Planning, Industry & Environment
NSW GOVERNMENT

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Mr Andrew Lawry
Chief Operating Officer
Heron Resources Limited
WOODLAWN MINE PROJECT

By email to: ALawry@HeronResources.com.au

Dear Mr Lawry

Woodlawn Mine Project (07_0143) – Approval Paste Fill Management Plan

I refer to your email dated 21 July 2019 seeking the Secretary's review and approval of the *Heron Resources Limited Woodlawn Zinc – Copper Project Paste Fill Management Plan* (Revision 7, dated 19 July 2019).

The Department has carefully reviewed the *Heron Resources Limited Woodlawn Zinc – Copper Project Waste Rock Management Plan* (Revision 7, dated 19 July 2019) and is satisfied that the Plan address the requirements of condition 5, Schedule 3 of Project Approval 07_0143.

Accordingly, the Secretary approves the *Heron Resources Limited Woodlawn Zinc – Copper Project Paste Fill Management Plan* (Revision 7, dated 19 July 2019).

Please ensure that a copy of Plan is placed on your website as soon as possible.

If you require further information, please contact Leesa Johnston on 8289 6861 or by email to leesa.johnston@planning.nsw.gov.au.

Yours sincerely

29/8/19.

Steve O'Donoghue
Director
Resource Assessments
as nominee of the Secretary

Waste and Waste Rock Management Plan

Woodlawn Copper Zinc Project

Document Review/Change History

Date	Review Change Summary Created, Reviewed, Changed or Obsolete	Revision No.	Authors	
			Reviewed by	Approved by
30/01/2015	Draft for internal review	1	HS	RB
30/06/2015	Update document	2	RB	-
20/04/2016	General update	3	RB	HS
25/05/2016	Government review	4	RB	AL
12/09/2016	Issue to department of Planning and Environment	5	RB	AL
10/05/2017	DPE Comments	6	RB	AL
11/05/2017	Operational	7	RB	AL
02/08/2017	Amendments for MOD2	8	RB	AL
06/06/2024	Amend company details, increase scope of plan to include all waste, updates following revised company strategy	9	KC	AVN

Glossary

Acronym	Definition
ANC	Acid Neutralising Capacity
APP	Acid Producing Potential
DEVELOP	Develop Global Limited - Tarago Operations Pty Limited
DPE	Department of Planning and Environment
DPI- Water	Department of Primary Industries - Water
DRG	Division of Resources and Geosciences
EA	Environmental Assessment
ED	Evaporation Dam
EMS	Environmental Management Strategy
EPA	Environment Protection Authority
EPL	Environmental Protection Licence
NAF	Non-Acid Forming
NAG	Net-Acid Generation
NAP	Net Acid Production
NAPP	Net Acid Production Potential
NATA	National Association of Testing Authorities
NSW	New South Wales
PA	Project Approval
PAF	Potentially Acid Forming
PAF-LC	Potentially Acid Forming - Low Capacity
PCD	Pollution Control Dam
Project	Woodlawn Zinc-Copper Mine
RWRD	Rehabilitated Waste Rock Dam
ROM	Run Of Mine
SML20	Special Mining Lease 20
TARP	Trigger Action Response Plan
TDN	Tailings Dam North
TSF4	Tailings Storage Facility 4
Veolia	Woodlawn Bioreactor
Waste MP	Waste Management Plan
WWRMP	Waste Rock Management Plan

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TABLES

Appendices

1. INTRODUCTION

1.1. Background

The Woodlawn Zinc-Copper mine (the Project) is located approximately 7 km northwest of Tarago in New South Wales (NSW) within Special (Crown and Private Land) Mining Lease no. 20 (SML20) as shown in

Plan 1, Appendix 1. Further details on the Project history and approvals are within the overarching Environmental Management Strategy (EMS) available on the Develop Global Limited (DEVELOP) website. This Waste and Waste Rock Management Plan (WWRMP) forms one component of the Projects overall EMS. The EMS includes a number of commitments and component management plans which together form the basis for the ongoing operation of the Woodlawn Mine.

