooded Mix Min. no. species/ genera	Reference list/species pool
Trees			
Dominant tall trees	3 species/ 1 genera	3 species/ 1 genera	<i>Eucalyptus crebra</i> , <i>Eucalyptus fibrosa</i> , <i>Eucalyptus moluccana</i> , <i>Corymbia maculata</i>
Sub-dominant tall trees	2 species/ 1 genera	1 species/ 1 genera	<i>Angophora floribunda</i> , <i>Eucalyptus dawsonii</i> , <i>Eucalyptus glaucina</i> , <i>Eucalyptus punctata</i> , <i>Eucalyptus tereticornis</i>
Small trees nitrogen fixing	2 species/ 1 genera	1 species/ 1 genera	<i>Acacia implexa</i> , <i>Acacia parvipinnula</i> , <i>Acacia salicina</i> , <i>Allocasuarina leuhmanii</i> , <i>Allocasuarina littoralis</i>
Small trees non-nitrogen fixing	1 species/ 1 genera	1 species/ 1 genera	<i>Brachychiton populneus</i> , <i>Callitris endlicheri</i> , <i>Geijera parviflora</i> , <i>Notelaea microcarpa</i>
Shrubs/woody climbers			
Primary colonising and/or short lived Acacias	1 species/ 1 genera	1 species/ 1 genera	<i>Acacia cultriformis</i> , <i>Acacia falcata</i> , <i>Acacia leiocalyx</i>
Long lived and/or understory Acacias	2 species/ 1 genera	2 species/ 1 genera	<i>Acacia amblygona</i> , <i>Acacia brownii</i> , <i>Acacia decora</i> , <i>Acacia paradoxa</i> , <i>Acacia pravifolia</i>

Category	Woodland Mix Min. no. species/ genera	Pasture/ Light Wooded Mix Min. no. species/ genera	Reference list/species pool
Nitrogen fixing shrubs-non-Acacias (<i>Fabaceae</i> family)	3 species/ 2 genera	2 species/ 1 genera	<i>Daviesia genistifolia</i> , <i>Daviesia ulicifolia</i> , <i>Hardenbergia violacea</i> , <i>Indigofera australis</i> , <i>Jacksonia scoparia</i> , <i>Podolobium ilicifolium</i> , <i>Pultenaea microphylla</i> , <i>Pultenaea spinosa</i>
Non-nitrogen fixing shrubs	4 species/ 3 genera	N/A	<i>Breynia oblongifolia</i> , <i>Cassinia aculeata</i> , <i>Cassinia arcuata</i> , <i>Cassinia quinquefaria</i> , <i>Clematis glycinoides</i> , <i>Dodonaea viscosa</i> , <i>Hakea sericea</i> , <i>Melaleuca decora</i> , <i>Melaleuca nodosa</i> , <i>Melichrus urceolatus</i> , <i>Myoporum montanum</i> , <i>Olearia elliptica</i> , <i>Ozothamnus diosmifolius</i> , <i>Pandorea pandorana</i>
Subshrubs			
Subshrubs	2 species/ 1 genera	N/A	<i>Einadia hastata</i> , <i>Einadia nutans</i> , <i>Einadia trigonos</i> , <i>Enchylaena tomentosa</i> , <i>Eremophila debilis</i> , <i>Hibbertia obtusifolia</i> , <i>Hovea linearis</i> , <i>Solanum cinereum</i> , <i>Solanum prinophyllum</i>
Forbs			
Forbs	5 species/ 4 genera	1 species/ 1 genera	<i>Ajuga australis</i> , <i>Arthropodium milleflorum</i> , <i>Arthropodium minus</i> , <i>Asperula conferta</i> , <i>Caesia parviflora</i> , <i>Calotis cuneata</i> , <i>Calotis lappulacea</i> , <i>Chrysocephalum apiculatum</i> , <i>Commelina cyanea</i> , <i>Desmodium brachypodium</i> , <i>Dichondra repens</i> , <i>Glycine clandestina</i> , <i>Glycine tabacina</i> , <i>Hypericum gramineum</i> , <i>Mentha sativoides</i> , <i>Podolepis neglecta</i> , <i>Pomax umbellata</i> , <i>Sida corrugata</i> , <i>Swainsona galegifolia</i> , <i>Vittadinia cuneata</i> , <i>Vittadinia sulcata</i> , <i>Wahlenbergia communis</i> , <i>Wahlenbergia gracilis</i> , <i>Wahlenbergia stricta</i>
Grasses			
Grasses primary colonising	4 species/ 3 genera	4 species/ 3 genera	<i>Austrostipa densiflora</i> , <i>Austrostipa scabra</i> , <i>Bothriochloa macra</i> , <i>Chloris truncata</i> , <i>Digitaria brownii</i> , <i>Elymus scaber</i> , <i>Panicum effusum</i>
Grasses long term understorey	4 species/ 3 genera	4 species/ 3 genera	<i>Aristida ramosa</i> , <i>Austrodanthonia fulva</i> , <i>Austrodanthonia setacea</i> , <i>Austrostipa ramosissima</i> , <i>Bothriochloa decipiens</i> , <i>Capillipedium spicigerum</i> , <i>Chloris ventricosa</i> , <i>Cymbopogon refractus</i> , <i>Dicanthium sericeum</i> , <i>Dichelachne crinita</i> , <i>Eragrostis leptostachya</i> , <i>Poa labillardieri</i> , <i>Sporobolus creber</i> , <i>Themeda triandra</i>
Grasses long term understorey shade tolerant	3 species/ 3 genera	1 species/ 1 genera	<i>Austrostipa verticillata</i> , <i>Aristida vagans</i> , <i>Dichelachne micrantha</i> , <i>Echinopogon caespitosus</i> , <i>Echinopogon intermedius</i> , <i>Echinopogon ovatus</i> , <i>Entolasia stricta</i> , <i>Imperata cylindrica</i> , <i>Joycea pallida</i> , <i>Microleana stipoides</i> , <i>Oplismenus aemulus</i>

Category	Woodland Mix Min. no. species/ genera	Pasture/ Light Wooded Mix Min. no. species/ genera	Reference list/species pool
Monocots other than grasses			
Monocots other than grasses	3 species/ 2 genera	2 species/ 1 genera	<i>Carex fascicularis</i> , <i>Cyperus gracilis</i> , <i>Dianella caerulea</i> , <i>Dianella revoluta</i> , <i>Dianella longifolia</i> , <i>Fimbristylis dichotoma</i> , <i>Gahnia aspera</i> , <i>Lepidosperma laterale</i> , <i>Lomandra confertifolia</i> , <i>Lomandra filiformis</i> , <i>Lomandra longifolia</i> , <i>Lomandra multiflorus</i>

Recommended quantities of seed to establish lightly wooded pasture and woodland areas are provided in **Table 29**.

Table 29 Recommended quantities of seed to be included from each species category

	Woodland mix	Pasture/ Light Wooded mix Woody mix
	Approximate Sowing rate kg/ha	
Trees		
Dominant tall trees	0.4	0.1
Sub-dominant tall trees	0.1	0.05
Small trees- nitrogen fixing	0.25	0.2
Small trees- non-nitrogen fixing	0.25	0.05
<i>Trees total</i>	1.0	0.4
Shrubs		
Primary colonising and/or short lived Acacias	0.5	0.25
Long lived and/or understory Acacias	0.5	0.25
Nitrogen fixing shrubs-non-Acacias (<i>Fabaceae</i> family)	0.75	0.25
Non-nitrogen fixing shrubs	0.75	0
<i>Shrubs total</i>	2.5	0.75
Sub shrubs		
<i>Sub shrubs total</i>	0.5	0
Forbs		
<i>Forbs total</i>	0.5	0.1
Grasses		
Grasses primary coloniser	5.0	5.0
Grasses long term understorey	5.5	10.5
Grasses long term understorey shade tolerant	1.5	1.5
<i>Grasses total</i>	12.0	17.0

	Woodland mix	Pasture/ Light Wooded mix Woody mix
Monocots (other than grasses)		
<i>Monocots total</i>	0.5	0.25
TOTAL	17.0	18.5

7.2.4.2.3 Revegetation schedule

The areas scheduled for rehabilitation during the term of this MOP are shown on **Maps 3A to 3E**, as well as **Table 30**.

It is the objective of HVO South to rehabilitate at least as much area as that disturbed each year. Although this is not always possible, on average, this will be achieved during the MOP period. Over the period of the MOP, total rehabilitation will exceed total disturbance (including new disturbance and rehabilitation disturbance) by 40 ha. Planned rehabilitation is shown in **Table 30** totalling 361.8 ha compared with total projected disturbance of 321.5 ha. Variations in the Business Plan may cause changes to the mine plan and consequently the dump plan and eventually the rehabilitation schedule.

Table 30 Rehabilitation Rates 2018-2022

Year	Rehabilitation (ha)
2018	85.4
2019	66.4
2020	59.8
2021	74.9
2022	75.3
Total	361.8

7.2.4.3 Maintenance

Maintenance activities undertaken by HVO in rehabilitated areas include repairs to water management structures, the annual application of fertilisers, land management (including weed and feral animal control, strategic fencing and cattle grazing and bushfire risk management) and rehabilitation monitoring and reporting.

7.2.4.3.1 Fertiliser Applications

Regular soil analysis is undertaken on re-contoured areas to determine suitable ameliorants for revegetation.

Pastures will be maintained by periodic aerial applications of fertilizer (currently 100 - 250 kg/ha Di-Ammonium Phosphate) until they become well established.

7.2.4.3.2 Land Management

Land management activities undertaken at HVO include the following control programmes:

- Regular weed management and control is carried out to the satisfaction of the Rural Lands Protection Board using control methods such as spraying, wick weeding, cultivation and grazing;
- Regular feral animal control programmes include ongoing baiting to control the numbers of rabbits, hares, foxes, wild dogs and feral cats, culling of kangaroos in consultation with the NPWS and special releases of myxomatosis and/or calicivirus on site in conjunction with the LLS for rabbit control;
- Management procedures to minimise the potential for bushfire hazard include maintenance of grazing practices, to reduce fuel loads and maintain low grass levels in areas of high bushfire potential, provision of fire breaks and access trails, regular maintenance and grading of access trails and provision of sufficient on-site fire fighting equipment; and

- Stock grazing will not be commenced until the pasture is well established and area securely fenced. Stocking rates will be carefully monitored to ensure that the areas are not overgrazed. Vehicular traffic will be generally kept off revegetation areas and restricted to designated access tracks.

7.2.4.3.3 Rehabilitation Monitoring

All rehabilitation areas are regularly checked to determine the success of vegetation growth, erosion controls, fencing and signage, and the need for weed and feral animal control. Where vegetation growth is unsatisfactory, the areas will be re-sown as necessary.

An Annual Rehabilitation Report is prepared, as part of the Annual Review, on the progress of rehabilitation.

7.2.5 Final Void

The final void is incomplete. As shown in Map 3E - 2022, mining the deeper seams beneath Riverview Pit is yet to be completed. Progressive rehabilitation is occurring and a Final Void Management Plan will be developed and submitted for approval prior to mining ceasing with HVO South.

7.3 Rehabilitation Summary Table

The changes in areas of each domain during the MOP period are summarised in **Table 31** and **Table 32** below.

Table 31 Summary of proposed rehabilitation during MOP, split by Primary Domain

Primary Domain	Total Area at MOP start ¹ (hectares)	Total Area at MOP end (hectares)
Final Void		
<i>Active</i>	150.1	135.7
<i>Decommissioning</i>	0	0
<i>Landform Establishment</i>	12.5	0
<i>Growth Medium Development</i>	0	0
<i>Ecosystem Establishment</i>	0	0.6
<i>Ecosystem Sustainability</i>	16.9	60.3
<i>Rehabilitation Complete</i>	0	0
<i>No Rehabilitation or Disturbance</i>	19.7	2.7
Water Management Area		
<i>Active</i>	59.9	59.3
<i>Decommissioning</i>	0	0
<i>Landform Establishment</i>	0	0
<i>Growth Medium Development</i>	0	0
<i>Ecosystem Establishment</i>	1.1	0
<i>Ecosystem Sustainability</i>	4.2	6.5
<i>Rehabilitation Complete</i>	0	0
<i>No Rehabilitation or Disturbance</i>	9.8	9.3

¹ As of 2018.

Infrastructure Area		
Active	135.3	151.0
Decommissioning	0	0
Landform Establishment	0	0
Growth Medium Development	0	0
Ecosystem Establishment	0	0
Ecosystem Sustainability	22.3	6.6
Rehabilitation Complete	0	0
No Rehabilitation or Disturbance	27.7	27.7
Tailings Storage Facility		
Active	30.3	46.2
Decommissioning	0	0
Landform Establishment	0	0
Growth Medium Development	0	0
Ecosystem Establishment		3.0
Ecosystem Sustainability	90.1	71.1
Rehabilitation Complete	0	0
No Rehabilitation or Disturbance	75.8	75.8
Overburden Emplacement		
Active	1220.8	1159.9
Decommissioning	0	0
Landform Establishment	53.9	21.4
Growth Medium Development	0	0
Ecosystem Establishment	84.3	71.7
Ecosystem Sustainability	800.5	908.6
Rehabilitation Complete	0	0
No Rehabilitation or Disturbance	206.8	204.7

Table 32 Summary of proposed rehabilitation during MOP, split by Secondary Domain

Secondary Domain	Total Area at MOP start ² (hectares)	Total Area at MOP end (hectares)
Final Void		
<i>Active</i>	150.1	135.7
<i>Decommissioning</i>	0	0
<i>Landform Establishment</i>	12.5	0
<i>Growth Medium Development</i>	0	0
<i>Ecosystem Establishment</i>	0	0.6
<i>Ecosystem Sustainability</i>	17.0	60.3
<i>Rehabilitation Complete</i>	0	0
<i>No Rehabilitation or Disturbance</i>	19.7	2.7
Water Management Area		
<i>Active</i>	59.9	59.3
<i>Decommissioning</i>	0	0
<i>Landform Establishment</i>	0	0
<i>Growth Medium Development</i>	0	0
<i>Ecosystem Establishment</i>	1.1	0
<i>Ecosystem Sustainability</i>	4.2	6.5
<i>Rehabilitation Complete</i>	0	0
<i>No Rehabilitation or Disturbance</i>	9.8	9.3
Rehabilitation Area - Pasture		
<i>Active</i>	862.7	905.1
<i>Decommissioning</i>	0	0
<i>Landform Establishment</i>	23.9	0
<i>Growth Medium Development</i>	0	0
<i>Ecosystem Establishment</i>	48.5	14.0
<i>Ecosystem Sustainability</i>	427.7	444.0
<i>Rehabilitation Complete</i>	0	0
<i>No Rehabilitation or Disturbance</i>	202.2	201.9
Rehabilitation Area – Woodland		
<i>Active</i>	523.5	451.8
<i>Decommissioning</i>	0	0
<i>Landform Establishment</i>	30.0	21.4
<i>Growth Medium Development</i>	0	0
<i>Ecosystem Establishment</i>	35.8	60.8
<i>Ecosystem Sustainability</i>	485.1	542.3

² As of 2018.

Secondary Domain	Total Area at MOP start ² (hectares)	Total Area at MOP end (hectares)
<i>Rehabilitation Complete</i>	0	0
<i>No Rehabilitation or Disturbance</i>	108.0	106.2

7.4 Rehabilitation Maintenance

On 3 October 2018, the RR issued a Notice under Section 240(1)(c) of the *Mining Act 1992* (Section 240 Notice). The Section 240 Notice related to the unsatisfactory establishment of target vegetation species and the unsatisfactory weed presence at rehabilitation areas at HVO North and HVO South.

The RR stated the following issues must be addressed:

- Unsatisfactory establishment of target vegetation species at woodland and pasture rehabilitation areas, including (but not necessarily limited to):
 - HVORIV201403 – HVO South;
 - HVORIV201404 – HVO South;
 - HVORIV201405 – HVO South;
 - HVOCHE201201 – HVO South; and
 - HVOWES201601 – HVO North.
- Unsatisfactory weed presence at woodland and pasture rehabilitation areas, including (but not necessarily limited to):
 - HVORIV201402 – HVO South;
 - HVORIV201403 – HVO South;
 - HVORIV201501 – HVO South;
 - HVORIV201503 – HVO South;
 - HVOWES201604 – HVO North;
 - HVOLEM201601 – HVO South;
 - HVOCAR200902 – HVO North;
 - HVORIV201401 – HVO South; and
 - HVOWES201601 – HVO North.

Note: the Section 240 Notice incorrectly referenced HVORIV201604 instead of HVOWES201604 and HVORIV201601 instead of HVOLEM201601.

Cumberland Plain Seeds (CPS) were engaged by HVO to undertake an assessment of mine rehabilitation quality at HVO North and HVO South. The report assessed the key issues associated with the rehabilitation areas identified in the Section 240 Notice and provided recommendations to improve the quality of the rehabilitation.

Table 33 summarises the proposed rehabilitation maintenance to be undertaken at HVO South. Additional detail regarding planned rehabilitation maintenance and identified issues are provided in **Appendix C**.

Table 33 Rehabilitation Maintenance at HVO North

Site Name	Key Issues	Recommendations
HVORIV201401	<ul style="list-style-type: none"> • Good native species diversity but relatively low native ground layer cover (higher percentage of bare ground). • Heavily infested with threatening weeds, especially Rhodes grass. • Evidence of soil issues in some areas. 	<ul style="list-style-type: none"> • Manage exotic grasses threat to avoid contamination of adjacent areas. This would involve a combination of targeted slashing/brush cutting, blanket spraying of larger areas of exotic grasses and spot spraying of isolated plants. • Investigate soil issues and ameliorate as necessary. Following control of exotic grasses increase native ground cover by resowing native grasses and Saltbushes.
HVORIV201402	<ul style="list-style-type: none"> • Generally good native grass diversity and cover, apart from in one area which appears to have a different topsoil type. • Good shrub layer cover and some Eucalypts, although stem density is low. • Threat of invasion and spread of Rhodes Grass and Green Panic. 	<ul style="list-style-type: none"> • Investigate soil issues and ameliorate as necessary. • Treat threatening weeds. • Augment native ground and shrub layer in areas with lower stem density.
HVORIV201403	<ul style="list-style-type: none"> • Good but patchy native diversity and cover in ground layer. • Evidence of soil issues. • Significant weed threats (in particular Rhodes Grass) 	<ul style="list-style-type: none"> • Manage weed threats in short term while investigating soil issues. • Ameliorate soil as necessary. • Resow restricted suite of natives (only sow proven successful species).
HVORIV201404	<ul style="list-style-type: none"> • Patchy native vegetation cover. • Majority of the site is dominated by threatening weeds. • Soil issues appear to be causing poor native establishment. 	<ul style="list-style-type: none"> • Manage any weeds which pose a threat to adjacent rehab areas (Rhodes Grass and Green Panic pose highest risk of quickly invading areas due to windblown seed). • Investigate soil issues and ameliorate as necessary. • Consider spraying out larger patches of weed infested vegetation and resowing with limited native seed mix (only sow proven successful species).
HVORIV201405	<ul style="list-style-type: none"> • Evidence of serious soil problems. • Site is almost entirely dominated by annual plants (both native and exotic) suggesting a serious issue with subsoil and/or topsoil. 	<ul style="list-style-type: none"> • Investigate soil issues and ameliorate as necessary. • Spray out and resow with limited native seed mix (only sow proven successful species).
HVORIV201501	<ul style="list-style-type: none"> • Good native cover and diversity in ground layer. • Shrub and canopy layer has low stem density (particularly Eucalypts). 	<ul style="list-style-type: none"> • Manage weed threats in short term while investigating soil issues. • Ameliorate soil as necessary. • Augment native tree and shrub layers by resowing as necessary.
HVORIV201503	<ul style="list-style-type: none"> • Good native cover and diversity across the majority of the site. • Two small zones within the site have lower tree and shrub stem density. 	<ul style="list-style-type: none"> • Manage weed threats while investigating soil issues in lower density zones. • Stimulate further germination or resow trees and shrubs if necessary.

HVOCHE201201	<ul style="list-style-type: none"> • Very poor native cover or diversity apart from some saltbushes. • Significant densities of threatening weeds. • Evidence of ongoing soil or subsoil problems – poor plant growth and health. • Normally vigorous weeds show signs of drought stress and nutrition problems when compared to other HVO sites. 	<ul style="list-style-type: none"> • Investigate soil issues and ameliorate as necessary. • Spray out whole site and resow native species. • Proposed strategy would be to spray out and resow in strips or patches to allow for some experimentation with techniques and to limit risk of further failure.
HVOLEM201601	<ul style="list-style-type: none"> • Good shrub diversity and density. • Ground layer dominated by couch. • Threat from <i>Acacia saligna</i> colonising from adjacent vegetation. • Contour banks and swales have low native cover and diversity. • Soil appears to be Warkworth Sands Woodland type so species sown may not have been appropriate to this soil type. 	<ul style="list-style-type: none"> • Manage weed threats • Investigate initially sown species mix. • Sow ground layer species appropriate for this soil type.

8.0 Rehabilitation Monitoring and Reporting

8.1 Rehabilitation Monitoring

The rehabilitation monitoring program was collectively established for HVO North, HVO South and Mount Thorley Warkworth mines. The program was designed to reflect the requirement of HVO North and Mount Thorley Warkworth to rehabilitate 2,118 ha to a vegetation community consistent with the Central Hunter Grey Box-Ironbark Woodland and Central Hunter Ironbark-Spotted Gum-Grey Box Forest Endangered Ecological Communities (EECs). All analogue sites for this rehabilitation monitoring program were established within EECs. HVO South must rehabilitate the site to pasture and woodland communities. Accordingly, suitable analogue sites need to be established in commensurate areas to allow the development of site specific criteria. This approach was discussed with the RR during a meeting 24 October 2019 and it was agreed that a new HVO South rehabilitation monitoring program would be developed.