Waste generation and management for the Project was previously described in detail in the Project Environmental Assessment (EA) (Parsons Brinkerhoff 2012). Previously, only a Waste Rock Management Plan existed for the Project. Given a waste management plan is also standard across NSW mines and was identified within the Projects original statement of commitment this update includes the management of other wastes, not just rock and potential acid forming material.

1.2. Scope and objectives

This WWRMP has been prepared for DEVELOPs Woodlawn Zinc-Copper mine in accordance with Schedule 4 Condition 19 of the Project Approval (PA). The objectives of this waste MP are to:

- Implement the commitments made in the EA including specific conditions of approval and the Statement of Commitments.
- Provide further details on the measures to be implemented during the operational phase of the Woodlawn Project to ensure that the Project's actual environmental impacts are consistent with those evaluated in the EA.
- Provide a mechanism to adapt new measures throughout the ongoing operation to improve the management and identification of waste rock characteristics.
- Provide for continuous improvement in environmental performance.
- Provide a mechanism to identify and correct areas of non-compliance.

1.3. Legislative Requirements

The Project is governed by the following:

- Project Approval: as issued in 2013 and amended in 2016 and 2017. Document ID: 07_0143MOD2
- Environment Protection License (EPL): 20821 as issued by the NSW Environmental Protection Agency (EPA).
- Special Mining Lease (SML): 20

1.3.1. Project approval requirements

This Waste MP has been developed in accordance with the PA environmental commitments which are listed Table 1-1 and includes a reference to where each of the conditions are addressed in this waste WMP.

Table 1-1 Consent Conditions Relating to waste management

Condition	Description	Where Addressed
Sch 4 Condition 3	Within 5 years of the date of this approval, the Proponent shall identify the passive system to treat seepage from the existing	Section 4.1.1

Condition	Description	Where Addressed
	Waste Rock Dump in consultation with DRG, and implement the preferred system to the satisfaction of the Secretary	
Sch 4 Condition 19	The Proponent shall prepare and implement a Waste Rock Management Plan to the satisfaction of the Secretary. The plan must: (a) be developed in consultation with Division of Resources and Geosciences (DRG), EPA and Department of Primary Industries - Water (DPI-Water); (b) be submitted for the approval of the Secretary prior to commencing underground mining operations; (c) include a detailed description of the procedures to be implemented to monitor and manage potential acid forming material, including: testing for potentially acid forming (PAF) waste rock prior to it being brought to the surface; prioritising the relocation of PAF material to suitable underground locations prior to oxidation; using all reasonable and feasible measures to prevent waste rock emplaced underground from further oxidising or causing impacts on groundwater; trigger levels for any material that has oxidised to the extent that it cannot be placed underground without impacting groundwater quality, and procedures for adequate capping and sealing of such material at the surface; effective isolation and/or neutralisation of PAF material in waste rock dumps; and (d) reflect the groundwater and surface water monitoring programs to monitor PAF waste rock and any leachate generated, including appropriately designed detection and response systems for acid generation	This Plan
Statement of Commitments Item 5A Soils & Waste	The EMS to be developed and implemented for the Project Site would include procedures for the identification and management of acid-producing waste rock; the storage and handling of chemicals and hydrocarbons; storage, handling and transportation of mineral concentrates; and the management and disposal of tailings.	This plan Transport management plan
Statement of Commitments Soils & Waste	A waste management plan would be developed to address the core objectives of waste minimisation and recycling throughout the Project. The plan would include: • carefully separating PAF waste rock from non-acid forming (NAF) waste rock; • designing the waste rock emplacement to ‘enclose’ PAF rock to mitigate against acid generation; • diverting any surface run-off or seepage from the waste rock emplacement to Tailings Storage Facility 4 (TSF4); • tracking hazardous waste through the establishment of a hazardous waste tracking system; • undertaking targeted rock testing on rock samples from the Woodlawn Underground Project (WUP)	This plan

Condition	Description	Where Addressed
	geological core library, to develop a sulfidic waste management and monitoring plan; and • disposing of PAF waste in underground voids, in the tailings dams or in a dump that is capped and rehabilitated.	
Statement of Commitments Item 5I Soils & Waste	Waste rock would be progressively characterised for net acid generating potential, both through physical identification by geologists and laboratory analysis.	Section 3.1
Statement of Commitments Statement of commitments Item 5O	TriAusMin would closely manage the waste rock and tailings throughout the life of the Project to ensure that acid leachate from past or future operations does not contaminate soil or water, or compromise effective rehabilitation.	This plan

1.4. Consultation

Schedule 4 Condition 19 of the Project Approval requires this WRMP to be prepared in consultation with the NSW DRG, EPA and the DPI-Water prior to being submitted to the Secretary of the Department of Planning and Environment (DPE) for approval. No comments were received prior to the preparation of version 5. Version 5 includes comments received from the DPE as reproduced in Appendix 2.

2. GENERAL WASTE MANAGEMENT MEASURES

2.1. Waste measurement measures

Wastes will be managed as summarised in Table 2-2.

Table 2-2 Waste management

Waste type	Storage	Removal
General waste	Covered bins	Regularly collected and taken off-site by a licensed waste contractor
Waste oils and greases	Bunded areas within workshop	Licensed waste contractor and disposed/recycled off-site
Tyres	Designated areas	Re-use on site or removal and taken off-site
Batteries and tyres	Marked storage area within the workshop area	Licensed waste contractor and disposed/recycled off-site
Scrap steel / metal	Designated areas	Scrap metal recycler as required
Paper / cardboard	Covered bins	Regularly collected and taken off-site by a licensed recycling contractor
Used reagent and chemical containers	Designated areas	Regularly collected and taken off-site by a licensed waste contractor or supplier
Tailings	Tailings dams	A component of the tailings will be used to produce a paste to backfill completed stopes or areas requiring stabilisation underground. Excess tailings will be disposed of in either the existing tailings dams once reprocessed or in TSF4.

2.1.1. Waste water

Wastewater from ablutions is either pumped out and transported off-site for disposal for the core-yard and workshop areas or treated via the treatment system on site with the treated water entering the Pollution Control Dam.

3. WASTE ROCK

3.1. General characterisation

The target ore is hosted within a bedded volcanogenic massive sulphide deposit which is itself hosted within the Woodlawn Felsic Volcanics. The volcanics are flanked by sedimentary strata consisting of mudstone, pyritic black shale, sandstone, conglomerate and limestone. The package is intruded by dolerite sills and dykes associated with the overlying basalts and has been subject to low grade metamorphism. From an environmental perspective, the geological environment presents a highly complex mixture of acidic, neutral, alkaline, saline, non-saline, high and low sulphide and metal bearing strata.

Rocks with high sulphide content include pyrite, sphalerite, galena and chalcopyrite have the potential to form acidity when exposed to air and water. The associated metals that are present tend to mobilise as pH falls. The trigger usually is elevated sulphide which also increases conductivity, but the salt is predominantly sulphate based rather than the more typical sodium chloride.

Sulphide minerals such as pyrite (FeS_2), sphalerite (ZnS), galena (PbS) and chalcopyrite ($CuFeS_2$) are the main sources of potentially acid forming materials or PAF. The zinc, lead and copper-based minerals are the target minerals for processing while pyrite is not.

The minerals surrounding the target ore are referred to as gangue minerals. These consist of quartz, talc, chlorite and calcite which are generally non-acid forming or NAF but can include other minerals such as pyrite which are potentially acid forming. It is often the gangue minerals which need to be extracted around the ore lens in order to maximise the recovery of the target ore. The gangue minerals generally report to the process waste stream and will be converted to NAF via the production of paste.