The proposed rehabilitation monitoring program will commence in spring 2019 and will:

- Continue monitoring existing rehabilitation sites;
- Establish pasture rehabilitation monitoring sites; and
- Establish HVO South woodland and pasture analogue sites.

Sections 8.1.1 – 8.1.7 provide an overview of the rehabilitation monitoring methodology implemented at HVO South in 2018. It is proposed that a similar methodology will be implemented during the MOP term to ensure data continuity; however options to improve the effectiveness of the program will be investigated. This may include but will not be limited to use of new technology such as drones to support traditional transects.

8.1.1 — Timeframes for the Implementation of the Monitoring Programme

~~During the MOP period a monitoring programme will be developed and implemented to assess the recovery of rehabilitation areas across the site. Information from monitoring of analogue sites has been used to inform the setting of targets for performance criteria.~~

8.1.1 Methodology

The monitoring methodology implemented at HVO South adopts a standard and simple procedure that can be replicated over any vegetation community or rehabilitation area and allows results to compare similar communities (AECOM 2012). The methodology uses a combination of:

- Landscape Function Analysis (LFA);
- Accredited soil analysis and various measures of ecosystem diversity and habitat values;
- Canopy Development;
- Biobanking - Site Value Scores;
- Visual Inspections; and
- Photographic Monitoring.

This combination of approaches allows a site to be assessed over time with the resultant data enabling the user to assess the trajectory of the ecosystem being monitored whilst also providing an overall assessment of land capability. This data can be used to decide if the site is converging on a target functional state or requires further works. An overview of the monitoring methodology is provided below.

~~The monitoring programme will be based on the performance indicators outlined in **Section 6.5.1 to Section 6.5.5** and will utilise methodologies that can provide quantitative data to assess changes occurring over time.~~

~~A consistent and quantitative methodology will be implemented and undertaken on a periodic basis, ensuring a satisfactory number of analogue/baseline sites are established to inform target setting. Data from analogue sites will be used to establish target values for key biophysical parameters and indicators related to vegetation diversity/structure and habitat complexity. Permanent quadrats will be established and reassessed at a maximum of two year intervals, at least in the short term, to ensure restorative strategies (i.e. maintenance of soil health, maintenance of ground cover, achievement of suitable species richness etc.) are progressing as desired.~~

In new revegetation sites, an annual monitoring programme will be required as the site rapidly changes and can be vulnerable to effects of climates, pests and diseases. In addition, general inspections for survival, mortality, weed control and pests will be undertaken more regularly and at least biannually until the sites have become well established. The duration between monitoring periods can be lengthened to five yearly intervals once it has been established that the restorative strategies are appropriate and that conservation objectives are being met.

The monitoring methodology adopted is a standard and simple procedure that can be replicated over any vegetation community or rehabilitation area and allows results to compare similar communities. The methodology uses a combination of:

- Landscape Function Analysis (CSIRO Tongway and Hindley 1996);
- Accredited soil analyses and various measures of ecosystem diversity and habitat values (adapted from CSIRO Gibbons 2002)
- The Biodiversity Assessment Methodology (BAM) (Office of Environment and Heritage 2017) (OEH 2017); and
- Assessment of pasture productivity, carrying capacity and stocking rates.

This combination of approaches allows a site to be assessed over time with the resultant data enabling the user to assess the trajectory of the ecosystem being monitored whilst also providing an overall assessment of lands in terms of land capability. In turn this data can be used to decide if the site is converging on a target functional state or requires further works. An overview of the monitoring methodology is provided in **Sections 8.1.2 to 8.1.6** of this report.

8.1.2 LFA Methodology

LFA is a monitoring procedure developed by the CSIRO (Tongway and Hindley 2004) that uses rapidly acquired field-assessed indicators to assess the biogeochemical functioning of landscapes at the hillslope scale. It provides a rapid, reliable, and easily applied method for assessing and monitoring landscape restoration or rehabilitation projects. LFA examines the way physical and biological resources are acquired, used, cycled and lost from a landscape.

Soil Surface Condition Indicators (SSCIs) focusing on the measurement of specific biological and/or physical processes are used to calculate three LFA indices – soil stability, soil infiltration and nutrient cycling. The three indices have scores of 0 to 100, which represent the ecosystem function of the area. These scores provide quantitative measures that may be used to compare rehabilitated areas with reference sites throughout the course of a monitoring program.

An LFA plot and transect is completed at each rehabilitation and reference site.

Landscape Function Analysis (LFA) is a methodology used to assess key indicators of ecosystem function including landscape organisation and soil surface condition as measure of how well the landscape retains and uses vital resources. The indicators used quantify the utilisation of the vital landscape resources of water, topsoil, organic matter and perennial vegetation in space and time.

Landscape Function Analyses LFA methodology collects data at two “nested” spatial scales:

- At coarse scale, landscape organisation is characterised. Patches and interpatches, indicators of resource regulation, are mapped at the 0.5 to 100 m scale from a gradient oriented transect (making sense of landscape heterogeneity); and
- At fine scale, soil surface assessment (soil “quality”) examines the status of surface processes at about the 1 m scale, with rapidly assessed indicators on the patches and interpatches identified at coarse scale.

8.1.3 Soil Analysis

Soil characterisation and analysis is performed to determine the physical and chemical properties of the growing media. Soil samples are collected from all monitoring sites (rehabilitation and reference sites). A composite sample, consisting of a minimum of nine sub-samples collected 10 m to 15 m apart, are collected within a 20 m radius. The radius is based on a central point 5 m in from the 20 m quadrat tape. All samples are placed in a bucket, and are mixed. The sample is then placed in a plastic bag, labelled, and sent for analysis.

The following soil parameters are tested:

- pH;

- Electrical conductivity (EC);
- Cation balance;
- Sodicity;
- Soil organic matter content; and
- Soil texture including clay content.

~~Soil samples are to be undertaken using standard soil sampling techniques with a core sampler within the monitoring quadrat. Cores are to be taken at each site and bulked together. Soil samples are to be sent an accredited laboratory for analysis. Soil analysis consist of assessing the parameters, pH, EC, Available Ca, Mg, K, Ammonia, sulphur, organic matter, exchangeable Na, Ca, Mg, K, H, Al, cation exchange capacity, available and extractable phosphorus, micronutrients (Zn, Mn, Fe, Cu, B), Total Carbon and Nitrogen. To assist in the interpretation of the data a report with analysis and appropriate recommendation is to be provided by the laboratory.~~

8.1.4 Canopy Development ~~Monitoring structural diversity, floristics and other biodiversity attributes~~

To understand the adequacy of canopy development at rehabilitation sites in terms of species diversity, stem density, size and habitat values, two additional assessment techniques were introduced.

One captures the adequacy of canopy recruitment, whilst the other captures canopy development and maturity:

- Introduction of stem density counts along two, 2 m strips along the length of the 50 m centre tape. The number and species of each individual canopy tree was counted. Where individuals could not be identified to species level, they were identified to genus.
- Information pertaining to canopy development; diversity and density, average trunk diameter, condition of the tree population, and percent of the endemic canopy with reproductive structures. This was undertaken in the nested 20 m x 20 m plot and each tree labelled with a metal tree tag or flagging tape with an ID number to allow for follow-up monitoring. Trees with a DBH less than 5 cm were not included in the count.

~~Permanent transects and photo-points will be established to record changes in these attributes over time.~~

~~The methodology is to provide quantitative data that measures changes in:~~

- ~~• Floristic diversity including species-area curves and growth forms;~~
- ~~• Ground cover diversity and abundance;~~
- ~~• Vegetation structure and habitat characteristics (including ground cover, cryptogams, logs, rocks, litter, projected foliage cover at various height increments);~~
- ~~• Understorey density and growth (including established shrubs, direct seeding and tubestock plantings and tree regeneration);~~
- ~~• Overstorey characteristics including tree density, health and survival; and~~
- ~~• Other habitat attributes such as the presence of hollows, mistletoe and the production of buds, flowers and fruit.~~

8.1.5 BioBanking Assessment of Vegetation Integrity

The NSW Biodiversity Banking and Offsets Scheme – known as 'BioBanking' was introduced by the NSW government in 2008. The BioBanking Assessment Methodology (BAM) assesses biodiversity values. These values include the composition, structure and function of ecosystems. They also include (but are not limited to) threatened species, threatened populations and threatened ecological communities, and their habitats.

AECOM (2012) refers to the use of 'site value' to provide a quantitative measure of the condition of the vegetation within each rehabilitation area. The site value for a particular zone is calculated based on quantitative measures of ten site attributes which are measured along a transect and within a survey plot, and assessed against benchmarks values (refer **Table 34**). A minimum number of plots are required based on the area of the site being assessed. It was thought to be more valuable to present results for each of the BioBanking criteria rather than just the site value score. In accordance with the relevant MOP performance criteria, the results for rehabilitation areas are compared to reference site benchmarks.

Table 34 BioBanking Assessment Value Scores

Attribute	Explanation
Native plant species richness (NPS)	Number of native species recorded within a nested 20 m x 20 m quadrat.
Native over-storey % cover (NOS)	Recorded at 5 m intervals along a 50 m tape
Native mid-storey % cover (NMS)	Recorded at 5 m intervals along a 50 m tape
Native ground cover (grass) % cover (NGCG)	Recorded at 1 m intervals along a 50 m tape
Native ground cover (other) % cover (NGCO)	Recorded at 1 m intervals along a 50 m tape
Native ground cover (shrubs) % cover (NGCS)	Recorded at 1 m intervals along a 50 m tape
Exotic plant cover % cover (EPC)	Recorded at 1 m intervals along a 50 m tape
Overstorey regeneration	Regeneration is measured as the proportion of over-storey species present in the zone that are regenerating (i.e. with diameter at breast height < 5 cm). For example, if there are three tree species present in the zone but only one of these species is regenerating, then the value is 0.33. The maximum value for this measure is 1.
Fallen logs (m) Length of logs (m) (FL)	Total length of logs recorded within the 20 m x 50 m quadrat. To be eligible for inclusion, logs must be >10 cm diameter and longer than 50 cm.
Number of trees with hollows (NTH)	Number of trees with hollows within the 20 m x 50 m quadrat.

The Biodiversity Assessment Method (BAM) (OEH 2017) was developed to provide a method of assessment of biodiversity values. This enables the identification of biodiversity values of land subject to a proposed action, determine the impacts of the action on biodiversity values and determine the biodiversity credits required to offset the proposed action. While the full BAM assessment is not required, aspects of the BAM methodology enable a repeatable assessment of the vegetation integrity so that the vegetation trends over time can be determined.

Vegetation Integrity is the quantitative measure which forms part of the BAM. The vegetation integrity assessment considers various aspects relating to site condition; specifically those relating to composition, structure and function.

The calculation of the site condition is determined from the assessment of the survey plots and entering the data into the BAM Credit Calculator to determine the vegetation integrity score. Details on the methodology are provided in Section 5.3 of Biodiversity Assessment Method (OEH 2017).

8.1.6 Visual Inspections Pasture productivity, carrying capacity and stocking rates

Species Composition

The dominant species present in the monitoring area are identified to obtain a 'picture' of the species composition. In rehabilitation areas, this allowed confirmation that the species establishing conformed to the target vegetation types being re-established.

Additionally, notes are made on the general health and sustainability of vegetation as indicated by presence/absence of flowering/fruited adult plants. The presence of plants at reproductive stage is an indication that the ecosystem is recruiting and, as such, capable of self-regeneration.

Habitat and Fauna Monitoring

Artificial habitat features installed throughout the site as part of the rehabilitation activities (e.g. stag trees) are recorded.

Notes are also made on the presence and extent of habitat features such as free standing water, coarse woody debris, rocks, mistletoes and whether plants were flowering or fruiting.

Disturbance Monitoring

Disturbance monitoring is undertaken using the visual monitoring tool developed by AECOM (2012). This technique is a field-based, rapid assessment tool to visually assess and award a score to various contributors. The objective of this monitoring is to identify factors and processes that occur at the landscape/catchment scale

and have the potential to impact on the monitoring site. The disturbance monitoring aims to cover those aspects that are not adequately covered in the BioBanking and LFA monitoring tools. The following disturbance categories (and associated disturbance factors) are monitored and assessed at each site:

- Disturbance related to mining activities, including:
 - Evidence of wheeled vehicles, tracked vehicles and foot disturbance;
 - Excavation; and
 - Presence of mine rubbish;
- Disturbance related to non-mining activities, including:
 - Evidence of grazing;
 - Presence of animal pads;
- Presence of exotic weeds and feral animal species;
- Presence of domestic litter/rubbish;
- Fire disturbance;
- Evidence of nearby maintenance activities (i.e. chemical treatments, fencing, earthworks);
- Surface stability and erosion issues, including:
 - Eroding factor (i.e. wind, water); and
 - Erosion type (i.e. sheet, rill/gully, pedestal, terracette, scalding).

~~The assessment of pasture productivity is to be undertaken utilising a range of pasture samples collected randomly along each transect following industry technique guidelines. An analysis of each sample is to be undertaken at an accredited laboratory to ascertain the quality of feed available.~~

~~Utilising this data carrying capacity calculations will be undertaken for each pasture type sampled from the pasture transects. Approximate minimum area per breeding unit will also be determined for both 'Weaner' and 'Dry Stock' production using the industry guidelines. Calculations utilising information from each transect such as, typical fertiliser use and the available phosphorus would also be reviewed based on the analysis results together with Dry Stock Equivalent (DSE) reference tables.~~

~~Using this information, site personnel would be able to predict the future carrying capacity and potential stocking rates for the site. Additionally, this information would then be used to underpin cattle land and cattle management procedures, whilst also being able to objectively answer stakeholder questions relating to land management and post mining land use.~~

8.1.7 Photographic Monitoring

Photographic monitoring is a simple and useful tool that allows for direct visual comparison of a specific site between monitoring events. Digital photographs are taken at the start and finish transect points at each monitoring site. This included:

- A photograph with the tape (and star picket) in the centre of the frame.
- Photograph to the left and right of the centre tape.

8.2 Reporting

Incidents will be reported in accordance with relevant mining leases and Schedule 5, Condition 2 of Project Approval 06_0261 which states that HVO South must immediately notify the Secretary and any other relevant agencies of any incident. Within 7 days of the date of the incident, HVO South must provide the Secretary and any relevant agencies with a detailed report on the incident, and such further reports as may be requested.

Non compliances and incidents will be reported within the Annual Review and (if relevant) the EPL Annual Return. If an incident causes or threatens serious environmental harm, then incident management and reporting will be completed as per the *Pollution Incident Response Management Plan*.

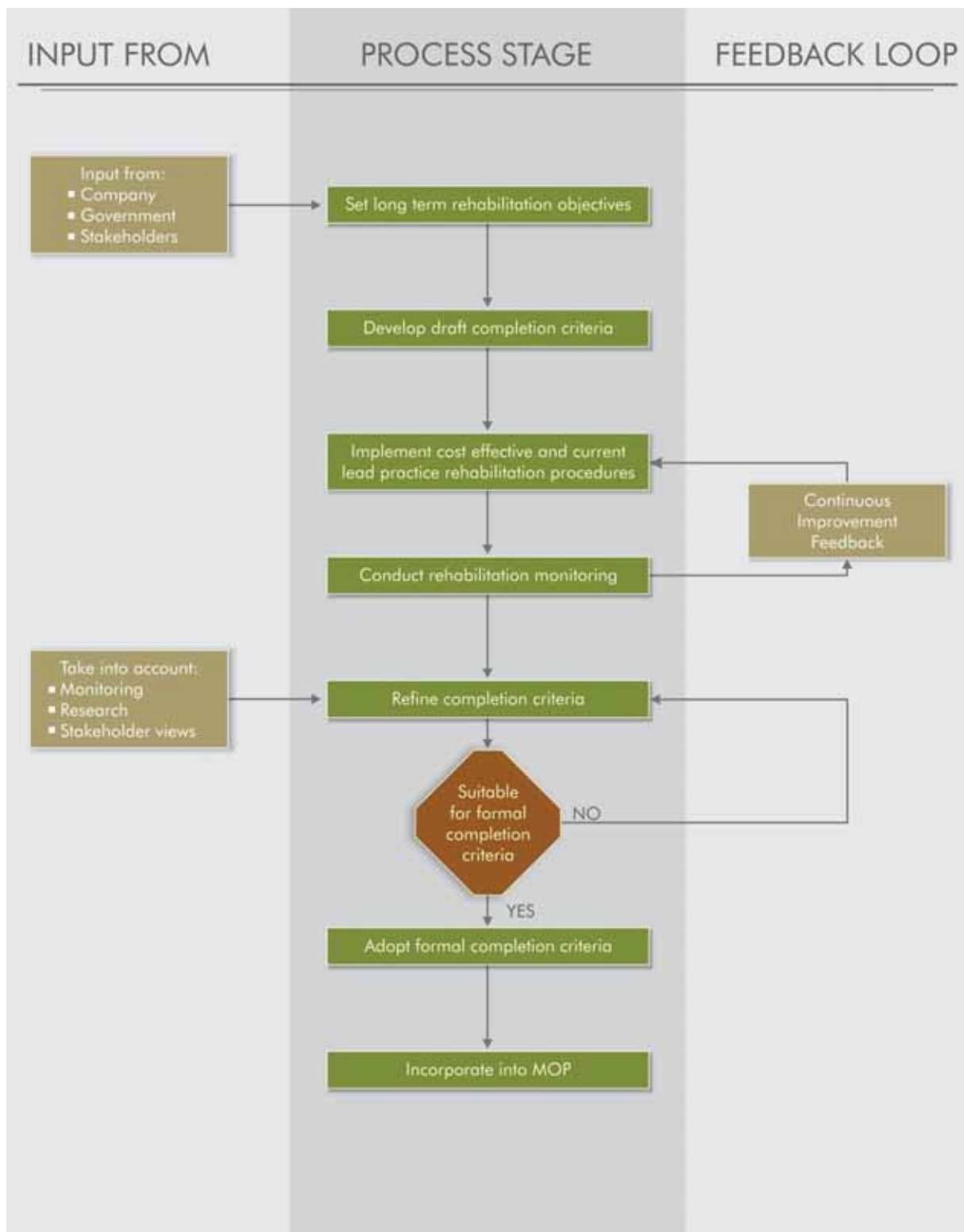
The following reporting will be undertaken in keeping with the requirements of Schedule 5 of the Project Approval for managing and reporting any incidents, complaints, non-compliances with statutory requirements and exceedance of the impact assessment criteria and/or performance criteria:

- Amendments to the Environmental Management System which incorporates components of the monitoring and reporting programme;
- Incident reporting mechanism;
- Annual Environmental Report;
- Independent Environmental Audit;
- Community Consultative Committee; and
- Access to information via the project website which is updated regularly.

The monitoring, review and implementation of this MOP will be the responsibility of the Manager Environment and Community.

Rehabilitation is an iterative process which allows activities to be defined and improved upon throughout the lifetime of the mine. Monitoring of rehabilitation successes and failures will enable lessons learnt in early years of rehabilitation to be applied in subsequent and later years. It will also ensure that continuous improvement in the site's performance in terms of landscape and land use is achieved. An example of an iterative, continual improvement approach to mine site rehabilitation which may be implemented as shown in **Figure 2** (based on Nichols, 2005).

Figure 2 Continuous Improvement including Monitoring and Review Process (based on Nichols 2005)



9.0 Trigger Action Response Plan

The following Trigger Action Response Plan (TARP) identifies the proposed contingency strategies in the event of unexpected variations or impacts to rehabilitation outcomes. A risk-based approach has been used to assess the potential consequences and mitigation measures in terms of the Consequence Category – Environment.

The key risks associated with site rehabilitation have been assessed using the likelihood ratings, maximum reasonable consequence ratings, risk matrix and classifications presented in **Section 4.1**.

Table 35 outlines the key identified risks and associated risk ratings. The ratings assume that the risks are untreated i.e. have not been addressed by specific risk mitigation measures other than routine design and operational practice. Proposed mitigation measures to reduce the identified risks are outlined in **Table 36**.

Table 35 Key risks associated with site rehabilitation and land management

Risk	Risk Rating	Consequence Rating	Risk Classification
Earthquake leading to failure and instability of void walls or TSF embankments.	E	2	Low
Continuous off-site release of contaminants from mined materials requiring long term management or treatment.	C	3	High
Inadequate or insufficient topsoil to create/enhance the desired ecological communities on offset areas.	C	3	High
Wind and water erosion.	C	2	Moderate
Geo-chemical soil instability results in erosion of built features or rehabilitation.	C	2	Moderate
Inadequate weed and vertebrate pest animal control leading to widespread failure of revegetation or continued sustainability of offset area ecosystems.	C	3	High
Insufficient or inadequate (incorrect species mix/quality) seed/seedlings for enhancement/rehabilitation of offset areas. Poor establishment success.	C	2	Moderate
Insect attack diseases etc.	C	3	High
Lack of follow up maintenance.	A	4	High
Stratification and overturning of void waters leading to environmental impacts.	D	3	Moderate
Inappropriate bushfire regime leading to widespread failure of revegetation or continued sustainability of offset area ecosystems.	C	3	High
Spontaneous combustion of coal seam leading to environmental impacts or property damage.	D	3	Moderate
Major storm event resulting in flooding, geotechnical instability, major erosion and/or widespread damage to rehabilitated areas.	C	3	High
Severe and/or prolonged drought leading to widespread failure of revegetation.	C	3	High
Changing climate leading to failure of rehabilitation, failure of environmental management controls and/or inability to attain completion criteria.	C	2	Moderate
New regulatory requirements or evolving community expectations leading to difficulties negotiating or attaining completion criteria.	C	3	High

The following TARP identifies the proposed contingency strategies in the event of unexpected variations or impacts to rehabilitation outcomes. A risk-based approach has been used to assess the potential consequences and mitigation measures in terms of the Consequence Category – Environment. Where necessary, rehabilitation procedures will be amended accordingly, with the aim of continually improving rehabilitation standards. ~~Hunter Valley Operations~~ HVO will notify ~~RR DRG~~ and other relevant stakeholders of any incident resulting in major impacts to rehabilitation. The TARP has been developed based on the rehabilitation and closure risks identified in the BBRA in Appendix 2. The TARP includes:

- Identification of the principal contributing factors and impacts for each major risk to rehabilitation;
- Identification of upper limits (trigger values) for causes and impacts that are considered to represent an unacceptable level of risk; and
- Identification of appropriate responses to mitigate or remediate the causes and impacts, including a notification protocol.