3.1.1. Model

A mine PAF/NAF model will be developed from existing drilling programs to identify potential high sulfur waste zones within the designated underground mining area prior to mining. This will be validated through laboratory testing and will assist in the planning of expected volumes and timing that material could be expected to be stored on the surface.

3.1.2. Laboratory testing

Laboratory testing will be used to accurately determine the classification of waste rock being produced by the Project. Definitions of terms used when referring to waste rock laboratory testing and results are included in Appendix 3 for reference. Samples collected will be analysed for NAPP, NAG testing (static testing) as well as kinetic testing.

Any testing completed by Heron either from internal or external laboratories has, so far, been unable to be located. Develop has undertaken some collection of waste rock material which has been tested at a National Association of Testing Authorities (NATA) compliant laboratory. The results of this have validated the presence of both non-acid and acid forming rock material as expected. As the Project has specialist laboratory testing facilities available on site, some routine testing is proposed to be performed on site.

3.2. Classification Process

NAG and NAPP are the main tests which will determine whether a particular waste rock is classified as PAF or NAF as detailed in Table 3-3.

Table 3-3 General Waste Rock Classification and Management

Risk level	Waste Rock Classification	NAPP	APP	NAG pH	ANC	Action / management / use
Green	NAF	Negative	-	≥4.5	-	Use in construction of TSF4 and ROM pad. General surface construction Stowage underground. Can be used for blending with PAF
Green	NAF (alkaline)	Negative	>0	>7	> 5 kg H2SO4 per tonne	As for NAF but can also be used for: rehabilitation of the tailings dams lining of drainage channels separated for specific acid neutralisation activities.
Yellow	Uncertain	Positive	-	≥ 4.5	-	Undertake kinetic testing to further define or treat as PAF low capacity If classification is still uncertain the material is to be treated as Potentially Acid Forming - Low Capacity (PAF-LC)
		Negative	-	< 4.5	-	
Yellow	PAFF-LC	0 - 10 kg H2SO4/T	-	<4.5	-	Material to be identified Use in low risk applications only Can be used in underground stowage Blending required if used in surface applications other than within the designated Waste Rock Emplacement Potential use by Veolia in low risk applications.
		Negative	-	3 - 4.5	-	
Red	PAF	> 10 kg H2SO4/T	-	<4.5	-	Material to be identified/designated as PAF May remain underground If brought to the surface must be stored in the designated Waste Rock Emplacement for no more than 2 years. Surface stockpiled PAF to be removed or treated after 2 years Surface disposal only in tailings dams Cannot be relocated underground from the surface without treatment

Kinetic tests will also be performed to quantify the rate at which the different waste types may begin to oxidise and to further analyse samples when the static test results are not definitive. As the dominant sulphide species at Woodlawn is pyrite, the rate of oxidation of the waste rock is expected to be rapid, however given the likelihood that the PAF could be mixed with NAF that has acid neutralising capacity (ANC), the actual rate could vary significantly. The kinetic test program will enable DEVELOP to determine the rate at which different PAF material types are likely to oxidise to make more appropriate management decisions particularly in relation to how long the material can be stockpiled and the need for blending or treatment.

The process for determining how waste rock mined will be classified and ultimately where the waste rock will be stored will be the function of the mine geological personnel. They will classify material on a mining block basis to assist in determining where this material is to be disposed. Geologists will be trained to identify sulphide zones within the waste material. This process will be validated by completing static tests (NAPP) on underground rock chip samples where appropriate. This process of visual inspection supported by validation through sampling will ensure geologists will be familiar with the rock type characterisation techniques for identifying NAF and PAF waste material.

3.3. Expected waste rock production

Waste rock will be generated throughout the project life and will produce waste including both NAF and PAF materials. As the underground mine develops, waste will be produced from new drives and production stopes. The drives will necessarily intersect both felsic volcanics and massive sulphides in order to access the ore lenses. However, the design of the stopes will minimise the production of waste rock which is a critical function of mine design in order to minimise production costs.

The majority of material mined within the stopes will be PAF and will generally be brought to the surface and processed to recover the metals or if non-economic grade will be stowed underground in available voids. NAF material generated by ongoing access road development may either be stowed underground or if needed, can be brought to the surface for construction activities. There will be an ongoing need for non-acid forming construction materials throughout the life of the project. The first stage of the TSF4 dam wall has been completed using NAF however stages 2 and 3 will require further NAF construction materials. This material will be stored near the dam wall to reduce construction costs when raising the TSF4 wall is required.

Woodlawn Bioreactor (Veolia) also has an ongoing need for NAF material and operates a dolerite stockpile area adjacent to the mine entry. They can also use some PAF material so long as it hasn’t oxidised. This stockpile may be added to with new NAF material from the underground workings.

3.4. Waste rock management

The management of waste rock moving forward will have two separate components, namely:

- The identification and separation of waste rock containing sufficient sulphide minerals such as pyrite to cause acid generation (i.e. PAF materials).
- Reducing the concentration of PAF materials in both existing tailings and future tailings material through more efficient processing technologies and fixing any residuals by correcting with lime and cement to form a backfill paste.

The identification process will occur underground from a combination of geological modelling, regular laboratory testing of rock and visual identification. This may include leaving it in-situ, relocating it to a designated underground stowage area or taking it to the surface for temporary storage within the designated PAF emplacement site.

Day to day management of acid-generating materials will involve a process of identification of acid risk materials, characterisation of the material, segregation, selective placement or blending and treatment. This process will be integrated with mine planning and operations and involve trained staff supported by laboratory analysis and refinement of the geological model.

As Woodlawn has an identified acid generation risk, measures are required to reduce the potential for acid generation from both the existing mine and future mining operations.

3.4.1. Disposal and Stockpiling of Waste Rock (PAF)

A designated Waste Rock Emplacement has been located to the west of the new TSF4. The site was chosen because it includes existing disturbance and drains into Tailings Dam North (TDN). Part of the site was previously used for retreatment of tailings in TDN and therefore already contains PAF materials. It is also accessed from the haul road which links the mine to the ROM pad making delivery of PAF materials easy.

A temporary stockpile has been created adjacent to the box cut to minimise haulage to the currently approved waste rock emplacement.

The Waste Rock Emplacement is for temporary storage of PAF only. Material should not be stored for more than 2 years without approval of the Mine Manager and Environmental Officer. Kinetic testing will be performed where PAF materials need to be stored above ground for period greater than 2 years. Should the results show that the material is, or is still at risk, of producing acid drainage, a program will be developed to relocate or treat the material. Should relocation be necessary, the material will be progressively removed over the subsequent 6 month period.

Once underground production has advanced, backfill areas underground will be available. PAF material will be either:

- transported from the mined area directly to an available backfill or stowage area;
- blended with NAF prior to backfill directly underground; or
- transported to the processing plant bound with ore which will ultimately be returned as paste used for backfilling completed stopes.

No PAF material that has been previously brought to the surface will be transported back underground without prior treatment and retesting to ensure it is no at risk of developing acid generation, that is, having a Net Acid Production Potential value greater than 10 kg H_2SO_4/T and NAG pH <4.5.

3.4.2. Treatment of PAF Waste Rock

The use of paste fill as the predominant backfilling method for mining voids will significantly reduce acid generation potential in these areas of the mine. The production of paste is an effective treatment process. It involves combining the crushed rock waste with hydrated lime and cement which will raise the pH of the material to at least pH10. Unprocessed waste rock can be added to the paste if available which increases the strength of the cured paste.