The TARP provides management responses for lower (first tier) and upper (second tier) trigger values. First tier trigger values identify opportunities for closer monitoring or early intervention that may mitigate potential impacts before notable impact to rehabilitation occurs. Second tier trigger values identify when indicators have reached a threshold that requires more substantive or widespread remedial actions to remediate or mitigate rehabilitation failure.

The TARP is presented in **Table 36** below, and will be reviewed and may be revised as conditions at HVO change or new risks to rehabilitation are identified.

Table 36 Trigger Action Response Plan – Rehabilitation and Closure

Aspect/ Category	Item	Element	Trigger	Response
Landform Stability	1	Water Management Structures	Water management structures (sediment dams, channels, contour banks) erosion &/or scouring	An inspection of the site will be undertaken by a suitably trained person. Undertake remedial actions such as amelioration, revegetation or alternative scour protection as required. For significant failures or repeat minor failures conduct review of design criteria and construction standards.
	2	Slope Gradient – General	Overall slope grades > 10 degrees unless otherwise agreed.	Undertake a review of the landform design, including survey if required. Undertake re-grading and revegetation of the area, if required. Note, localised steepening of slopes will occur due to contour bank construction etc.
	3	Slope Gradient – Internally draining slopes	Overall slope grades > 18 degrees unless otherwise agreed.	Undertake a review of the landform design, including survey if required. Undertake re-grading and revegetation of the area, if required. Note, localised steepening of slopes will occur due to contour bank construction etc.
	4	Batter Slopes – Final Void	Failure of final void batter slopes.	Undertake a review of final void design, including survey if required. Undertake remedial blasting &/or re-grading of the area, if required.
	5	TSF Final Capping Surface	Settlement of tailings causing ponding of water on TSF capping surface.	An inspection of the site will be undertaken by a suitably trained person. Undertake remedial actions such as backfilling, reinstating drainage lines and revegetating as required.
	6	Geo-chemical instability	Evidence of erosion due to geo-chemical instability in the soil.	An inspection of the site will be undertaken by a suitably trained person. The soil will be examined and remedial actions such as amelioration, backfilling and/or revegetation will be undertaken as appropriate.

Spontaneous Combustion	7	Carbonaceous Material on Surface of Rehabilitation	Active spontaneous combustion within rehabilitation areas.	An inspection of the site will be undertaken by a suitably trained person. Undertake remedial actions such as extinguishment by watering, capping with inert material or excavation and removal as required. For widespread spontaneous combustion activity review management measures for carbonaceous material.
	8	Exposed Coal Seams	Active spontaneous combustion from exposed coal seams.	Although generally low, the seams at HVO have been examined for their potential to spontaneously combust and are managed to avoid this risk. A burial depth of 5 m of exposed coal seams is considered appropriate as outlined in Appendix B. Should it occur, an inspection of the site will be undertaken by a suitably trained person. Remedial actions such as extinguishment by watering or flooding or burial with inert material will be undertaken as required. For widespread spontaneous combustion activity, management measures for covering exposed coal seams will be reviewed and implemented as appropriate.
Growth Medium Suitability	9	Acid Rock Drainage (ARD)	Evidence of ARD products affecting vegetation establishment.	An inspection of the site will be undertaken by a suitably trained person. Undertake remedial actions such as capping with inert material and revegetating as required. For widespread ARD activity review management measures for burial of potential ARD producing material.

Vegetation Establishment	10	Chemical and Nutritional Properties	Soil properties atypical for the surrounding landscape &/or outside desirable ranges provided by the agricultural industry: <u>Pasture Trigger Levels</u> pH <5.5 or >8.5; Electrical Conductivity >2 dS/m; Phosphorous <40ppm; Organic Carbon <1.5%; Cation Exchange Capacity <12 Cmol+/kg; Exchangeable Sodium Percentage >10%; and Calcium/magnesium ratio <1 or >10. <u>Woodland Trigger Levels</u> pH <5.5 or >8.5; Electrical Conductivity >2 dS/m; Phosphorous and Organic Carbon not within levels in analogue sites by Year 5; Cation Exchange Capacity, Exchangeable Sodium Percentage and Calcium/magnesium ratio not within levels in analogue sites by Year 2.	Engage a consultant to recommend appropriate soil/spoil amelioration. Undertake amelioration and revegetation in accordance with the consultant recommendations as required.
	11	Growth Medium Depth	Soil depth (topsoil and ameliorates) is less than 100mm in areas in the Growth Medium Development phase.	Top dress with additional suitable topsoil resource and /or ameliorants if required. For repeat topsoil thickness issues conduct review of topsoil placement procedures and operational practices.
	12	Weed Levels	>10% cover of problematic weed species present in Ecosystem Establishment phase.	Engage land management contractor to control problematic weed using methods such as removal, biological control, herbicide application and slashing. Treatment of infestations as appropriate to the species. Conduct follow-up inspections to assess the effectiveness of weed management measures.
	13	Bushfire Resilience	Rehabilitation areas not able to recover in a reasonable time from effects of bushfire.	An inspection of the site will be undertaken by a suitably trained person. Undertake remedial actions such as re-seeding affected area as required. Review bushfire management procedures particularly with a view to

				protecting young rehabilitation areas.
14	Uncontrolled Entry of Livestock or Vehicles	Damage to vegetation caused by uncontrolled access by livestock or vehicles.		An inspection of the site will be undertaken by a suitably trained person. Undertake remedial actions such as fence installation or repairs, maintaining access tracks and sign posting.
15	Understorey Species Diversity	Understorey species diversity atypical compared to analogue sites. Trigger levels still to be determined for understorey diversity in Grassland and Woodland areas.		An inspection of the site will be undertaken by a suitably trained person. Undertake remedial actions such as grazing, controlled burning, soil amelioration, reseeding and fertilising as required. For widespread low understorey diversity review seed mix understorey species composition and seeding rates. Review monitoring results to determine rates of successful establishment for various understorey species in seed mixes.
16	Tree and Shrub Species Diversity	Tree and shrub species diversity atypical compared to analogue sites. Trigger levels still to be determined for tree and shrub diversity in Woodland areas.		An inspection of the site will be undertaken by a suitably trained person. Undertake remedial actions such as cultivation or spraying to reduce grass competition, reseeding and fertilising as required. For widespread low tree and shrub diversity review seed mix tree/shrub species composition and seeding rates. Review monitoring results to determine rates of successful establishment for various tree/shrub species in seed mixes.
17	Tree Density	Tree density is outside typical range for analogue sites. Trigger levels still to be determined for tree density in Woodland areas.		An inspection of the site will be undertaken by a suitably trained person. Undertake remedial actions such as cultivation or spraying to reduce grass competition, reseeding (for low density) and thinning (for high density) as required. For widespread tree density outside analogue site ranges review seed mix tree species composition and seeding rates. Review monitoring results to determine rates of successful establishment for various tree species in seed mixes. Review seed bed preparation, weed/grass control and sowing procedures.
18	Ground Cover	Total ground cover < 70% during Ecosystem Establishment phase.		An inspection of the site will be undertaken by a suitably trained person. Undertake remedial actions such as soil amelioration, soil aeration, reseeding and fertilising as required. For widespread low results for total ground cover review seasonal mixes and seeding rates.
19	Tree Growth Rate	Average trunk diameter (dbh) of the tree population measuring		An inspection of the site will be undertaken by a suitably trained person. Undertake remedial actions such as soil amelioration and fertilising as

			growth rate are atypical compared to analogue sites. Trigger levels still to be determined for tree growth rate in Woodland areas.	required. For widespread low results for tree growth rate review soil amelioration and preparation procedures.
	20	Tree Health	Tree health is atypical compared to analogue sites. Trigger levels still to be determined for tree health in Woodland areas.	An inspection of the site will be undertaken by a suitably trained person. Undertake remedial actions such as soil amelioration and fertilising as required. For widespread low results for tree health review land management practices with a view to increasing biodiversity to provide habitat for pest insect predators.
	21	Tree Productive Health and Recruitment	Tree health and recruitment levels are atypical compared to analogue sites. Trigger levels still to be determined for tree productive health and recruitment in Woodland areas.	An inspection of the site will be undertaken by a suitably trained person. Undertake remedial actions such as soil amelioration and fertilising as required. For widespread low results for tree productive health review land management practices with a view to increasing biodiversity to provide habitat for pollinators.
Fauna Recolonisation	22	Vertebrate Pest Levels	Vertebrate pest species density increased in annual monitoring events or causing significant damage to rehabilitation.	Consult with relevant government agencies (including OEH) to develop and implement appropriate vertebrate pest control programme.
Ecosystem Function	23	Stability, Infiltration and Nutrient Cycling	LFA indices values for stability, infiltration, nutrient cycling or landscape organisation are trending away from the values of analogue sites.	An inspection of the site will be undertaken by a suitably trained person. Undertake remedial actions such as soil amelioration, soil aeration, reseeded and fertilising as required. For widespread negative trends for LFA indices review rehabilitation procedures related to soil amelioration and preparation.

10.0 Research and Rehabilitation Trials

10.1.1 Mixed Source Compost Trials

Trials commenced in 2011 using mixed source compost as a soil ameliorant in rehabilitation activities. This material is being assessed against the more traditional chemical fertilisers. The purpose of the trials is to ascertain the effectiveness of compost in both areas of pasture mix and diverse tree/shrub/understorey native species mix. The material is also being assessed in context of two substrates with topsoiled and spoil areas being used in the trial. Investigations have also been undertaken in relation to the inoculation of the compost stockpiles to mitigate odour nuisance for onsite personnel whilst also improving the agronomic properties of the compost.

10.1.2 Native Understorey Establishment Trials

The native vegetation seed mixes used for rehabilitation activities at HVO were modified in 2011 to include more native understorey species diversity. Trials are also being undertaken in relation to the sowing techniques for the native seed with previous trials of hydro seeding, hand broadcasting and a triple – disc direct drill machine with a native seed box. The direct drill has proved to be the most cost-effective method and has the added benefit of placing seed at the desired depth and providing seed/soil contact rather than broadcasting seed on the surface.

Banded seed mixes have been assessed to determine if sowing separate bands of tree/shrub seed and native understorey seed is more efficient for establishing trees and shrubs with a diverse native understorey. Results of previous trials indicated that banded seed mixes were not more effective at establishing the desired vegetation so the seed mixes being used have all of the various strata combined.

10.1.3 Carlson Regrade Landform Investigation

The purpose of this study is to investigate the effect on dump volume and dump extents (i.e. dump limits and heights) from using the Carlson package to design the landform. It is understood that the benefits of using Carlson Regrade is that it will produce more natural looking landforms with inherent stability, removing the need for contour drains and rock lined drop structures to convey water off slopes.

10.1.4 Grazing Trial

An Australian Coal Association Research Program (ACARP) supported grazing trial commenced in 2014 across rehabilitated mined land and unmined land to compare the performance of rehabilitation areas as grazing land. HVO has a trial site at HVO North and a control site on the nearby Wandewoi property. A previous grazing trial conducted at Howick Mine only ran for twelve months while this trial is planned to be conducted over at least three years to provide information over a variety of seasonal conditions. Monitoring is being conducted by personnel from NSW DPI and includes soil testing, pasture composition and productivity, feed quality, cattle weighting and blood testing.

10.1.5 Other Research and Trials

Hunter Valley Operations has undertaken, and continues to undertake extensive research into rehabilitating open cut mines in the Hunter Valley. Research is undertaken in conjunction with organisations such as DPE, NSW State Forests and the NSW Minerals Council. Some examples of research undertaken and rehabilitation techniques developed as a result of the research includes:

- Establishing forests by direct seeding into overburden emplacements or CPP reject without topsoil;
- Growing pastures on overburden emplacements with and without topsoil;
- Developing a sustainable pasture mix that provides year round grazing capacity;
- Managing rehabilitated areas so that viable grazing land is maintained;
- Commercial forestry trials;
- Nutrient cycling in rehabilitated mine spoils; and
- Phytoremediation treatment of hydrocarbon contaminated soils.

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intentionally.

11.0 Review and Implementation

11.1 Review

This section provides the Protocol for periodic review of this MOP. Reviews are conducted to assess the effectiveness of the procedures against the objectives of MOP. The MOP will be reviewed, and if necessary revised, within three months of the submission of an:

- Annual review which has been undertaken as per Schedule 5 – Condition 4 of the Approval;
- **Incident report;**
- Independent Environmental Audit which has been undertaken as per Schedule 5 – Conditions 5 and 6 of the Approval; and
- Any modification to the conditions of the Approval.

This MOP may also be revised due to:

- Deficiencies being identified;
- Results from the monitoring and review programme;
- Recommendations resulting from the monitoring and review programme;
- Changing environmental requirements;
- Improvements in knowledge or technology become available;
- Change in legislation;
- Where a risk assessment identifies the requirement to alter the MOP; and
- Change in the activities or operations associated with HVO South.

Prior to completing any amendment to the MOP, HVO South will liaise with DPE to confirm the requirements for submission and consultation (in accordance with Schedule 5, Condition 4A of PA 06_0261). Following any amendments, a copy of the revised MOP will be provided to the DPE for approval.

Any major amendments to the MOP that affect its application will be undertaken in consultation with the appropriate regulatory authorities and stakeholders. Minor amendments to the MOP, such as formatting edits may be made with version control on the HVO website.

11.2 Implementation

Table 37 defines personnel who are responsible for the monitoring, review and implementation of this MOP.

Table 37 Responsibilities for Implementation of the MOP

Title	Responsibility
Mine Manager	<ul style="list-style-type: none"> • Implement the procedures referenced in this MOP. • Undertake training in relevant Management Plans and procedures as required. • Provide resources required and support to implement these procedures. • Allow for forward planning to prepare and bulk shape areas.
Technical Service Manager	<ul style="list-style-type: none"> • Implement the procedures referenced in this MOP. • Undertake training in relevant Management Plans and procedures as required. • Provide resources required to implement these procedures. • Allow for forward planning to prepare and bulk shape areas.
Environment and Community Manager	<ul style="list-style-type: none"> • Manage environmental staffing levels to verify that outlined tasks can be achieved. • Confirm that personnel preparing management plans, procedures and monitoring have suitable experience for the task. • Verify that all personnel undertaking works in relation to this MOP are trained and competent.

Title	Responsibility
Environment and Community Coordinator	<ul style="list-style-type: none">• Prepare the relevant Management Plans.• Implement, monitor and review the procedures linked to this MOP.• Consult with regulatory authorities as required.• Undertake monitoring as required.• Undertake maintenance as required.• Provide measures for continual improvement to this MOP and procedures.• Ensure all personnel undertaking works in relation to this MOP are trained and competent.• Report the progress of any rehabilitation and monitoring of biodiversity in the Annual Review.
Environment and Community Officer	<ul style="list-style-type: none">• Provide support for the implementation of the Environmental Coordinator's responsibilities.

12.0 Rehabilitation Maps

The Rehabilitation Maps are the core of the MOP. These maps assist to describe the full rehabilitation and closure process of the mine site. The maps include:

- Maps 1A – 1C show the land use prior to the commencement of the HVO South operations, whilst also showing current land ownership, relevant cadastre information and features of the natural and built environment;
- Map 2 shows the mine domains and the mining features at commencement of the MOP;
- Maps 3A – 3E are a series of maps which show the annual sequence of mining and rehabilitation activities over the term of the MOP;
- Map 4 shows the proposed post mining land use and landform at the completion of the project; and
- Map 5 which shows the cross and longitudinal sections.

The Maps are contained within **Appendix D**.

13.0 References

AECOM (2012) Monitoring Methodology - Post-mined Lands MTW and HVO North Mine Sites

Coal and Allied (2007) *Draft Conceptual Landscape and Rehabilitation Management Strategy – Hunter Valley Operations*, prepared with the assistance of Corinne Unger – Environmental Consultant, June 2007.

Coal & Allied (2014b) *Hunter Valley Operations Air Quality and Greenhouse Gas Management Plan*, (approved for implementation on 12th February 2014)

Coal & Allied (2014c) *The Regional Offset Management Plan – Warkworth Mine, NSW, Hunter Valley Operations, NSW (June 2014)*

Coal and Allied (2017) *Hunter Valley Operations South – Modification 5 Environmental Assessment*. EMM Consulting

CSIRO Tongway and Hindley (1996) *Landscape Function Analyses*

DECC (2008) *Managing Urban Stormwater Volume: 2E mines and Quarries*

DECCW (2008) *Biobanking Assessment Methodology – Site Value Score*

Department of Trade and Investment, Regional Infrastructure and Services (2013) *ESG3: Mining Operations Plan (MOP) Guidelines*, Department of Trade and Investment, Regional Infrastructure and Services – Division of Resources and Energy, Sydney.

DMR (1999) *Synoptic Plan: integrated landscapes for coal mine rehabilitation in the Hunter Valley of NSW*, prepared by Andrews Neil Architects Planners for the NSW Department of Mineral Resources, Sydney, 152 pp.

ERM (2008) *Raising of Lake James Dam – Environmental Assessment*, prepared for Coal and Allied

EMGA Mitchell McLennan (2010) *Proposal Modification to HVO South Project – Environmental Assessment*, prepared for Coal and Allied 2009

EMGA Mitchell McLennan (2012) *HVO South Project Approval – Administrative Omissions and Clarifications - Environmental Assessment*, prepared for Coal and Allied 2012a.

EMGA Mitchell McLennan (2012) *HVO South Project Approval – Dedication of Lands for Offsets - Environmental Assessment*, prepared for Coal and Allied 2012b.

Hunter Valley Operations (2017) *Bushfire Management Plan*, last updated June 2017.

Hunter Valley Operations (2016) *Environmental Management Strategy*, last updated 2016.

Nichols, O.G. (2005) *Development of rehabilitation completion criteria for native ecosystem establishment on mineral mines in the Hunter Valley*. Australian Centre for Minerals Extension and Research. ACARP Project No. C13048, Queensland.

Office of Environment and Heritage (OEH) (2017) *Biodiversity Assessment Method*, Office of Environment and Heritage, Sydney.

Peak (2006) *Vegetation lists for Central Hunter Box-Ironbark Woodland and Central Hunter Ironbark-Spotted Grey-Gum Box Forest*

Umwelt (2010) *Hunter Valley Operations River Red Gum Rehabilitation and Restoration Strategy*, prepared for Coal and Allied by Umwelt Australia Pty Ltd on behalf of EMGA Mitchell McLennan, March 2010.

Victorian DPI (2005) *Monitoring Tools – Sustainable Carrying Capacity*, Victorian Department of Primary Industries, Melbourne.

14.0 Acronyms

ACARP	Australian Coal Association Research Program
ADCC	Aboriginal Development Consultative Committee
AHIP	Aboriginal Heritage Impact Permit
ACHMP	Aboriginal Cultural Heritage Management Plan
AQMP	Air Quality & Greenhouse Gas Management Plan
ARI	Average Recurrence Interval
AWS	Annual Works Schedule
BA	Biodiversity Area
bcm	Bank cubic metre
Coal and Allied	Coal and Allied Operations Pty Limited
CCC	Community Consultation Committee
CCL	Consolidated Coal Lease
CFMEU	Construction, Forestry, Mining and Energy Union
CHCC	Cultural Heritage Consultation Committee
CHMS	Cultural Heritage Management System
CHWG	Hunter Valley Cultural Heritage Working Group
CL	Coal Lease
CLRMS	Conceptual Landscape and Rehabilitation Management Strategy
CLWD	Crown Lands & Water Division
CPP	Coal Preparation Plant
DA	Development Application
DECC	Department of Environment and Climate Change
DI	Department of Industry
DMR	NSW Department of Mineral Resources (now DRG)
DPE	NSW Department of Planning and Environment
DPI-MP	NSW Department of Primary Industry—Minerals and Petroleum (now DRG)
DRE-MR	NSW Department of Trade and Investment, Regional Infrastructure and Services— Division of Resources and Energy Mineral Resources Branch (now DRG)
DRG	Division of Resources and Geoscience
DSE	Dry Stock Equivalent
DoP	NSW Department of Planning (now DPE)
EA	Environmental Assessment
EFA	Ecological Function Analysis
EIS	Environmental Impact Statement
EMGA	Environmental Management Group Australia
EMP	Environmental Management Plan
EMS	Environmental Management Strategy
EPA	Environmental Protection Authority

EP&A Act	<i>Environmental Planning and Assessment Act 1979</i>
EPL	Environmental Protection Licenses
GDP	Ground Disturbance Permit
GIS	Geographic Information System
ha	Hectare
HSEQ	Health, Safety, Environment and Quality
HRSTS	Hunter River Salinity Trading Scheme
HVCP	Hunter Valley Coal Preparation Plant
HVGC	Hunter Valley Gliding Club
HVLP	Hunter Valley Loading Point
HVO	Hunter Valley Operations
kV	Kilo Volts
LCPP	Lemington Coal Preparation Plant
LLS	Local Land Services
Mbcm	Million bank cubic metre
ML	Mining Lease
MOP	Mining Operations Plan
MSC	Muswellbrook Shire Council
MSDS	Material Safety Data Sheets
Mt	Million tonnes
Mtpa	Million tonnes per annum
MTW	Mount Thorley Warkworth
NLP	Newdell Loading Point
NNCRS	Near Neighbour Community Relations Strategy
NMP	Noise Management Plan
NOW	NSW Office of Water
NPWS	National Parks and Wildlife Service
NSW	New South Wales
OEH	NSW Office of Environment and Heritage
OLC	Overland Conveyor
OMP	Regional Offset Management Plan
PCBs	Polychlorinated biphenyls
RR	NSW Department of Planning and Environment - Resources Regulator
RL	Reduced Level
RFS	Rural Fire Service
ROM	Run Of Mine
RRG	River Red Gum
RRGRS	River Red Gum Rehabilitation and Restoration Strategy
RMS RTA	Roads and Maritime Services Roads and Traffic Authority

SC	Singleton Council
t	tonne
TARP	Trigger Action Response Plan
tph	Tonnes per hour
TSC Act	Threatened Species Conservation Act 1995 (NSW)
TSF	Tailings Storage Facility
TWMS	Total Waste Management System
UHVAC	Upper Hunter Valley Aboriginal Community
WMP	Water Management Plan
WWAP	Working Weed Action Plan

Appendix A

Planning Approval PA 06_0261

Project Approval

Section 75J of the *Environmental Planning and Assessment Act 1979*

I approve the project referred to in Schedule 1, subject to the conditions in Schedules 2 to 5.

These conditions are required to:

- prevent, minimise, and/or offset adverse environmental impacts;
- set standards and performance measures for acceptable environmental performance;
- require regular monitoring and reporting; and
- provide for the on-going environmental management of the project.

The Hon Kristina Keneally MP
Minister for Planning

Sydney

Signed: 24 March 2009

SCHEDULE 1

Project Application:	06_0261
Proponent:	Coal and Allied Operations Pty Limited
Approval Authority:	Minister for Planning
Land:	See Appendix 1
Project:	Hunter Valley Operations South Coal Project

Blue type represents December 2009 modification
Red type represents 3 February 2012 modification
Green type represents 31 October 2012 modification
Purple type represents 31 October 2012 modification
Light blue type represents 28 February 2018 modification

Appendix B

Consultation Response



DOC18/517773

25 July 2018

Tony Galvin
HV Operations Pty Ltd
PO Box 315
Singleton NSW 2330

By email: Michael.Lloyd@coalandallied.com.au

Dear Tony,

Consolidated Coal Lease (CCL) 714, Coal Lease (CL) 327, CL 398 (1973), Mining Lease (ML) 1465, ML 1634 and ML 1734, ML 1682 (1992) HVO South Mining Operations Plan:

NOTICE OF APPROVAL

Pursuant to Condition 3 of CCL 714, CL 327, CL398, ML 1634, ML 1682, ML 1734, and Condition 2 of ML 1465, the Mining Operations Plan (MOP) that was submitted to the Department of Planning and Environment – Resources Regulator (the Regulator) on 11 July 2018 (our reference: DOC18/486291) is approved for the period from the date of this approval until 30 July 2023.

This MOP approved by the Regulator is limited to:

- Current preliminary rehabilitation objectives and completion criteria; and,
- Rehabilitation activities proposed for the MOP period.

The Regulator considers that the MOP is prepared in accordance with the ESG3 Guideline, however the following gaps have been identified:

1. The MOP does not adequately define final landuses. Additional work is required to develop specific and detailed rehabilitation objectives and completion criteria that clearly define the final land uses (particularly the agricultural capabilities for 'grazing areas' and the biodiversity values for woodland areas). Extensive trials have been undertaken on site and there is no integration of the results into the rehabilitation program.
2. Rehabilitation methodologies and completion criteria for landform construction (earthworks and final landform drainage) are preliminary and do not commit to recognised design standards; and
3. The rehabilitation monitoring program is not well aligned to the current completion criteria.

The Regulator has approved the MOP however will seek further development of completion criteria following the current Annual Environmental Management Report review of rehabilitation performance and planning.

Department of Planning and Environment

516 High Street Maitland NSW 2320 | PO Box 344 Hunter Region MC 2310 | planning.nsw.gov.au

It is the responsibility of the Authorisation Holder to ensure that all mining and mining related operations described in this MOP are as approved within the relevant Project Approval or Development Consent and all necessary approvals, consents or permits required under the relevant NSW or Commonwealth regulations have been obtained prior to carrying out the operations.

It is the responsibility of the Authorisation Holder to fulfil their obligations and commitments to the rehabilitation outcomes and performance standards as approved by the relevant consent authority to ensure the rehabilitation outcomes identified are achieved.

DEFINITIONS

In this letter, words have the meaning given to those terms in the Mining Act 1992, unless otherwise specified below.

Regulator means NSW Department of Planning and Environment – Resources Regulator.

Authorisation Holder means the holder of the relevant authorisation(s).

Mining Operations Plan means the project, mining and mining related operations described in the "Mining Operations Plan HVO South" submitted by HV Operations Pty Ltd and dated 9 July 2018.

If you have any questions about this Notice, please contact Chris Cooper on 02 4063 6622.

MONIQUE MEYER
Manager Environmental Operations (Eastern)
Compliance Operations
Resources Regulator
NSW Department of Planning and Environment

Signed under delegation from the Minister for Resources.

Signed under delegation from the Secretary of the NSW Department of Planning and Environment.

The original MOP was approved by the RR on 25 July 2018, citing gaps in information relating to rehabilitation. In response to the letter above, the below table has been prepared.

RR requests from MOP Approval

Item	MOP Section where item has been addressed
The MOP does not adequately define final land uses. Additional work is required to develop specific and detailed rehabilitation objectives and completion criteria that clearly define the final land uses (particularly the agricultural capabilities for 'grazing areas' and the biodiversity values for woodland areas). Extensive trials have been undertaken on site and there is no integration of the results into the rehabilitation program.	Sections 5.0, 6.4 and 6.5
Rehabilitation methodologies and completion criteria for landform construction (earthworks and final landform drainage) are preliminary and do not commit to recognised design standards.	Blue Book, relevant engineering design standards and site specific requirements. Sections 4.2.4 and 6.5
The rehabilitation monitoring program is not well aligned to the current completion criteria.	Section 8.0



18 June 2018

Mr Michael Lloyd
Approvals Specialist – Project Approvals
Hunter Valley Operations
Hunter Valley Services
P O Box 315
SINGLETON NSW 2330

Dear Michael

**Request for comment on Hunter Valley Operations Mining Operations Plan
2018 to 2023**

I refer to our meeting of 8 June 2018 regarding the Mining Operations Plan for Hunter Valley Operations South. Council acknowledges that the Mining Operations Plan reflects the requirements of the relevant planning and mining approvals against which the mine operates.

As discussed at the meeting, the Mining Operations Plan lacks clarity around the intended final land use and alignment with these uses with the rehabilitation objectives identified in Table 16 of the development approval. Specifically, Council is concerned that the lack of identified final land use within the MOP, and other documents, could lead to less than desirable outcomes for the community.

Council is developing a new Strategic Planning Statement in accordance with clause 3.9 of the *Environmental Planning and Assessment Act 1979*, and supporting guidelines. This Planning Statement will include the future land use planning actions for the Singleton Local Government Area. More information regarding the intended final land use of various mining domains (final void, infrastructure areas, agricultural land uses, ecosystem land uses and security) would assist Council and the community in understanding the liability incurred post mining.

I would like to thank you for the opportunity to provide input into the MOP for the Hunter Valley Operations. Please contact me on 02 6578 7290 if you have any questions.


Yours sincerely






A handwritten signature in black ink, appearing to read 'Mary-Anne Crawford'.

Mary-Anne Crawford
Manager Development and Environmental Services

12-14 Queen Street Singleton NSW 2330
PO Box 314 Singleton NSW 2330

T 02 6578 7290 E ssc@singleton.nsw.gov.au
F 02 6572 4197 W singleton.nsw.gov.au

 You replied to this message on 29/06/2018 3:59 PM.

From:  Megan Dawson <Megan.Dawson@planning.nsw.gov.au> Sent: Fri 29/06/2018 3:43 PM
 To:  Lloyd, Michael
 Cc:  Michael Frankcombe;  Leah Cook;  Speechly, Andrew
 Subject: HVO South MOP consultation

Hi Michael,

Please see below the Department's combined comments on the HVO South MOP against the Rehabilitation Management Plan requirements under condition 36 of Schedule 3 of PA 06_0261.

Condition	Compliance	Comments
36. The Proponent must prepare a Rehabilitation Management Plan for the project to the satisfaction of the DRG. This plan must:		
(a) be prepared by suitably qualified expert/s;	Unable to verify	No details provided on the expertise of the author/s
(b) be prepared in consultation with the Department, CLWD, and Council by a suitably qualified and experienced person/s;	Compliant	Consultation with the Department has been undertaken. Consultation with CLWD or Council not assessed.
(c) be submitted for approval within 3 months of the determination of Modification 5, unless otherwise approved by the Secretary;	-	Extension given to 27 July 2018
(d) be prepared in accordance with any relevant DRG Guideline;	-	For DRG to assess
(e) describe how the rehabilitation of the site would achieve the objectives identified in Table 16 and be integrated with the measures in the Biodiversity Management Plan;	Partial	Unclear how the plan has been integrated with the Biodiversity Management Plan
(f) include detailed performance and completion criteria for evaluating the performance of progressive and final rehabilitation and include triggers for remedial action, where these performance or completion criteria are not met;	Non-compliant	<p>Performance and completion criteria are provided however they do not contain sufficient detail. For example, one of the performance indicators provided for landform stability is 'drainage paths and contour drains installed' and the performance criteria is 'drainage paths and contour drains to be constructed to suitable design standards'. At a minimum it should reference Table 6.1 in DECC (2008) which nominates the minimum design standards for drainage and erosion control measures. Further details should also be included on soil geo-chemical suitability, maximum permissible velocity, design ARI's etc.</p> <p>Another example is spontaneous combustion. The performance indicator is 'exposed coal seams will be covered'. The performance criteria provided is 'Exposed coal seam will be covered with 5 metres of inert materials to prevent spon com where practical'. This language is too vague and the cover thickness needs to be justified.</p> <p>The rehabilitation objectives for returning disturbed</p>

		land to areas of native woodland or pasture states that species will 'not necessarily conform to any particular vegetation community'. However, later text states that the species options are based on target vegetation communities identified from analogue sites. This appears to be contradictory and should be clarified.
(g) describe the measures to be implemented to meet the performance and completion criteria, to ensure compliance with the relevant conditions of this approval and to address all aspects of rehabilitation including mine closure, final landform (including the final void), final land use/s, and water management in the final landform;	Partial	Discussed in Section 7, but the level of detail is insufficient
(g) include procedures for the use of interim stabilisation and temporary vegetation strategies, where reasonable to minimise exposed areas;	Partial	Interim revegetation discussed briefly in Section 7.2.4.2, however more techniques should be considered, such as soil polymers or hydraulically applied mulches
(h) include a program to monitor, independently audit and report on the effectiveness of the rehabilitation measures, and progress against the performance and completion criteria;	Partial	Discussed in Section 8, however the timeframes should made more clear ie when/how often will the monitoring, auditing and reporting occur
(i) identify the potential risks to the successful implementation of rehabilitation, and include a description of the contingency measures to be implemented to mitigate against these risks; and	Partial	Discussed in Section 9, however the level of detail in Tables 33 and 34 is insufficient. The risk assessment should also consider tunnel and gully erosion risk post by dispersive and/or magnesian soils as well as saline mine spoils.
(j) include details of who would be responsible for monitoring, reviewing, and implementing the plan.	Compliant	Addressed in Section 11.2
The Proponent must implement the Rehabilitation Management Plan as approved by the Secretary.	-	
General Comments: <ul style="list-style-type: none"> Section 2.6 incorrectly states 'The current approval under the HVO South EA allows for 20 Mtpa to be trucked from HVO South to the HVCPP facility'. This is still restricted to 16 Mtpa because of the HVO North consent. Plans 2, 3A to E depict South Pit Lemington 2 as an active domain '4C'. However, the Department understands that this pit has not yet been mined and is still awaiting Commonwealth approval. Please clarify and adjust the figures accordingly. 		

If you would like to discuss, feel free to contact myself or Michael Frankcombe on 6575 3413.

Regards, Megan

Megan Dawson

Team Leader

Resource Assessments | Planning Services

320 Pitt Street | GPO Box 39 | Sydney NSW 2001

T 02 9274 6391 E megan.dawson@planning.nsw.gov.au

Table: Location where the consultation responses have been addressed.

Consulted Entity	Comment	Response
Singleton Council	Singleton Council requested clarification regarding the final land use and alignment with the rehabilitation objectives.	The rehabilitation objectives in Table 19 of this MOP were adjusted to ensure that the objectives reflected those outlined in Table 16 of the Project Approval.
Department Planning and Environment	No details provided on the expertise of the author/s	Details of author expertise provided following the Table of Contents.
	Unclear how the plan has been integrated with the Biodiversity Management Plan	The relationship between the MOP and the BMP is discussed in Section 1.5 and 4.1.2.
	<p>1. Performance and completion criteria are provided however they do not contain sufficient detail. For example, one of the performance indicators provided for landform stability is 'drainage paths and contour drains installed' and the performance criteria is 'drainage paths and contour drains to be constructed to suitable design standards'. At a minimum it should reference Table 6.1 in DECC (2008) which nominates the minimum design standards for drainage and erosion control measures. Further details should also be included on soil geo-chemical suitability, maximum permissible velocity, design ARI's etc.</p> <p>2. Another example is spontaneous combustion. The performance indicator is 'exposed coal seams will be covered'. The performance criteria provided is 'Exposed coal seam will be covered with 5 metres of inert materials to prevent spon com where practical'. This language is too vague and the cover thickness needs to be justified.</p> <p>3. The rehabilitation objectives for returning disturbed land to areas of native woodland or pasture states that species will 'not necessarily conform to any particular vegetation community'. However, later text states that the species options are based on target vegetation communities identified from analogue sites. This appears to be contradictory and should be clarified.</p>	<p>1. An additional Performance Indicator has been included in Table 23 to explain soil geo-chemical suitability.</p> <p>2. The proposed 5m of capping cover of the exposed coal seams as specified in the HVO South MOP to prevent spontaneous combustion was proposed following information presented in Mine Rehabilitation (J.C. Hannan 1995). Hannan 1995 <i>Section 4.2 Selective Handling of Materials</i> states:</p> <ul style="list-style-type: none"> - that the maximum depth of root zone needed for most types of vegetation is 2m; - Field measurements have shown that, even in very wet years, rainfall rarely penetrates further into stockpiles than about 4-5m. Acid producing and high salinity spoils are therefore recommended to be capped with 5m of inert material. <p>While the seams that are mined at HVO are managed to avoid the risk of spontaneous combustion, 5m of capping for carbonaceous materials prone to spontaneous combustion has also been adopted so that these materials are buried below a sufficient layer of inert material to ensure no moisture or oxygen flow occurs at the burial depth.</p> <p>The justification is explained in Tarp Item #8.</p> <p>3. The statements are not contradictory. The rehabilitation objectives are correct in that the approved rehabilitation will be grassland as well as areas of native woodland or 'trees over grass'. To ensure that the rehabilitation considers the surrounding ecosystems as per the EA, the species selected will be based on the surrounding vegetation communities. For example, if the surrounding vegetation community is CHVEF and the overstorey is dominated by ironbark, the rehabilitation will utilise similar species as the dominant canopy trees. This will not necessarily classify the rehabilitation as that vegetation community as other factors need to be realised to meet the community criteria.</p>
	Measures to implement the criteria to ensure compliance with conditions has been	The measures to be implemented to meet the performance and completion criteria are described in Sections 6.4 to 6.10. These sections have references to TARPs outlined in

	discussed in Section 7, but the level of detail is insufficient	Section 9.0. Additional information has been added to Section 7 of this MOP to ensure compliance with the conditions of consent.
	Interim revegetation discussed briefly in Section 7.2.4.2, however more techniques should be considered, such as soil polymers or hydraulically applied mulches	The use of cover crops are the preferred method of interim revegetation at HVO and have been discussed with the Department. In addition to assisting with reducing site exposure, cover crops inhibit weed establishment and encourage the commencement of nutrient cycling to promote the development of a soil profile and improve the organic matter content of the soils. Progressive rehabilitation occurs at HVO to reduce the amount of exposed ground and thus soil polymers are not generally used at HVO.
	Monitoring and reporting on rehabilitation progress discussed in Section 8, however the timeframes should be made more clear ie when/how often will the monitoring, auditing and reporting occur	The paragraphs two and three of section 8.1.2 outlines the monitoring of revegetation sites to ensure restorative strategies are progressing as desired. In the early stages, an annual monitoring programme will be implemented in conjunction with biannual inspections. These will be lengthened to five yearly once confirmation that the conservation strategies are being met. Reporting is outlined in Section 8.2 which included the annual environmental report. The Audit schedule is dictated by Schedule 5 Condition 5 of the Project Approval.
	Potential risks to rehabilitation are discussed in Section 9, however the level of detail in Tables 33 and 34 is insufficient. The risk assessment should also consider tunnel and gully erosion risk post by dispersive and/or magnesian soils as well as saline mine spoils.	As requested, the TARP has been updated to reflect geo-chemical instability and spontaneous combustion risks and responses. As requested, the risk assessment has been updated to consider soil geo-chemical issues relating to land preparation, rehabilitation as well as rehabilitated lands and features. These factors are also considered in the risk assessment for erosion and sedimentation.
	Section 2.6 incorrectly states 'The current approval under the HVO South EA allows for 20 Mtpa to be trucked from HVO South to the HVCPP facility'. This is still restricted to 16 Mtpa because of the HVO North consent	This is now explained in Section 2.6. HVO South EA allows for the processing of 20Mtpa ROM coal extracted from HVO South across the HVO coal processing plants. All coal won from the south is delivered to the HVCPP. While the development consent for HVO North permits the HVCPP to process this volume, the Plant is limited to receiving 16Mtpa of coal from mining operations south of the Hunter River. The HVO North development consent is to be modified before the 20Mtpa ROM coal transported from HVO South can be achieved.
	Plans 2, 3A to E depict South Pit Lemington 2 as an active domain '4C'. However, the Department understands that this pit has not yet been mined and is still awaiting Commonwealth approval. Please clarify and adjust the figures accordingly	Discussed in Section 2.5.2. No mining is planned for South Lemington Pit 2 in this MOP period. Pit 2 does not have approval from the Commonwealth to disturb the listed vegetation community and hence no disturbance that will affect Matters of National Environmental Significance (MNES) will occur within South Lemington Pit 2. While the domains have been removed from South Lemington Pit 2 in the Plans, it is possible that exploration may occur where MNES will not be affected, hence the disturbance boundary is shown to encompass the South Lemington Pit 2 footprint.

Appendix C

Common Appendix

To:	Andrew Speechly	At:	Hunter Valley Operations
From:	Adam Williams	At:	SLR Consulting Australia Pty Ltd
Date:	15 January 2018	Ref:	630.12640 Common Appendix Final 20190115.docx
Subject:	HVO Common Appendix		

CONFIDENTIALITY

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1 Introduction

On 3 October 2018, the Department of Planning and Environment – Resources Regulator (RR) issued a Notice under Section 240(1)(c) of the *Mining Act 1992* (Section 240 Notice). The Section 240 Notice related to the unsatisfactory establishment of target vegetation species and the unsatisfactory weed presence at rehabilitation areas across Hunter Valley Operations (HVO) North and HVO South.

The Section 240 Notice stipulated that the following must be addressed:

- Unsatisfactory establishment of target vegetation species at woodland and pasture rehabilitation areas, including (but not necessarily limited to):
 - HVORIV201403 – HVO South;
 - HVORIV201404 – HVO South;
 - HVORIV201405 – HVO South;
 - HVOCHE201201 – HVO South; and
 - HVOWES201601 – HVO North.
- Unsatisfactory weed presence at woodland and pasture rehabilitation areas, including (but not necessarily limited to):
 - HVORIV201402 – HVO South;
 - HVORIV201403 – HVO South;
 - HVORIV201501 – HVO South;
 - HVORIV201503 – HVO South;
 - HVOWES201604 – HVO North;
 - HVOLEM201601 – HVO South;
 - HVOCAR200902 – HVO North;
 - HVORIV201401 – HVO South; and

- HVOWES201601 – HVO North.

Note: the Section 240 Notice incorrectly referenced HVORIV201604 instead of HVOWES201604 and HVORIV201601 instead of HVOLEM201601.