The hydraulic conductivity of the cemented paste backfill will be between $1x10^{-8}$ to $1x10^{-10}$ m/s. This is a very low permeability value which is typically lower than the host sulphide volcanic strata which is often fractured. The paste filling process would therefore limit the normal flow of groundwater through the mined area and in turn reduce the natural formation of acidity. The Paste Fill Management Plan contains further details on the use and management of paste fill.

Other treatment measures are available including:

- Oxygen exclusion – this can be achieved by capping or wet cover such as disposal in the tailings dams. Following the completion of mining activities, groundwater will be allowed to inundate the mine workings. This will eliminate the availability of oxygen preventing oxidation of the PAF material for the long term.
- Hardpan development to reduce oxidation of the underlying materials. This option can include permanent rock cover for sealing
- Bacteria inhibitors – using chemicals to inhibit the growth of the *Thiobacillus ferrooxidans* bacteria may slow the rate of acid production. Anionic surfactants act as bactericides and kill these bacteria by effectively stopping the reactions where pyrite (ferric sulphide) is converted to soluble iron (ferrous sulphate) and where the soluble iron is further converted to ferric sulphate. By halting the production of the ferrous sulphate, further degeneration of the cycle of the pyrite to create sulphuric acid is halted.
- Using alkaline material such as limestone and dolomite to chemically alter the PAF waste rock permanently. The rate of alkali can be determined through calculating the required nett acid neutralisation requirement.

Given the demand for paste over the life of the operation, it is anticipated that the majority of PAF material that needs to be brought to the surface will end up being used for paste manufacture. PAF material unsuitable for processing and temporarily stored in the Waste Rock Emplacement will likely to be relocated to a tailings dam. PAF material can also be used within the tailings dams to construct dividing walls and ramps as required during operations or rehabilitation activities. As the tailings dams will always be a source of acid generation, the use of PAF material is suitable for this purpose. The rehabilitation methods for the tailings dams assume permanent separation between the tailings material and surface capping and growing media will be required.

3.4.3. Blending of PAF Waste Rock

Although the majority of waste rock produced by the underground mine will be brought to the surface, there will be opportunistic direct deposition into stopes or stowage areas. In these circumstances, blending and/or co-disposal of PAF material will be used as a means of reducing the total acid producing potential (APP) of the material. The process involves mixing material that has a higher potential to produce acid with material with an acid neutralising potential. The blended material will result in a reduced total acid production potential.

As the underground mine develops, the opportunities for blending may increase. The developing geological model will enable characterisation of waste rock prior to removal. The model, coupled with ongoing NAPP and NAG testing, will endeavour to predict the outcome of separation and blending of acid forming materials stowed underground. The aim of this will be to reduce the overall acid generation potential of the waste rock disposed underground as a result of mining.

3.4.4. Management of Waste Rock in Practice

Management of waste rock will be an ongoing and detailed task requiring complex scheduling. The principles of how this will work in practice is as follows:

- Rock located away from the mineralised ore body and at shallow depth has been tested and has been confirmed as Non-Acid Forming. This material will generally be extracted during decline and access road construction and will be brought to the surface if stowage underground is not possible.
- NAF material brought to the surface will be used for construction purposes and stockpiled adjacent to the area of next intended use. This will include TSF4 to enable Stages 2 and 3 to be constructed, near the existing tailings dams where dividing walls are to be constructed, road construction sites or nominated rehabilitation areas or made available for Veolia to use.
- Mineralised rock containing high pyrite content has the potential to be acid forming. Based on the results of the testing outlined in Section 3.2, the material will be coded Green, Yellow or Red and managed accordingly.
- Mineralised rock will be encountered from time to time within decline or access development. This material will generally need to be brought to the surface due to the practicalities of constructing single drive declines and level development where no space exists for underground stowage.
- Mineralised rock primarily occurs within the stopes which is all likely to be classified as PAF.
- Most of the stoped material will be brought to the surface and processed to extract the ore. Most of the waste from this process will be sent to the Paste Plant and used for stope filling.
- Tailings not required for paste manufacture will be pumped into the existing tailings dams. This material, is still likely to be acid forming and will be rehabilitated in accordance with the approved Rehabilitation Management Plan.
- Some PAF material will remain underground within the stopes or other stowage areas. This is not considered environmentally hazardous to groundwater as the material was originally located underground and will simply remain underground.
- All material is brought to the surface using underground haulage trucks which are unsuitable for general surface transport. Therefore, it will be necessary to have some rehandling of the material where it is essentially transferred from the underground mining equipment to surface trucks. During the decline construction phase the staging area will be the general material stockpile while during mining operations the underground haul trucks will also dump PAF material at the ROM pad. PAF material unsuitable for processing will then be transported to either the Waste Rock Emplacement or the tailings dams.
- PAF material contained in the Waste Rock Emplacement will be either treated, blended or disposed of in the final tailings dams prior to rehabilitation within 2 years.
- PAF material brought to the surface that has a NAPP value of >10 kg H_2SO_4/T and NAG pH <4.5 will not be returned to the underground workings.