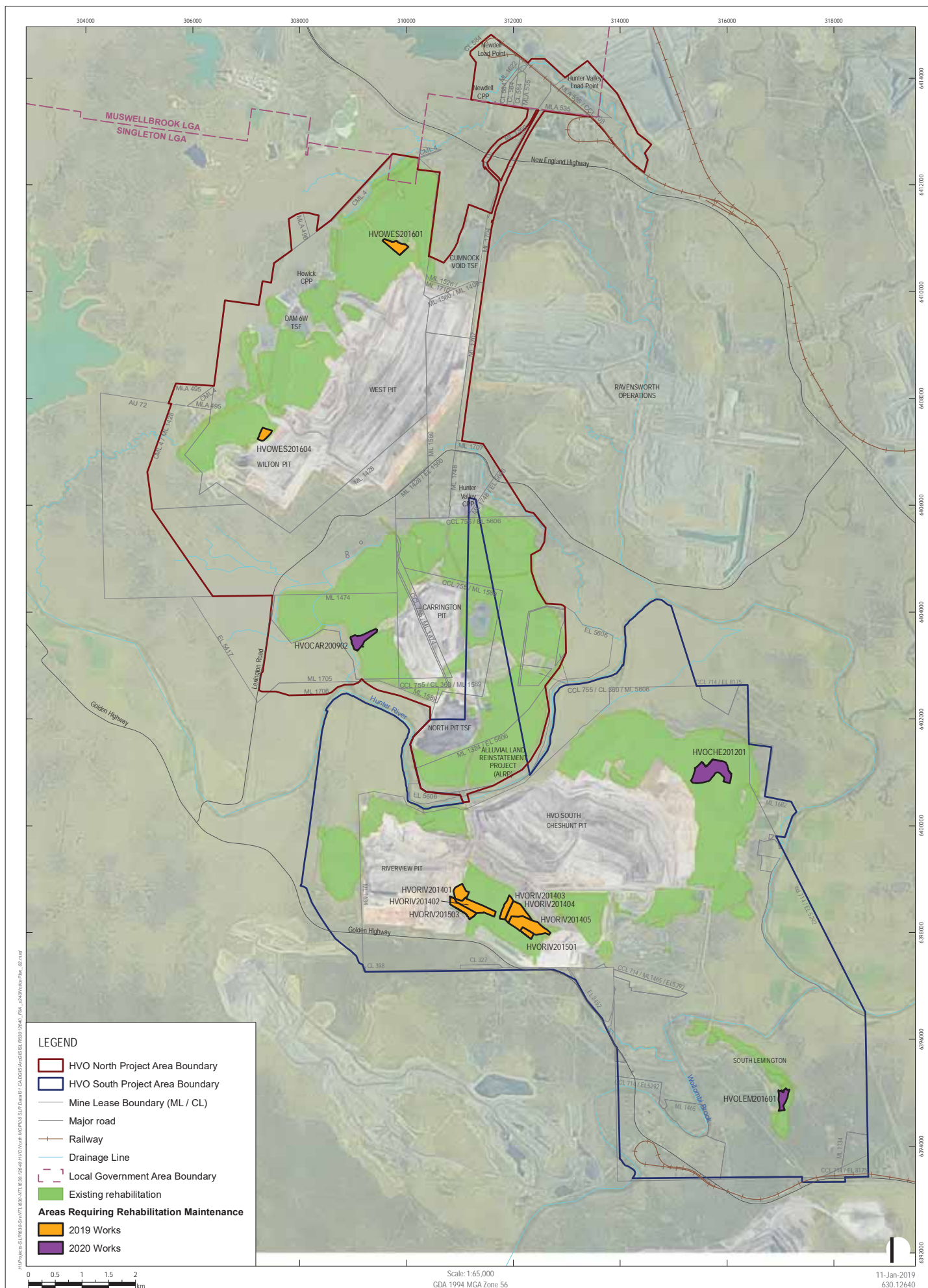
Figure A shows the location of the 12 sites requiring rehabilitation maintenance in relation to all existing rehabilitation.

2 Scope

The Section 240 Notice stipulated a number of actions that need to be addressed by HVO prior 15 January 2019. **Table A** summarises these actions and describes how the requirements have been addressed within this report, the HVO North MOP or the HVO South MOP Amendment.

Table A Section 240 Notice Actions

RR Actions	Where Addressed
Prepare a management plan to address risks to satisfactory rehabilitation progress.	In a meeting with the RR on 24 October 2018, it was confirmed that a specific standalone management plan was not required. It was suggested instead that relevant aspects would be included within the HVO North MOP and HVO South MOP Amendment. Remaining requirements would be addressed within a supporting appendix (this memorandum). The approach was confirmed to be appropriate.
An assessment of the causes of unsatisfactory target species establishment and weed presence in rehabilitation areas. The scope of the assessment must include topsoil handling and management practices, and current weed management practices.	Section 3
A schedule of time bound management actions to address risks of achieving satisfactory rehabilitation progress on all mining authorisations held by HV Operations Pty Ltd.	Figure A and Table B
The location(s) and total area(s) undergoing rehabilitation is generally in accordance with rehabilitation consent conditions and commitments document in any relevant development consents	Section 5



3 Rehabilitation Assessment

Cumberland Plain Seeds (CPS) were engaged to undertake an assessment of rehabilitation areas at HVO North and HVO South. The areas assessed by CPS included, but were not limited to those specified in the Section 240 Notice.

The CPS assessment aims to complement existing rehabilitation monitoring which uses a combination of:

- Landscape Function Analysis (LFA);
- Soil observations and various measures of ecosystem diversity and habitat values;
- Canopy Development;
- Biobanking - Site Value Scores;
- Visual Inspections; and
- Photographic Monitoring.

The BioBanking Assessment Methodology (BAM) is used to assess biodiversity values including composition, structure and function of vegetation. This means that it is a useful method for assessing rehabilitation quality in established vegetation, but it is less suitable for early stage rehabilitation as it assumes vegetation is in a stable condition and most plants in the community are mature. The CPS methodology will focus upon early stages of vegetation establishment (i.e. the first 2 years following sowing). The intention is to produce data that will inform appropriate land management actions and prioritise implementation using a risk based approach.

3.1 Methodology

Inspection of all target areas was undertaken by CPS and HVO representatives during October – November 2019. Targeted inspections were undertaken to achieve:

- Rapid visual survey to identify broad scale patterns in the landscape.
- Demarcation and mapping of management zones based on parameters including: soil characteristics; presence and density of threatening weed species (e.g. Galenia (*Galenia pubescens*), Green Panic (*Panicum maximum* var. *trichoglume*), Rhodes Grass (*Chloris gayana*) and Couch grass (*Cynodon dactylon*); and density and diversity of native species.
- Once different zones have been established within the block a monitoring transect was set up at a random location. Photographs were taken looking at the ground surface at 10 m intervals along the transect.
- Sampling of management zones using 1 m² quadrats established at 10 m intervals along the transect. In each quadrat the following values were measured:
 - Species composition.
 - Native vegetation cover (%).
 - Threatening weed cover (%).
 - Bare ground cover (%).
 - Number of native individuals.
 - Native diversity.

- Sampling of non-typical areas which are not representative of the management zone as a whole but have an effect on the success or failure of the rehabilitation block (e.g. contour bank swales).
- Analysis of data gathered from the assessment.
- Assessment made regarding each rehabilitation block and trajectory towards success or failure.
- Recommendations made based on previous monitoring data, visual assessments, soil observations and current targeted inspection data.
- Development of action plans for each management zone, prioritised using a risk-based approach.

3.2 Results

Following implementation of the monitoring methodology outlined in **Section 3.1**, CPS analysed available data and completed reporting. The results of the assessment have been summarised in **Table B**. The location of rehabilitation sites have been shown on **Figure A**.

Table B Outcomes of Rehabilitation Assessment

Site Name	Trajectory Ranking	Key Issues	Recommendations	Timing
HVOWES201601	Failing	<ul style="list-style-type: none"> • Soil issues. • Poor plant health and growth. • Threatening weeds present in significant density. 	<ul style="list-style-type: none"> • Repeat monitoring and assessment. • Investigate soil issues and ameliorate as necessary. • Control Galenia (spot spraying). Aerate to prepare a seed bed and stimulate germination of natives. • Seeding options include: <ul style="list-style-type: none"> ➤ If significant germination/reshooting of natives, consider: <ol style="list-style-type: none"> 1. Oversow with native seed mix. 2. Sow only chenopods, trees and shrubs to enable treatment of grass weeds with selective herbicide, then following 1-2 seasons of weed control sow grasses. ➤ If there is no evidence of improvement in native cover: <ol style="list-style-type: none"> 3. Spray out entire block, prepare seedbed and resow either entire suite of natives or staged native sowing such as grasses and herbs only, followed by trees and shrubs as required. 	2019
HVOWES201604	Stable but needs work to improve	<ul style="list-style-type: none"> • Stable native vegetation with good grass cover, low shrub and tree diversity and low stem density. • Some threat from weeds. 	<ul style="list-style-type: none"> • Following soil analysis, build on existing native vegetation to increase diversity and cover. • Control weed threats. • Selective seeding, if required. 	2019

Site Name	Trajectory Ranking	Key Issues	Recommendations	Timing
HVOCAR200902	Failing	<ul style="list-style-type: none"> Well established canopy but stem density too high for continued success. Under storey and ground layer have low diversity dominated by threatening weeds (Green Panic). Contour banks and swales without significant native cover. 	<ul style="list-style-type: none"> Thin Eucalypts using mechanical means or fire. Control weed threats. Increase shrub layer diversity (fire would stimulate Acacia germination). Increase shrub and ground layer diversity with soil disturbance and sowing. 	2020
HVOCHE201201	Failing	<ul style="list-style-type: none"> Very poor native cover or diversity apart from some saltbushes. Significant densities of threatening weeds. Evidence of ongoing soil or subsoil problems – poor plant growth and health. Even normally vigorous weeds show signs of drought stress and nutrition problems when compared to other HVO sites. 	<ul style="list-style-type: none"> Investigate soil issues and ameliorate as necessary. Develop and implement a re-establishment plan. 	2020
HVOLEM201601	Stable but needs work to improve	<ul style="list-style-type: none"> Good shrub diversity and density. Ground layer dominated by Couch. Threat from Acacia saligna colonising from adjacent vegetation. Contour banks and swales have low native cover and diversity. Soil appears to be Warkworth Sands Woodland type so species sown may not have been appropriate to this soil type. 	<ul style="list-style-type: none"> Manage weed threats. Investigate initially sown species mix. Sow ground layer species appropriate for this soil type, if required. 	2020

Site Name	Trajectory Ranking	Key Issues	Recommendations	Timing
HVORIV201401	Stable but needs work to improve	<ul style="list-style-type: none"> Good native species diversity but relatively low native groundcover layer (higher percentage of bare ground). Heavily infested with threatening weeds, especially Rhodes Grass. Evidence of soil issues in some areas. 	<ul style="list-style-type: none"> Manage exotic grasses threat to avoid contamination of adjacent areas. This should involve a combination of targeted slashing/brush cutting, blanket spraying of larger areas of exotic grasses and spot spraying of isolated plants. Following control of exotic grasses increase native ground cover by re-sowing native grasses and Saltbushes. 	2019
HVORIV201402	Stable but needs work to improve	<ul style="list-style-type: none"> Generally good native grass diversity and cover, apart from one area which appears to have a different topsoil type. Good shrub layer cover and some Eucalypts, although stem density is low. Threat of invasion and spread of Rhodes Grass and Green Panic. 	<ul style="list-style-type: none"> Treat threatening weeds. Augment native ground and shrub layer in areas with lower stem density, if required. 	2019
HVORIV201403	Stable but needs work to improve	<ul style="list-style-type: none"> Good but patchy native diversity and cover in ground layer. Evidence of soil issues. Significant weed threats (in particular Rhodes Grass). 	<ul style="list-style-type: none"> Investigate soil issues and ameliorate as necessary. Manage weed threats. Re-sow restricted suite of natives (only sow proven successful species), if required. 	2019
HVORIV201404	Failing	<ul style="list-style-type: none"> Patchy native vegetation cover. Majority of the site is dominated by threatening weeds. Soil issues appear to be causing poor native establishment. 	<ul style="list-style-type: none"> Investigate soil issues and ameliorate as necessary. Manage any weeds which pose a threat to adjacent rehab areas (Rhodes Grass and Green Panic pose highest risk of quickly invading areas due to windblown seed). Consider re-sowing with limited native seed mix (only sow proven successful species). 	2019

Site Name	Trajectory Ranking	Key Issues	Recommendations	Timing
HVORIV201405	Failed	<ul style="list-style-type: none"> Evidence of serious soil problems. Site is almost entirely dominated by annual plants (both native and exotic) suggesting a serious issue with subsoil and/or topsoil. 	<ul style="list-style-type: none"> Investigate soil issues and ameliorate as necessary. Spray out and resow with limited native seed mix (only sow proven successful species). 	2019
HVORIV201501	Tracking towards success but needs work	<ul style="list-style-type: none"> Good native cover and diversity in ground layer. Shrub and canopy layer has low stem density (particularly Eucalypts). 	<ul style="list-style-type: none"> Manage weed threats. Selective seeding, if required. 	2019
HVORIV201503	Tracking towards success but needs work	<ul style="list-style-type: none"> Good native cover and diversity across the majority of the site. Two small zones within the site have lower tree and shrub stem density. 	<ul style="list-style-type: none"> Manage weed threats. Selective seeding, if required. 	2019

3.3 Proposed Changes to Site Management Practices

Existing site topsoil management practices broadly reflect industry standards, typically encompassing:

- Minimal annual disturbance to allow mine advance;
- Ground Disturbance Permit control of topsoil disturbance;
- Topsoil stripping with appropriately sized equipment, and skilled and experienced operators;
- Incorporation of residual mulched native vegetation to bulk topsoils, aiding in preservation of soil biological resources;
- Direct placement to rehabilitation, prompt reuse, and minimal rehandling, where possible;
- When stockpiling, establishment of stockpiles less than 3 metres in height and sown to a desirable cover crop in timely manner;
- Weed control upon stockpiles on as needs basis;
- Program of progressive improvement / re-sowing of historic stockpiles;
- Scalping of stockpiles with unsuitable cover prior to re-use; and
- Maintaining records of topsoil resources encompassing source, storage (where relevant) and reuse.

Despite these established practices there is opportunity to improve the application of the practices.

The following improvements are proposed to ensure that high standards of topsoil management are maintained:

1. Improved integration of topsoil 'mining' and placement into the mine planning process including:
 - Identification of appropriate rehabilitation placement and/or storage locations;
 - Sequencing of topsoil stripping and movement to maximise opportunities for direct placement to rehabilitation or short-term stockpiling (<12-18 months) and prompt reuse within the window of biological activity; and
2. Where feasible, stockpile different soil types separately (including soils with a history of exotic pasture cover which may be unsuitable for use in native rehabilitation areas without additional treatment).
3. Review of site topsoil tracking procedures and associated documentation.
4. Review inspection processes which verify compliance with site topsoil management processes.
5. Review of site training materials, supporting knowledge and understanding of key personnel (site and contractor supervisors and operators) of site procedures and underlying drivers.
6. Development of a Topsoil Management Plan, or review and update of existing site documentation, encompassing:
 - Type and depth of topsoils to be stripped across site;
 - Life of Mine (LOM) topsoil requirements and deficiency mitigations (if any);
 - Topsoil stripping processes in plain English terms;
 - Processes for handling, placement and stockpiling of topsoils; and
 - Processes for maintenance of the site topsoil register.

Site weed management practices also reflect industry standards encompassing inspections to identify weed infestations, targeted control of weed infestations, and maintenance weed control across the site generally. In the context of site rehabilitation key weed management processes include:

- Use of sacrificial cover crops to allow treatment of aggressive weed threats (primarily exotic grasses and *Galenia*) in new rehabilitation;
- Broadacre selective and knockdown control of weed threats in new rehabilitation areas prior to sowing of final seed mixes, and using timely pre-emergent passes following sowing to final seed mixes;
- Focussed spot spraying of key target weed species in the early stage of rehabilitation vegetation establishment;
- Follow-up and periodic targeted spot spraying in rehabilitation areas as required based on inspections and monitoring;
- Management of weeds on topsoil stockpiles; and
- Limited, selective control of key weed species ahead of mining.

Site experience has been that a key threat to successful native vegetation establishment is competition from exotic pasture grasses, in addition to competition from the herbaceous groundcover, *Galenia pubescens*. Due to revisions of the mine plan in association with contemporary approvals, many of the areas of topsoil stripping are historic rehabilitation areas which were initially established with exotic pasture species. Consequently the soil seed bank associated with these re-disturbed topsoils has been a key source of weed infestation.

While site weed management practices are considered broadly appropriate to manage the weed threat in rehabilitation areas, a key additional focus will be on discrete management of topsoils from areas with identified weed infestations compared with soil from previously undisturbed native vegetation areas. Topsoils identified as likely to contain significant exotic grass seed loads will, where possible, be preferentially placed on pasture rehabilitation areas so that the seed load acts in a beneficial manner. Additional improvements to topsoil management procedures which will assist in mitigating weed risk have been detailed above.

It is also noted that weed infestation has been identified in the CPS assessment (refer **Table B**) as the key threat to favourable rehabilitation trajectory and as such the maintenance plan (refer **Table D**) is strongly focussed on weed control as the primary activity needed to re-establish the desired trajectory in impacted blocks. Targeted weed control on a needs basis across all rehabilitation areas will remain a key site focus with site inspections and monitoring continuing to inform of emerging issues, the effectiveness of work undertaken, and work prioritisation.

A further potential issue which has been identified as a risk to successful rehabilitation weed management is the increasing footprint of rehabilitation areas and ensuring resourcing is appropriate to adequately address the areas requiring treatment. While current resourcing is considered appropriate, identification and ongoing planning will ensure resourcing remains at an appropriate level into the future. Significant modifications to existing site weed management procedures are not proposed. Rather, the site reiterates its commitment to ongoing resourcing at an appropriate level to manage known and emerging weed infestations and to the refinement of topsoil management procedures to lessen the weed risk over time.

4 Proposed Maintenance Program

Table C provides an annual summary of the total area of rehabilitation to undergo maintenance at HVO North and HVO South. Progress against these predictions will be reported in the Annual Review.

A detailed maintenance schedule has been provided as **Table D**.

Table C Rehabilitation Maintenance Timing

Year	Area (ha)
2019	61.85
2020	33.55

Table D Rehabilitation Maintenance Schedule

Location	Maintenance	Relative Priority	2019				2020				Section 240 Issue	
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4		
HVOWES201601 [West North 190, 6.2 ha]												
<u>Priorities</u> 1. Additional monitoring 2. Weed control 3. Understanding growth medium	Re-monitoring, investigate soil issues	2									Vegetation, Weeds	
	Soil amelioration (if required)											
	Weed control / spray out											
	Seeding											
HVOWES201604 [Wilton 210, 3.7 ha]												
<u>Priorities</u> 1. Weed control 2. Understanding growth medium 3. Increase diversity	Weed control	2									Weeds	
	Selective seeding (if required)											
HVOCAR200902 [Carrington, 7.7 ha]												
<u>Priorities</u> 1. Open canopy 2. Weed control 3. Increase diversity	Stem thinning	5									Weeds	
	Weed control											
	Selective seeding											
HVOCHE201201 [Cheshunt Rim, 20.8 ha]												
<u>Priorities</u> 1. Understanding growth medium 2. Addressing medium constraints 3. Plan development	Investigate soil issues	5									Vegetation	
	Develop re-establishment plan											
	Plan execution											
HVOLEM201601 [Lemington South, 5 ha]												
<u>Priorities</u> 1. Weed control	Weed control	4									Weeds	
	Selective seeding (if required)											
HVORIV201401 [Riverview 145, 5.8 ha]												
<u>Priorities</u> 1. Weed control	Weed control	3									Weeds	
	Selective seeding (if required)											
HVORIV201402 [Riverview 145, 10 ha]												
<u>Priorities</u> 1. Weed control	Weed control	3									Weeds	
	Selective seeding (if required)											
HVORIV201403 [Riverview 145/155, 4.8 ha]												
<u>Priorities</u> 1. Weed control 2. Soil amelioration 3. Manage for re-disturbance	Investigate soil issues	1									Vegetation, Weeds	
	Soil amelioration (if required)											
	Weed control											
	Selective seeding (if required)											
HVORIV201404 [Riverview 155, 8.4 ha]												
<u>Priorities</u> 1. Weed control 2. Soil amelioration 3. Manage for re-disturbance	Investigate soil issues	1									Vegetation	
	Weed control / spray out											
	Soil amelioration											
	Seeding											
HVORIV201405 [Riverview 155, 14.3 ha]												
<u>Priorities</u> 1. Weed control 2. Manage for re-disturbance	Investigate soil issues	1									Vegetation	
	Weed control / spray out											
	Soil amelioration											
	Seeding											
HVORIV201501 [Riverview 155, 2.4 ha]												
<u>Priorities</u> 1. Weed control	Weed control	2									Weeds	
	Selective seeding (if required)											
HVORIV201503 [Riverview 145, 6.2 ha]												
<u>Priorities</u> 1. Weed control	Weed control	2									Weeds	
	Selective seeding (if required)											
Notes:												
1. Work to occur across the periods shown, however may not occur in all periods shown.												
2. Relative priorities balance addressing at-risk areas with maintaining areas demonstrating favourable trajectories.												
3. 2020 work plans are indicative only. Final 2020 plans to be informed by observations and trajectory at 2019 monitoring events, and will be detailed in annual reporting. Work plans beyond 2020 to be informed by future monitoring.												
4. Changes to work plans may occur due to weather events and climatic influences. Where work components are not undertaken details will be provided in annual reporting.												
5. Maintenance of HVORIV201403, HVORIV201404 and HVORIV201405 reflect that blocks are temporary rehabilitation and blocks will be progressively re-disturbed with mine advance.												
Legend - Rehabilitation Trajectory (after CPS monitoring)												
	Tracking towards success but needs work											
	Stable but need work to improve											
	Failing											
	Failed											
Legend - Planned work												
	Primary task timing											
	Secondary timing (contingency / follow-up as needed)											

5 Rehabilitation Comparison against Predictions

5.1 HVO North

HVO North operates under Development Consent DA 450-10-2003, which was issued under Part 4 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) on 12 June 2004. Since 2004, DA 450-10-2003 has been modified on seven occasions with the most recent modification (Mod 7) approved on 28 July 2017.

A comparison of the rehabilitation predictions approved under DA 450-10-2003 and the seven modifications has been prepared by HVO North, and is outlined in **Table E** and shown in **Figure B**. **Table E** and **Figure B** show that the rehabilitation predictions are largely on track with the rehabilitation undertaken to date.

Table E HVO North Rehabilitation

Existing Rehabilitation	Predicted Rehabilitation	Difference
1,812.07 ha	1,766.85 ha	45.22 ha

5.2 HVO South

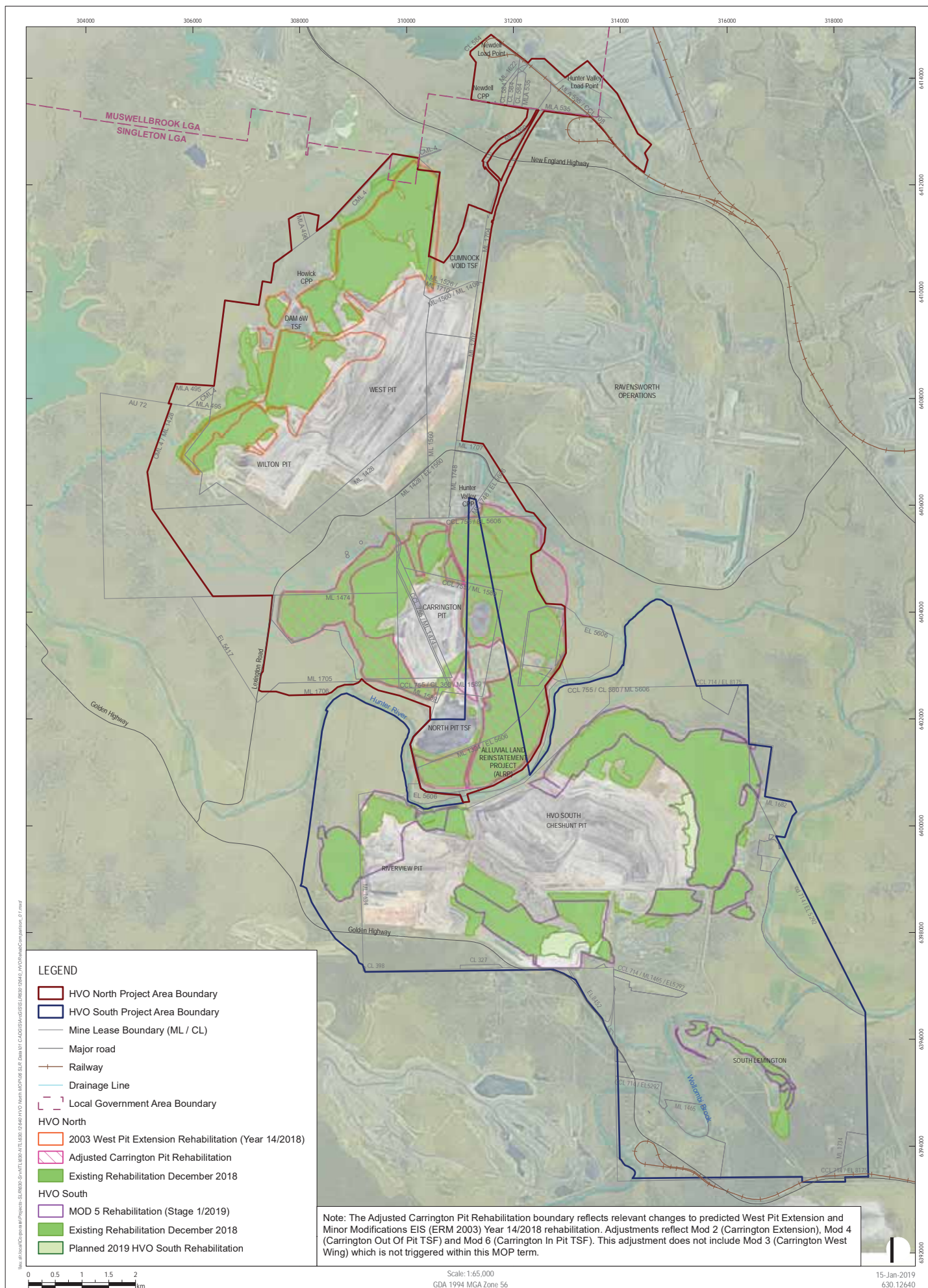
HVO South received Development Consent PA 06_0261 under Part 3A of the EP&A Act from the Minister for Planning for the HVO South Coal Project on 24 March 200. The consent replaced 25 separate development consents and 10 associated modifications granted by both DPE and Singleton Council. PA 06_0261 has been modified on five occasions, with the most recent modification approved in February 2018.

A comparison of the rehabilitation predictions approved under PA 06_0261 has been prepared by HVO South, and is outlined in **Table F** and shown in **Figure B**. **Table F** and **Figure B** show that the rehabilitation predictions are largely on track with the rehabilitation undertaken to date.

Table F HVO South Rehabilitation

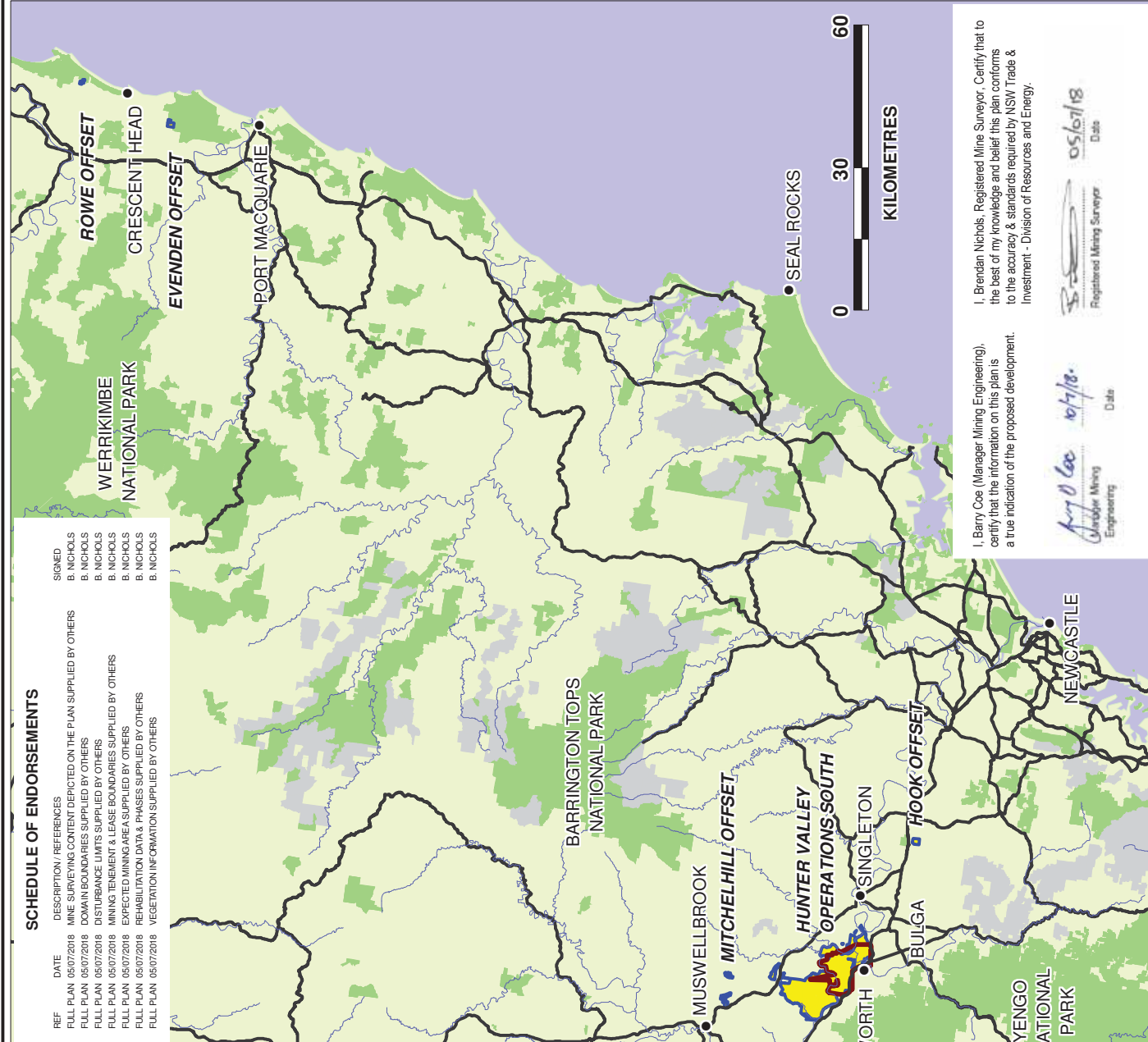
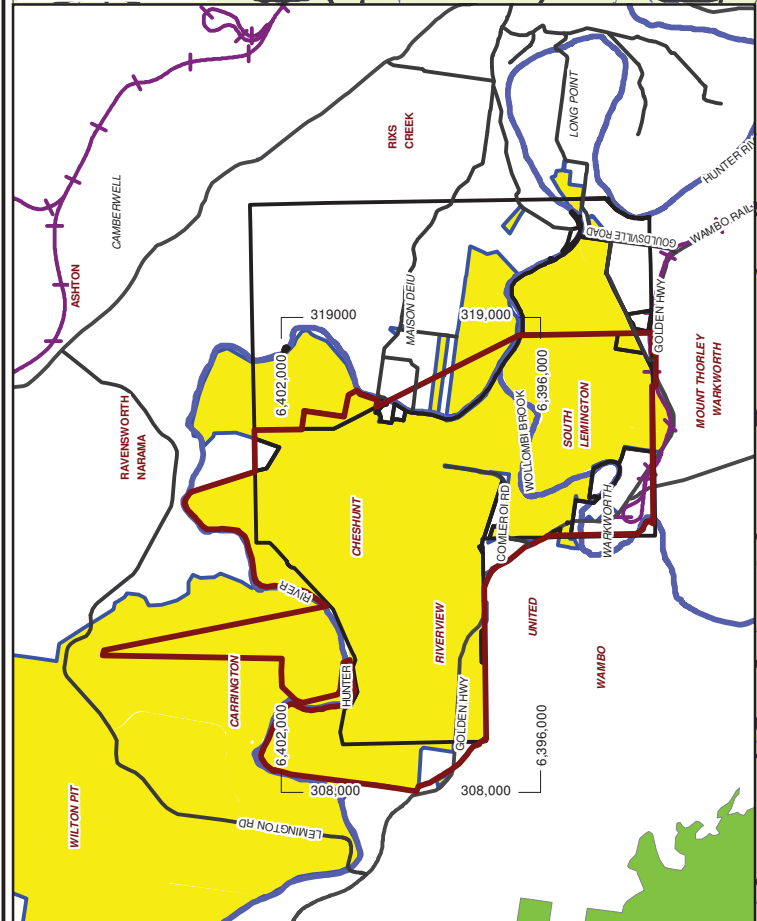
Existing Rehabilitation	Planned 2019 Rehabilitation	Total of Existing and Planned 2019 Rehabilitation	Predicted Rehabilitation	Difference
1,043.94 ha	61.69 ha	1,105.63 ha	1,047.55 ha	58.08 ha

Checked/
Authorised by: AW



Appendix D

Maps



SCHEDULE OF ENDORSEMENTS

REF	DATE	DESCRIPTION / REFERENCES
FULL PLAN	05/07/2018	MINE SURVEYING CONTENT DEPICTED ON THE PLAN SUPPLIED BY OTHERS
FULL PLAN	05/07/2018	DOMAIN BOUNDARIES SUPPLIED BY OTHERS
FULL PLAN	05/07/2018	DISTURBANCE LIMITS SUPPLIED BY OTHERS
FULL PLAN	05/07/2018	MINING TENEMENT & LEASE BOUNDARIES SUPPLIED BY OTHERS
FULL PLAN	05/07/2018	EXPECTED MINING AREA SUPPLIED BY OTHERS
FULL PLAN	05/07/2018	REHABILITATION DATA & PHASES SUPPLIED BY OTHERS
FULL PLAN	05/07/2018	VEGETATION INFORMATION SUPPLIED BY OTHERS

SIGNED
B. NICHOLS
B. NICHOLS
B. NICHOLS
B. NICHOLS
B. NICHOLS
B. NICHOLS
B. NICHOLS

- HVO SOUTH PROJECT APPROVAL (PA_06_0261)
- HVO SOUTH TENEMENT BOUNDARY
- HVO LAND
- NATIONAL PARK
- STATE FOREST
- MAJOR WATERCOURSE
- MAJOR ROAD

I, Barry Coe (Manager Mining Engineering),
certify that the information on this plan is
a true indication of the proposed development.

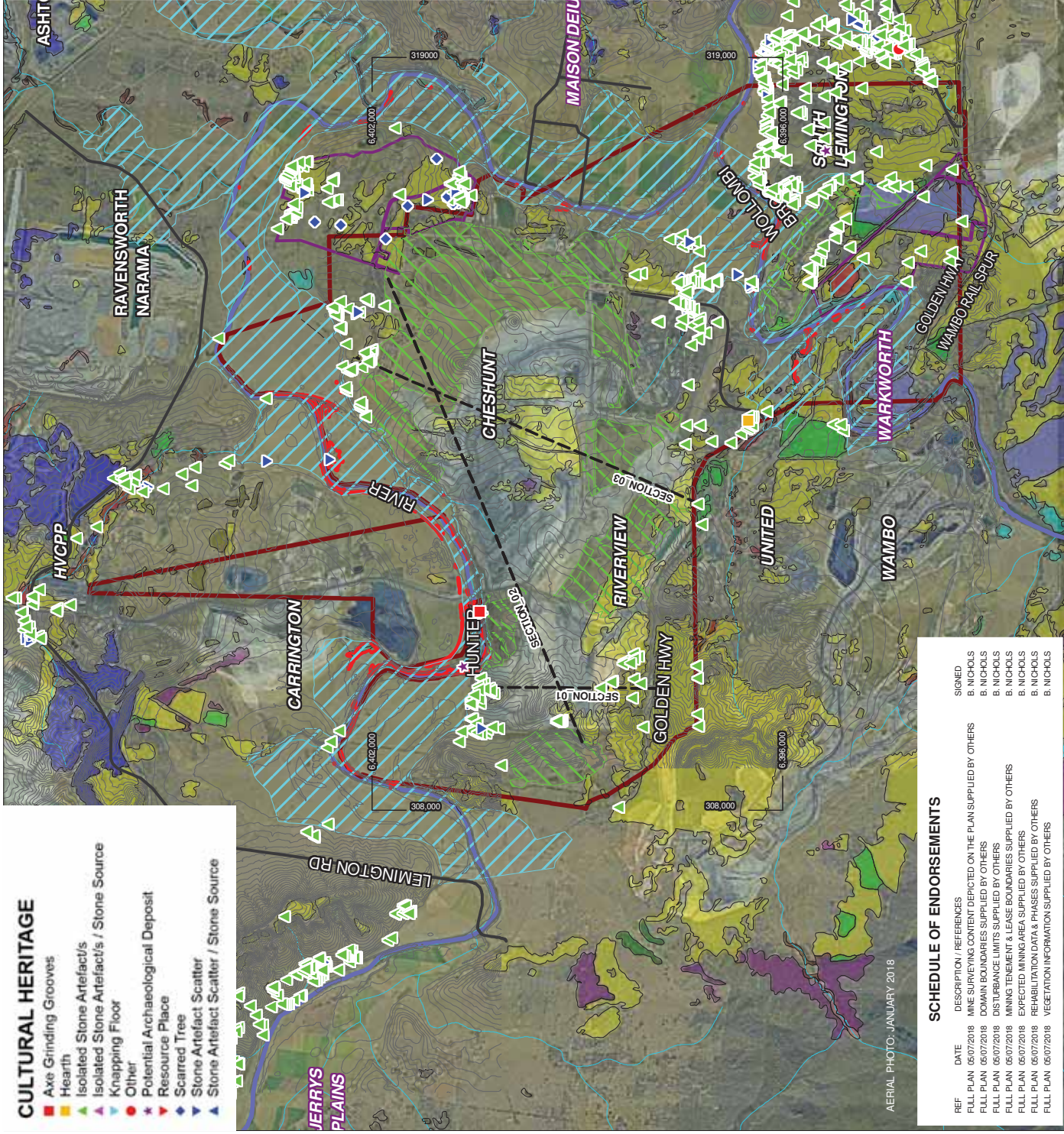
Barry Coe
10/7/18
Registered Mining Engineer
Date

I, Brendan Nichols, Registered Mine Surveyor, Certify that to
the best of my knowledge and belief this plan conforms
to the accuracy & standards required by NSW Trade &
Investment - Division of Resources and Energy.

Brendan Nichols
05/10/18
Registered Mining Surveyor
Date

CULTURAL HERITAGE

- Axe Grinding Grooves
- Hearths
- Isolated Stone Artefact/s
- Isolated Stone Artefact/s / Stone Source
- Knapping Floor
- Other
- Potential Archaeological Deposit
- Resource Place
- Scarred Tree
- Stone Artefact Scatter
- Stone Artefact Scatter / Stone Source



SCHEDULE OF ENDORSEMENTS

REF	DATE	DESCRIPTION / REFERENCES
FULL PLAN	05/07/2018	MINE SURVEYING CONTENT DEPICTED ON THE PLAN SUPPLIED BY OTHERS
FULL PLAN	05/07/2018	MINE SURVEYING CONTENT DEPICTED ON THE PLAN SUPPLIED BY OTHERS
FULL PLAN	05/07/2018	DOMAIN BOUNDARIES SUPPLIED BY OTHERS
FULL PLAN	05/07/2018	DISTURBANCE LIMITS SUPPLIED BY OTHERS
FULL PLAN	05/07/2018	MINING TENEMENT & LEASE BOUNDARIES SUPPLIED BY OTHERS
FULL PLAN	05/07/2018	EXPECTED MINING AREA SUPPLIED BY OTHERS
FULL PLAN	05/07/2018	REHABILITATION DATA & PHASES SUPPLIED BY OTHERS
FULL PLAN	05/07/2018	VEGETATION INFORMATION SUPPLIED BY OTHERS

SIGNED
B. NICHOLS
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HUNTER VALLEY OPERATIONS

Mine Operations Plan 2018 Hunter Valley Operations South Plan 1B - Pre-mining Environment - Natural Environment

Date: 05/07/18
Produced By: SC
Map Size: A4 Landscape
Coordinate System: MG494 Zone 56
Revision: 01
Data Source: Various

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I, Brendan Nichols, Registered Mine Surveyor, Certify that to
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to the accuracy & standards required by NSW Trade &
Investment - Division of Resources and Energy.

Barry Coe
05/07/18
Mining Engineering
Date

Brendan Nichols
05/07/18
Registered Mining Surveyor
Date

RIVER RED GUM SITES

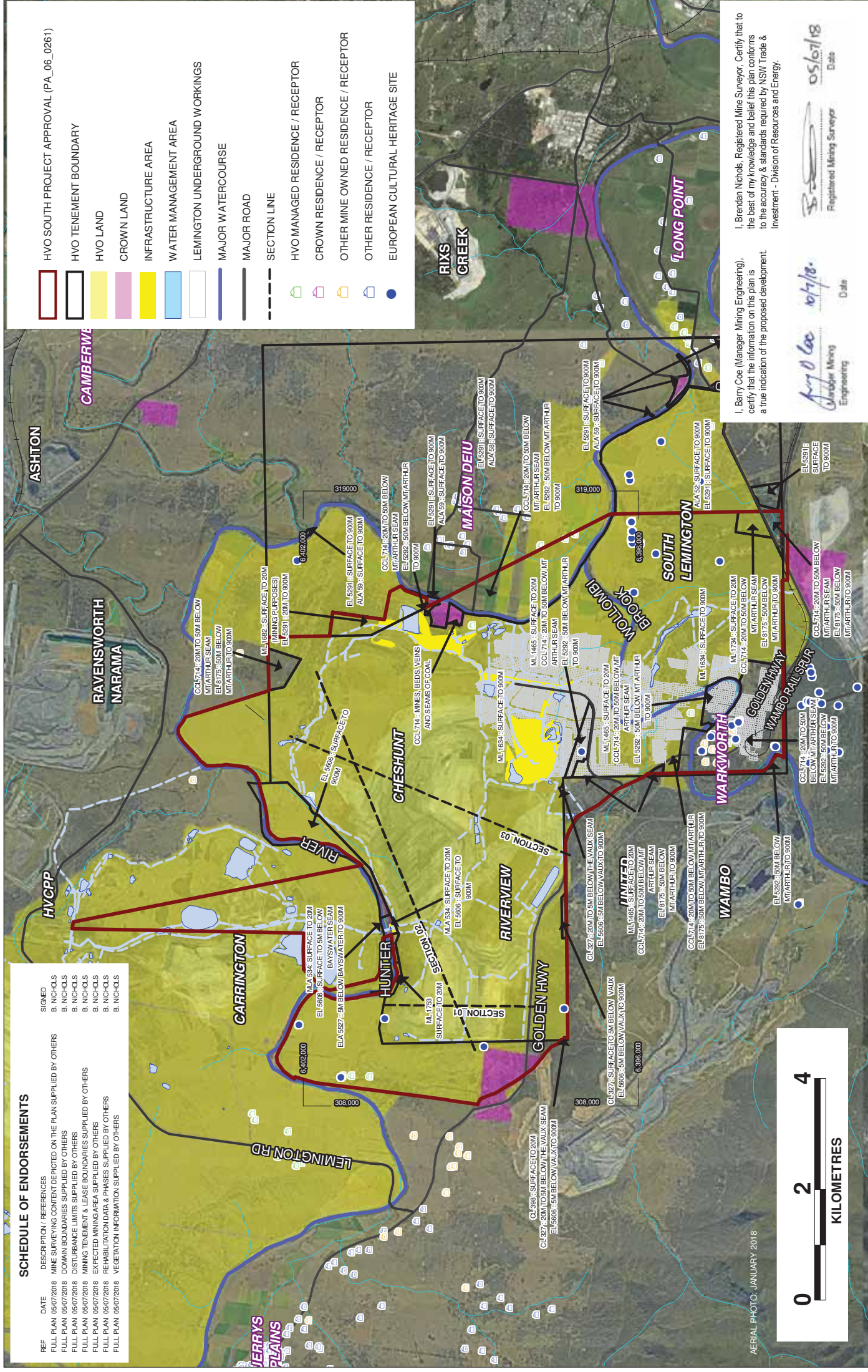
- ### HRVP CMA 2005 Vegetation Communities
- Central Hunter Box - Ironbark Woodland
 - Central Hunter Bullock Forest Regeneration
 - Central Hunter Ironbark - Spotted Gum - Grey Box Forest
 - Central Hunter Paperbark Soaks Woodland
 - Central Hunter Swamp Oak Forest
 - Hunter Floodplain Red Gum Woodland Complex
 - Hunter Valley River Oak Forest
 - Hunter Valley Vine Thicket
 - Hunter Valley Weeping Myall Woodland
 - Narrabeen Footslopes Slaty Box Woodland
 - Planted areas
 - Southern Hunter Escarpment Spotted Gum Woodland
 - Southern Hunter Footslopes Sheltered Forest
 - Upper Hunter Coastal Myall Exposed Forest
 - Warkworth Sands Woodland

- HVO SOUTH PROJECT APPROVAL (PA_06_0261)
- BIODIVERSITY AREA
- EXISTING REHABILITATION
- FLOOD PRONE LAND
- MAJOR WATERCOURSE
- PRE MINING CONTOUR
- SECTION LINE

SCHEDULE OF ENDORSEMENTS

REF	DATE	DESCRIPTION / REFERENCES
FULL PLAN	05/07/2018	MINE SURVEYING CONTENT DEPICTED ON THE PLAN SUPPLIED BY OTHERS
FULL PLAN	05/07/2018	DOMAIN BOUNDARIES SUPPLIED BY OTHERS
FULL PLAN	05/07/2018	DISTURBANCE LIMITS SUPPLIED BY OTHERS
FULL PLAN	05/07/2018	MINING TENEMENT & LEASE BOUNDARIES SUPPLIED BY OTHERS
FULL PLAN	05/07/2018	EXPECTED MINING AREA SUPPLIED BY OTHERS
FULL PLAN	05/07/2018	REHABILITATION DATA & PHASES SUPPLIED BY OTHERS
FULL PLAN	05/07/2018	VEGETATION INFORMATION SUPPLIED BY OTHERS

SIGNED
B. NICHOLS
B. NICHOLS
B. NICHOLS
B. NICHOLS
B. NICHOLS
B. NICHOLS
B. NICHOLS



HUNTER VALLEY OPERATIONS Plan 1C - Pre-mining Environment - Built Environment

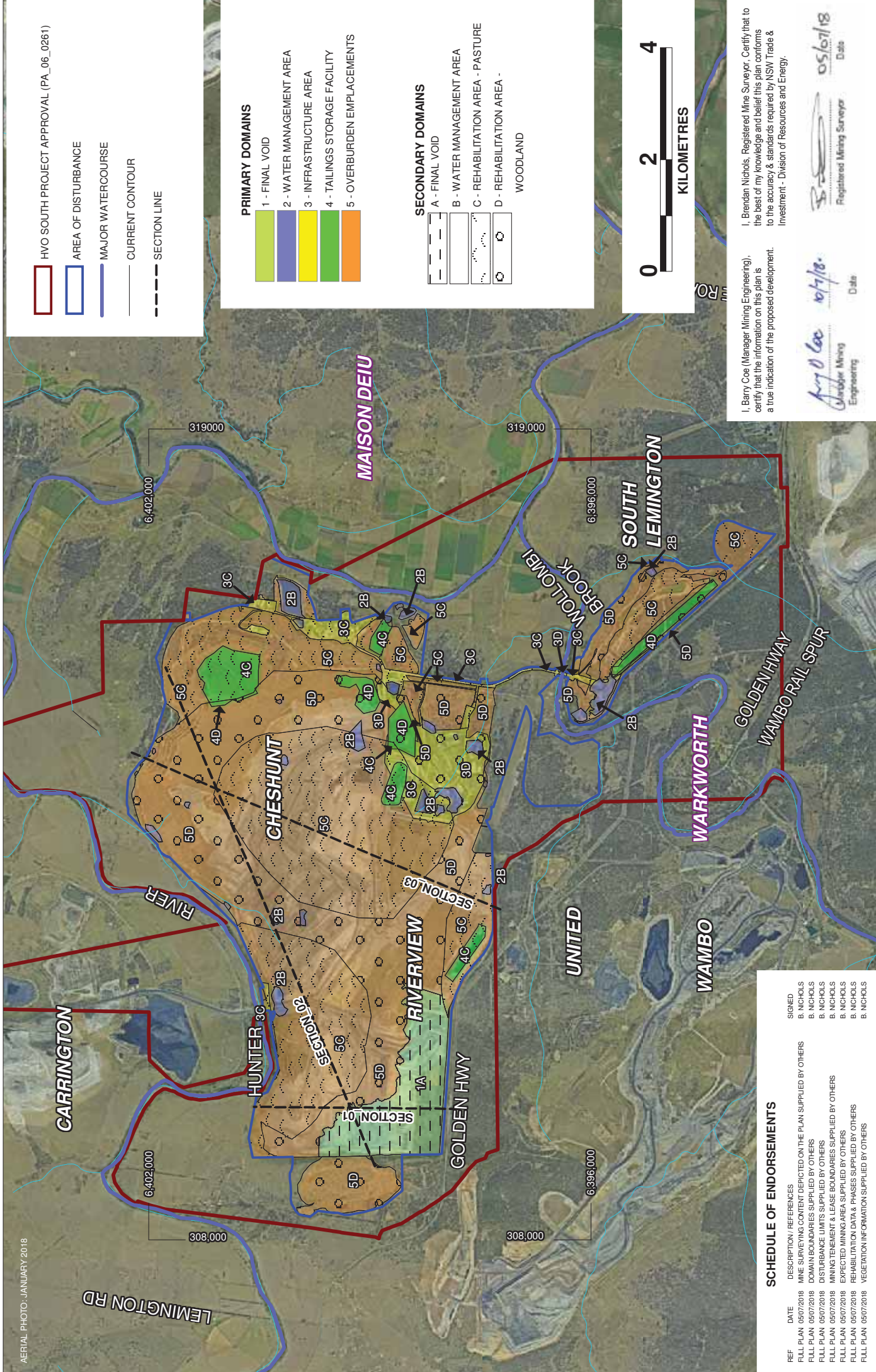
Mine Operations Plan 2018
Hunter Valley Operations South
Plan 1C - Pre-mining Environment - Built Environment

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Barry Coe 05/07/18
Brendan Nichols 05/07/18
Registered Mining Surveyor
Date



SCHEDULE OF ENDORSEMENTS

REF	DATE	DESCRIPTION / REFERENCES	SIGNED
FULL PLAN	05/07/2018	MINE SURVEYING CONTENT DEPICTED ON THE PLAN SUPPLIED BY OTHERS	B. NICHOLS
FULL PLAN	05/07/2018	DOMAIN BOUNDARIES SUPPLIED BY OTHERS	B. NICHOLS
FULL PLAN	05/07/2018	DISTURBANCE LIMITS SUPPLIED BY OTHERS	B. NICHOLS
FULL PLAN	05/07/2018	MINING TENEMENT & LEASE BOUNDARIES SUPPLIED BY OTHERS	B. NICHOLS
FULL PLAN	05/07/2018	EXPECTED MINING AREA SUPPLIED BY OTHERS	B. NICHOLS
FULL PLAN	05/07/2018	REHABILITATION DATA & PHASES SUPPLIED BY OTHERS	B. NICHOLS
FULL PLAN	05/07/2018	VEGETATION INFORMATION SUPPLIED BY OTHERS	B. NICHOLS

HUNTER VALLEY OPERATIONS

Mine Operations Plan 2018
Hunter Valley Operations South
Plan 2 - Mine Domains

Date: 05/07/18
Produced By: SC
Map Size: A4 Landscape
Coordinate System: MGA94 Zone 56
Revision: 01
Data Source: Various

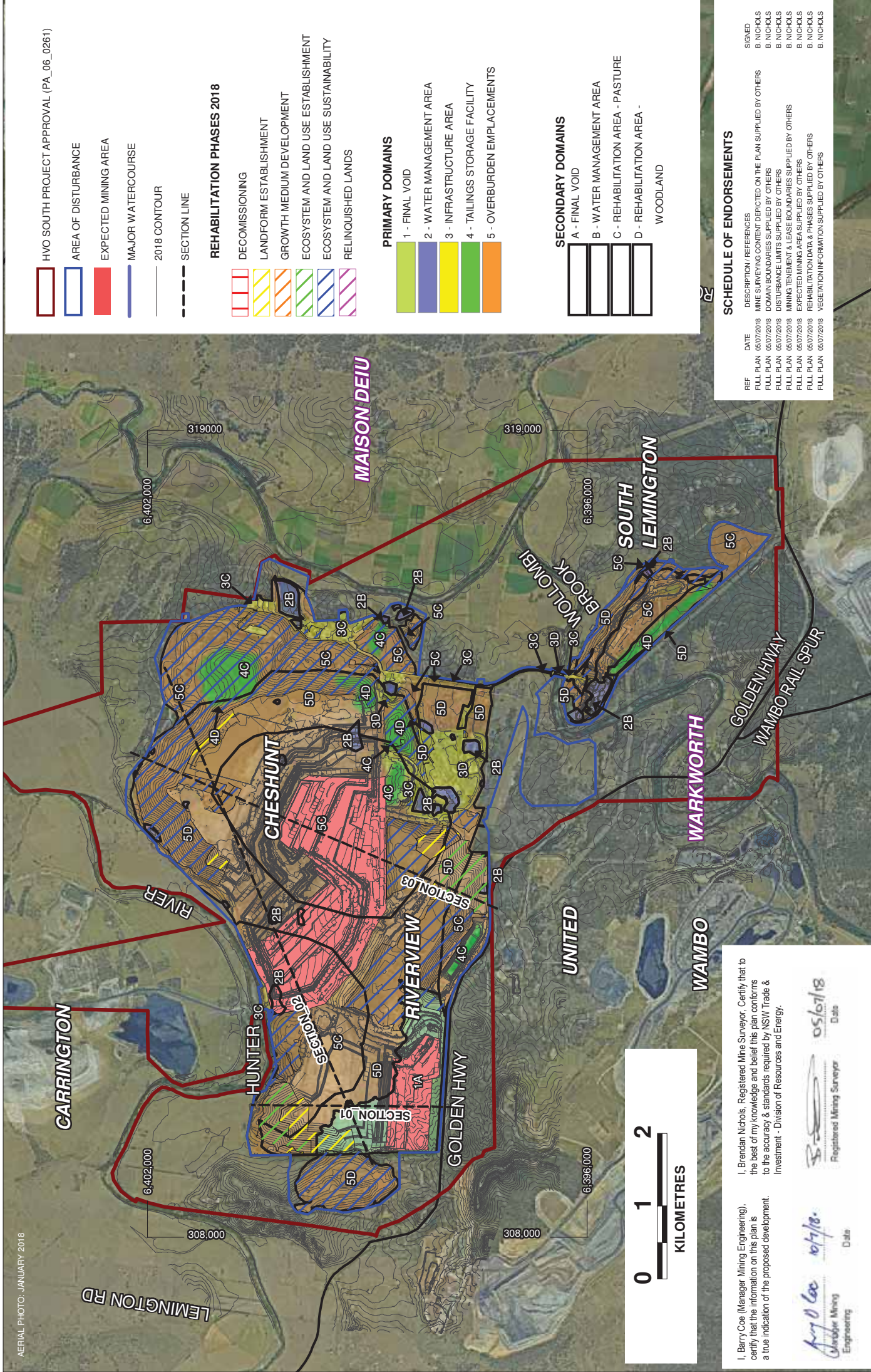
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I, Barry Coe (Manager Mining Engineering), certify that the information on this plan is a true indication of the proposed development.

05/07/18
B. Nichols
Registered Mining Surveyor
Date

05/07/18
Barry Coe
Manager Mining Engineering
Date



HVO SOUTH PROJECT APPROVAL (PA_06_0261)

AREA OF DISTURBANCE
EXPECTED MINING AREA
MAJOR WATERCOURSE

2018 CONTOUR
SECTION LINE

REHABILITATION PHASES 2018

DECOMMISSIONING
LANDFORM ESTABLISHMENT
GROWTH MEDIUM DEVELOPMENT
ECOSYSTEM AND LAND USE ESTABLISHMENT
ECOSYSTEM AND LAND USE SUSTAINABILITY
RELINQUISHED LANDS

PRIMARY DOMAINS

1 - FINAL VOID
2 - WATER MANAGEMENT AREA
3 - INFRASTRUCTURE AREA
4 - TAILINGS STORAGE FACILITY
5 - OVERBURDEN EMPLACEMENTS

SECONDARY DOMAINS

A - FINAL VOID
B - WATER MANAGEMENT AREA
C - REHABILITATION AREA - PASTURE
D - REHABILITATION AREA - WOODLAND

SCHEDULE OF ENDORSEMENTS

REF	DATE	DESCRIPTION / REFERENCES
FULL PLAN 6/07/2018	MINE SURVEYING CONTENT DEPICTED ON THE PLAN SUPPLIED BY OTHERS	SIGNED B. NICHOLS
FULL PLAN 6/07/2018	DOMAIN BOUNDARIES SUPPLIED BY OTHERS	B. NICHOLS
FULL PLAN 6/07/2018	DISTURBANCE LIMITS SUPPLIED BY OTHERS	B. NICHOLS
FULL PLAN 6/07/2018	MINING TENEMENT & LEASE BOUNDARIES SUPPLIED BY OTHERS	B. NICHOLS
FULL PLAN 6/07/2018	EXPECTED MINING AREA SUPPLIED BY OTHERS	B. NICHOLS
FULL PLAN 6/07/2018	REHABILITATION DATA & PHASES SUPPLIED BY OTHERS	B. NICHOLS
FULL PLAN 6/07/2018	VEGETATION INFORMATION SUPPLIED BY OTHERS	B. NICHOLS

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Produced By: SC
Map Size: A4 Landscape
Coordinate System: MGA94 Zone 56
Revision: 01
Data Source: Various

Mine Operations Plan 2018
Hunter Valley Operations South
Plan 3A 2018 - Mining and Rehabilitation

I, Brandon Nichols, Registered Mine Surveyor, Certify that to the best of my knowledge and belief this plan conforms to the accuracy & standards required by NSW Trade & Investment - Division of Resources and Energy.

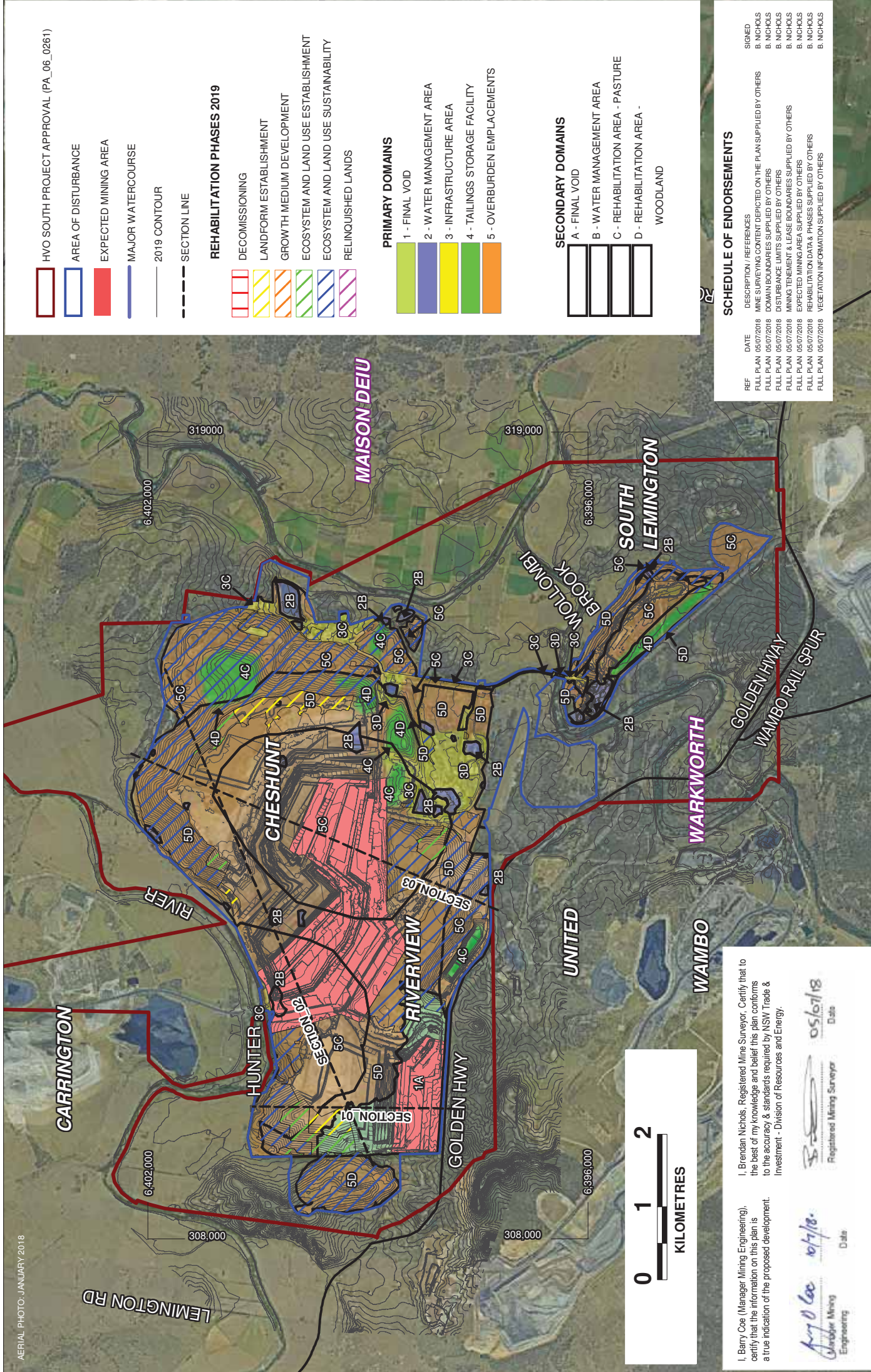
05/07/18
Date

Registered Mining Surveyor

10/7/18
Date

Registered Mining Surveyor

HUNTER VALLEY
OPERATIONS



HVO SOUTH PROJECT APPROVAL (PA_06_0261)

AREA OF DISTURBANCE

EXPECTED MINING AREA

MAJOR WATERCOURSE

2019 CONTOUR

SECTION LINE

REHABILITATION PHASES 2019

DECOMMISSIONING

LANDFORM ESTABLISHMENT

GROWTH MEDIUM DEVELOPMENT

ECOSYSTEM AND LAND USE ESTABLISHMENT

ECOSYSTEM AND LAND USE SUSTAINABILITY

RELINQUISHED LANDS

PRIMARY DOMAINS

1 - FINAL VOID

2 - WATER MANAGEMENT AREA

3 - INFRASTRUCTURE AREA

4 - TAILINGS STORAGE FACILITY

5 - OVERBURDEN EMPLACEMENTS

SECONDARY DOMAINS

A - FINAL VOID

B - WATER MANAGEMENT AREA

C - REHABILITATION AREA - PASTURE

D - REHABILITATION AREA -

WOODLAND

SCHEDULE OF ENDORSEMENTS

REF	DATE	DESCRIPTION / REFERENCES
FULL PLAN 05/07/2018	05/07/2018	MINE SURVEYING CONTENT DEPICTED ON THE PLAN SUPPLIED BY OTHERS
FULL PLAN 05/07/2018	05/07/2018	DOMAIN BOUNDARIES SUPPLIED BY OTHERS
FULL PLAN 05/07/2018	05/07/2018	DISTURBANCE LIMITS SUPPLIED BY OTHERS
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FULL PLAN 05/07/2018	05/07/2018	REHABILITATION DATA A PHASES SUPPLIED BY OTHERS
FULL PLAN 05/07/2018	05/07/2018	VEGETATION INFORMATION SUPPLIED BY OTHERS

Mine Operations Plan 2018
Hunter Valley Operations South
Plan 3B 2019 - Mining and Rehabilitation

HUNTER VALLEY
OPERATIONS

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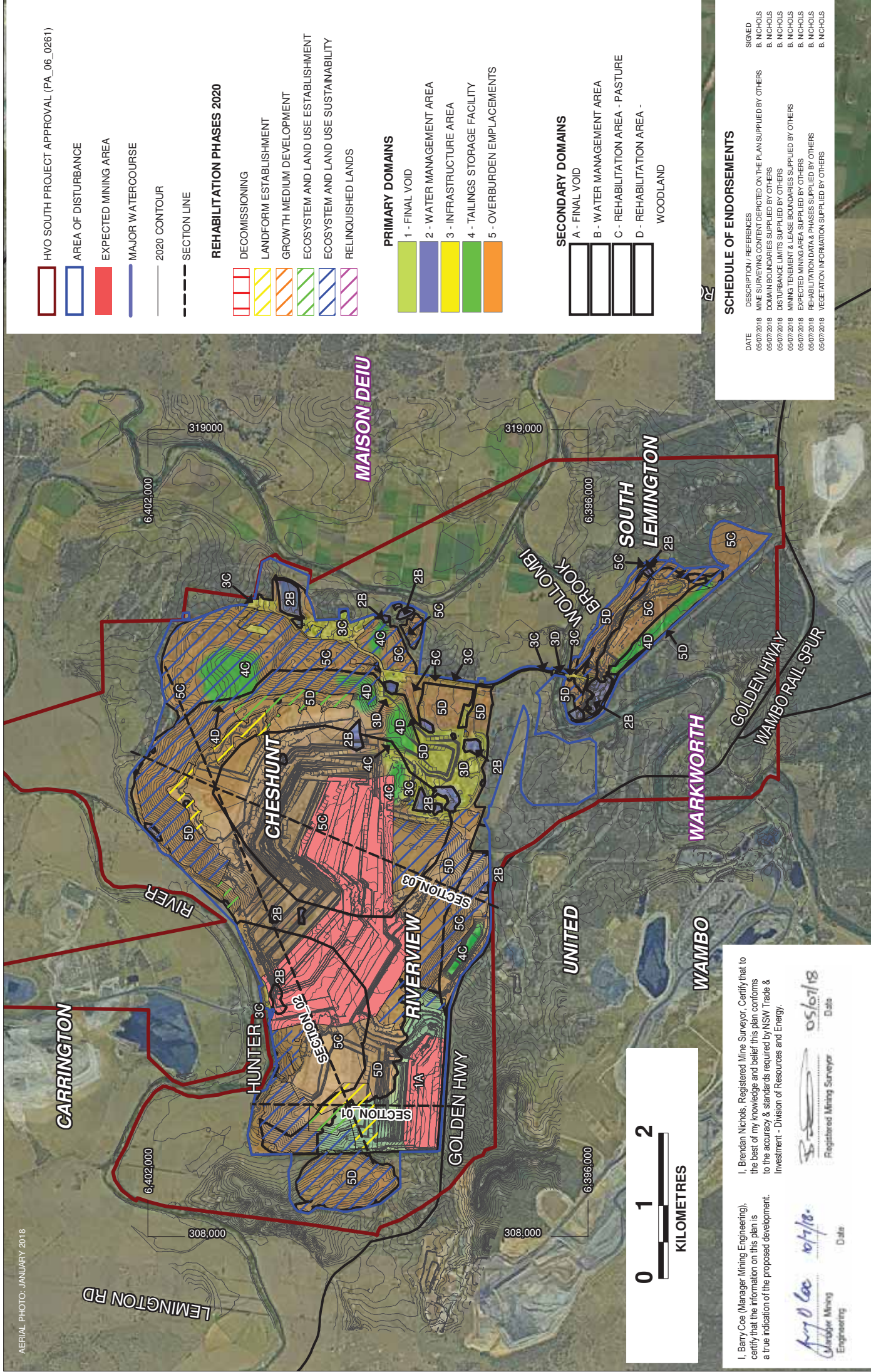
10/7/18
Barry Coe
Manager Mining Engineering

05/07/18
Date

Registered Mining Surveyor

Date: 05/07/18
Produced By: SC
Map Size: A4 Landscape
Coordinate System: MG/94 Zone 56
Revision: 01
Data Source: Various

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- HVO SOUTH PROJECT APPROVAL (PA_06_0261)
- AREA OF DISTURBANCE
- EXPECTED MINING AREA
- MAJOR WATERCOURSE
- 2020 CONTOUR
- SECTION LINE

REHABILITATION PHASES 2020

- DECOMMISSIONING
- LANDFORM ESTABLISHMENT
- GROWTH MEDIUM DEVELOPMENT
- ECOSYSTEM AND LAND USE ESTABLISHMENT
- ECOSYSTEM AND LAND USE SUSTAINABILITY
- RELINQUISHED LANDS

PRIMARY DOMAINS

- 1 - FINAL VOID
- 2 - WATER MANAGEMENT AREA
- 3 - INFRASTRUCTURE AREA
- 4 - TAILINGS STORAGE FACILITY
- 5 - OVERBURDEN EMPLACEMENTS

SECONDARY DOMAINS

- A - FINAL VOID
- B - WATER MANAGEMENT AREA
- C - REHABILITATION AREA - PASTURE
- D - REHABILITATION AREA - WOODLAND

SCHEDULE OF ENDORSEMENTS

DATE	DESCRIPTION / REFERENCES
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05/07/2018	EXPECTED MINING AREA SUPPLIED BY OTHERS
05/07/2018	REHABILITATION DATA PHASES SUPPLIED BY OTHERS
05/07/2018	VEGETATION INFORMATION SUPPLIED BY OTHERS

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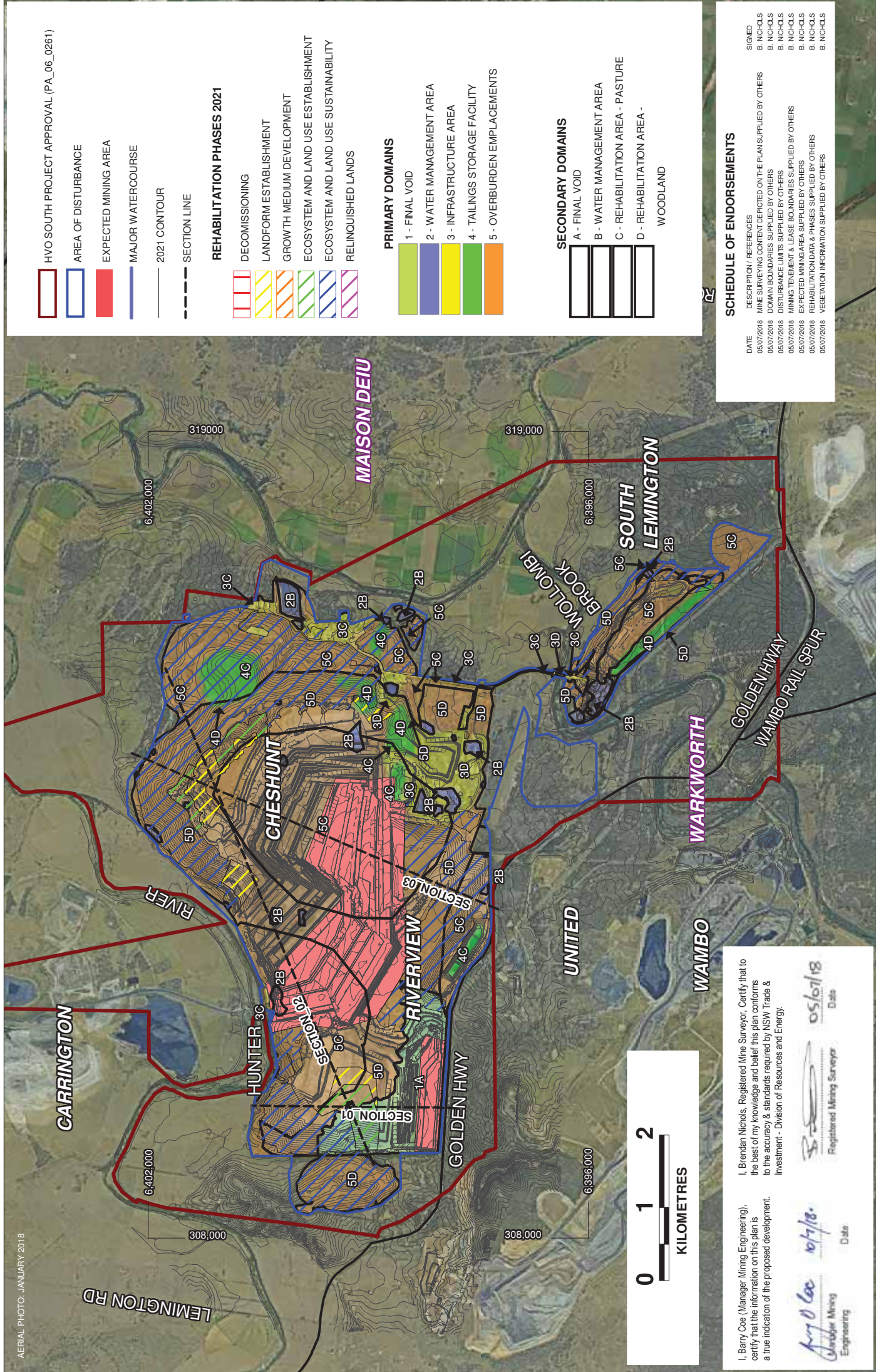
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Barry Coe 10/7/18
Manager Mining Engineering

Brendan Nichols 05/07/18
Registered Mining Surveyor



HVO SOUTH PROJECT APPROVAL (PA_06_0261)

AREA OF DISTURBANCE

EXPECTED MINING AREA

MAJOR WATERCOURSE

2021 CONTOUR

SECTION LINE

REHABILITATION PHASES 2021

DECOMMISSIONING

LANDFORM ESTABLISHMENT

GROWTH MEDIUM DEVELOPMENT

ECOSYSTEM AND LAND USE ESTABLISHMENT

ECOSYSTEM AND LAND USE SUSTAINABILITY

RELINQUISHED LANDS

PRIMARY DOMAINS

1 - FINAL VOID

2 - WATER MANAGEMENT AREA

3 - INFRASTRUCTURE AREA

4 - TAILINGS STORAGE FACILITY

5 - OVERBURDEN EMPLACEMENTS

SECONDARY DOMAINS

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D - REHABILITATION AREA - WOODLAND

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Barry Coe 10/7/18
Barry Coe
Manager Mining Engineering

Brendan Nichols 05/07/18
Brendan Nichols
Registered Mining Surveyor

Date

Date

SCHEDULE OF ENDORSEMENTS

DATE DESCRIPTION / REFERENCES

05/07/2018 MINE SURVEYING CONTENT DEPICTED ON THE PLAN SUPPLIED BY OTHERS

05/07/2018 DOMAIN BOUNDARIES SUPPLIED BY OTHERS

05/07/2018 DISTURBANCE LIMITS SUPPLIED BY OTHERS

05/07/2018 MINING TENEMENT & LEASE BOUNDARIES SUPPLIED BY OTHERS

05/07/2018 EXPECTED MINING AREA SUPPLIED BY OTHERS

05/07/2018 REHABILITATION DATA & PHASES SUPPLIED BY OTHERS

05/07/2018 VEGETATION INFORMATION SUPPLIED BY OTHERS

SIGNED
B. NICHOLS
B. NICHOLS
B. NICHOLS
B. NICHOLS
B. NICHOLS
B. NICHOLS

HUNTER VALLEY OPERATIONS

Mine Operations Plan 2018

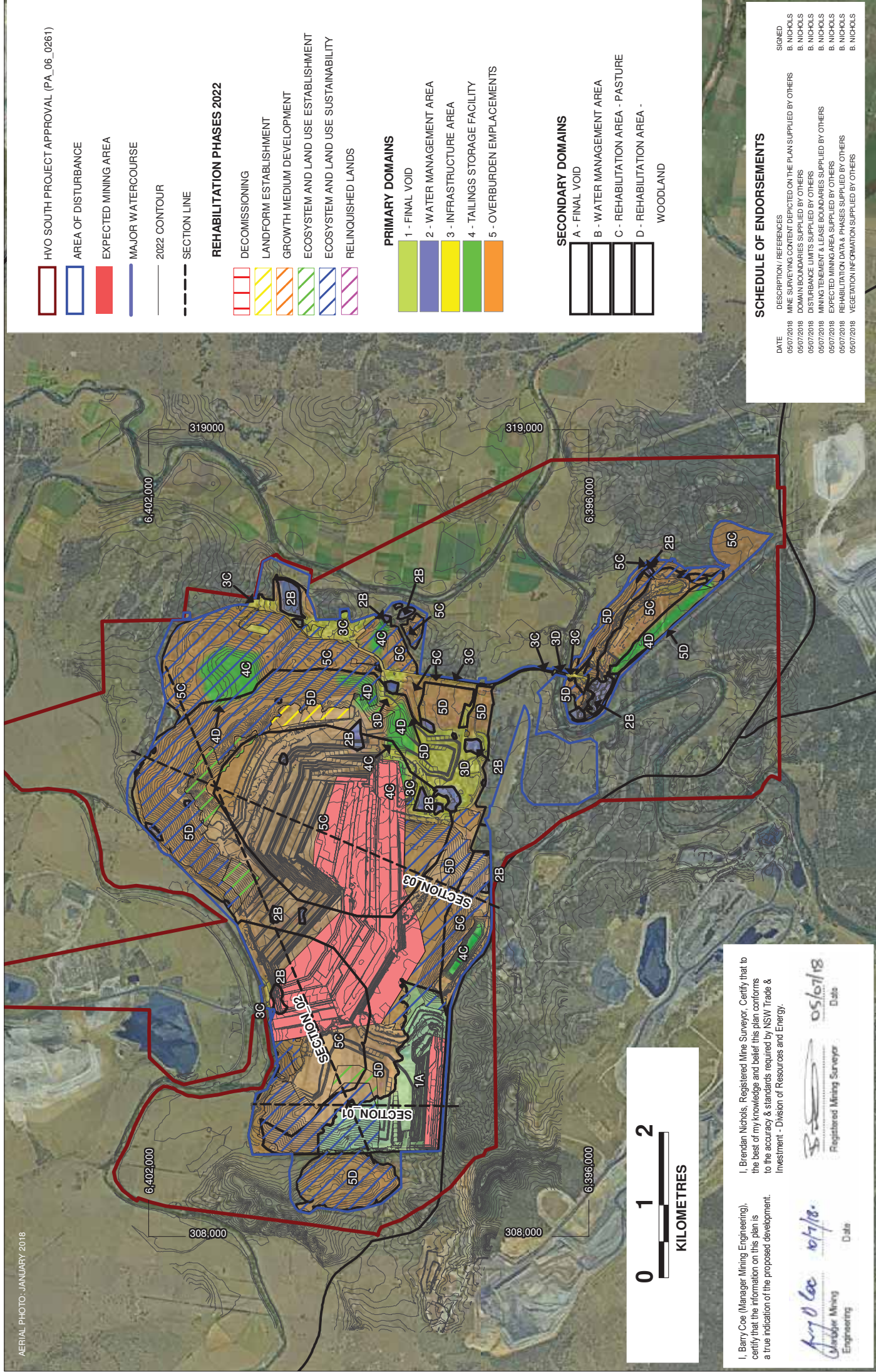
Hunter Valley Operations South

Plan 3D 2021 - Mining and Rehabilitation

Date: 05/07/18
Produced By: SC
Map Size: A4 Landscape
Coordinate System: MGA84 Zone 56
Revision: 01
Data Source: Various

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- HVO SOUTH PROJECT APPROVAL (PA_06_0261)
- AREA OF DISTURBANCE
- EXPECTED MINING AREA
- MAJOR WATERCOURSE
- 2022 CONTOUR
- SECTION LINE

REHABILITATION PHASES 2022

- DECOMMISSIONING
- LANDFORM ESTABLISHMENT
- GROWTH MEDIUM DEVELOPMENT
- ECOSYSTEM AND LAND USE ESTABLISHMENT
- ECOSYSTEM AND LAND USE SUSTAINABILITY
- RELINQUISHED LANDS

PRIMARY DOMAINS

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- 5 - OVERBURDEN EMPLACEMENTS

SECONDARY DOMAINS

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SCHEDULE OF ENDORSEMENTS

DATE	DESCRIPTION / REFERENCES	SIGNED
09/07/2018	MINE SURVEYING CONTENT DEPICTED ON THE PLAN SUPPLIED BY OTHERS	B. NICHOLS
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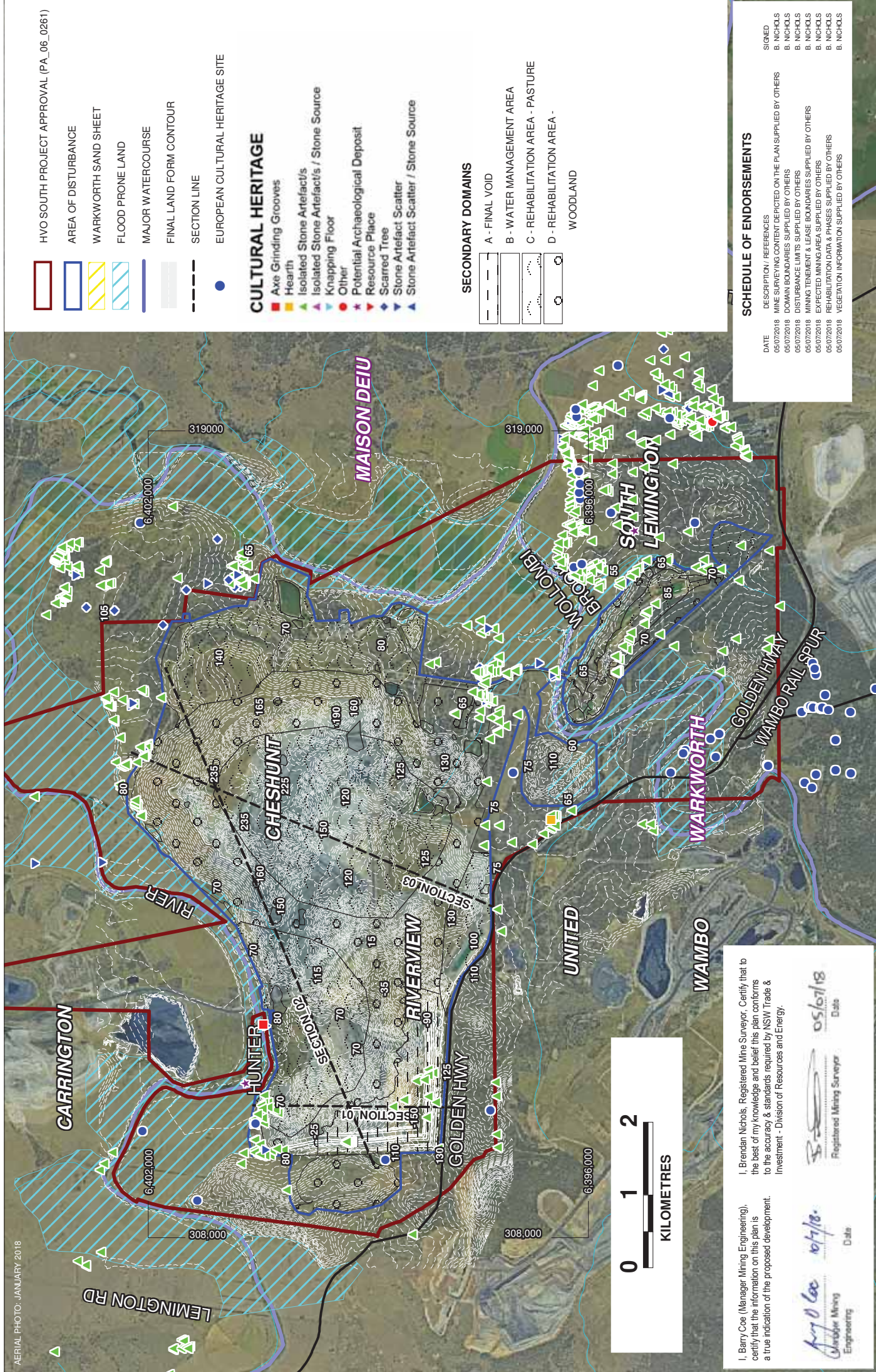
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Barry Coe
10/7/18
Date

Registered Mining Surveyor
05/07/18
Date



- HVO SOUTH PROJECT APPROVAL (PA_06_0261)
- AREA OF DISTURBANCE
 - WARKWORTH SAND SHEET
 - FLOOD PRONE LAND
 - MAJOR WATERCOURSE
 - FINAL LAND FORM CONTOUR
 - SECTION LINE
 - EUROPEAN CULTURAL HERITAGE SITE

- CULTURAL HERITAGE**
- Axe Grinding Grooves
 - Hearth
 - Isolated Stone Artefact/s
 - Isolated Stone Artefact/s / Stone Source
 - Knapping Floor
 - Other
 - Potential Archaeological Deposit
 - Resource Place
 - Scarred Tree
 - Stone Artefact Scatter
 - Stone Artefact Scatter / Stone Source

- SECONDARY DOMAINS**
- A - FINAL VOID
 - B - WATER MANAGEMENT AREA
 - C - REHABILITATION AREA - PASTURE
 - D - REHABILITATION AREA - WOODLAND

SCHEDULE OF ENDORSEMENTS

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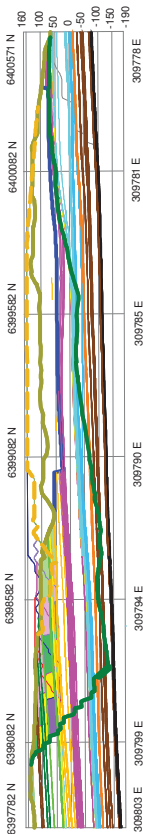
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Barry Coe 10/4/18 Date
Manager Mining Engineering

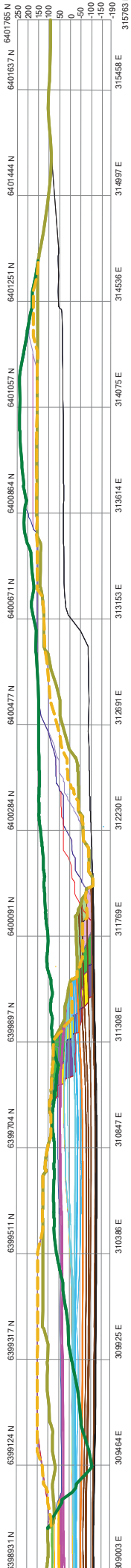
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Brendan Nichols 05/07/18 Date
Registered Mining Surveyor

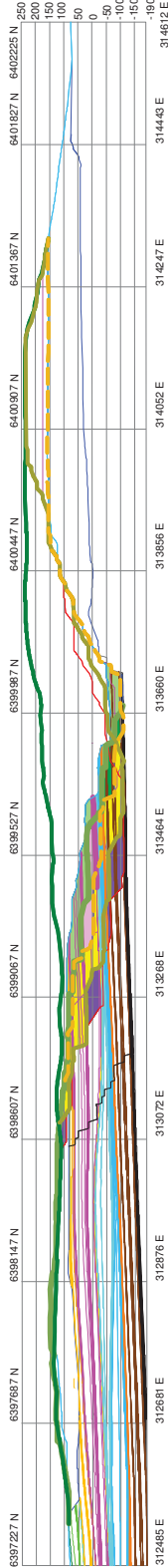
Section 1



Section 2



Section 3



MINING BY YEAR



I, Barry Coe (Manager Mining Engineering), certify that the information on this plan is a true indication of the proposed development.

Barry Coe
10/7/18
Registered Mining Engineering
Date

SEAM LEGEND

- MILBRODALE
- VAUX
- PERCEFIELD
- BAYSWATER
- BROONIES
- GLEN MUNROE
- WOODLANDS HILL
- ARROWFIELD
- BOWFIELD
- FAIRFORD CLAYSTONE
- WARKWORTH
- MT ARTHUR

TOPO (JANUARY 2018)

LANDFORM END OF YEAR 2018

FINAL REHAB SURFACE