The management of waste rock will be further refined based on the ongoing testing regime and mine development. Any significant changes to the management of waste rock will be included in a revision to the plan and provided to DPE for review.

3.5. Monitoring program

The number of samples required in order to achieve full characterisation will depend on the advice of DEVELOP's Geology Department. Samples are characterised on a matrix of lithology, alterations and mineralisation. The geochemical analysis for each sample is matched to the NAPP and NAG test result plotted on the AMIRA 2002 “Preventing Acid and Metalliferous Drainage” guideline for classification, also the basis of classification within this management plan. Correlation plots of the geology characteristics and the NAPP/ NAG results will determine the population variance and requirement for number of samples within population types. Results will be compiled into a block model that represents the classification and risk for blocks of material within the mine plan.

When determining acid potential of blended material, testing will involve composite sampling methodologies with each composite representing no less than 3 sub-samples and thoroughly combined. A summary of the results will be provided in the Annual Review. The testing regime is outlined in Table 3-4.

Table 3-4 Monitoring Parameters and Testing Frequency

Material type or location	Testing Parameters	Frequency
Felsic Volcanic Strata*	ANC, NAPP	Sufficient for full characterisation**
Metamorphic Strata*	ANC, NAPP	Sufficient for full characterisation**
Sulphide Volcanics*	NAPP, APP, NAG	Sufficient for full characterisation**
Blended underground stowage*	NAPP, NAG	Sufficient for full characterisation**
Run of Mine Ore	NAG	Sufficient for full characterisation**
Process Tailings	NAG	Sufficient for full characterisation**
Paste Fill	Kinetic leach, NAG, NAPP	Sufficient for full characterisation**
PAF Waste Rock Emplaced material	Kinetic leach, NAG, NAPP	Once off after year 2 Annual thereafter while stored
NAF Waste Rock used on surface	Kinetic leach, NAG, NAPP	Sufficient for full characterisation**
New tailings not used for paste fill	NAPP, APP, NAG, Kinetic leach	Sufficient for full characterisation**
Paste	Physical	Daily when Paste Plant operational
	Strength	Average Weekly
	NAPP and Kinetic leach	Six Monthly

* Note: this material will generally be sampled from the underground workings prior to being brought to the surface. This may not be possible in some situations where safety concerns prohibit underground sampling
** Note: full characterisation may require multiple tests to be performed on each rock type.

3.6. Competence Awareness Training

Waste rock awareness training will be a component of the competency-based site training program. All personnel involved in the identification and management of waste rock materials on site will receive specific training including:

- Significance of acid mine drainage, its formation, controls and importance to the environmental management of the site both now and at final closure.
- Procedures for identifying and classifying PAF material.
- Awareness of monitoring requirements both on the surface and underground.
- Procedures for relocating, storage and blending of PAF materials.
- Procedures for temporarily storing PAF material at surface.

The Mine Manager will be responsible for ensuring the key personal have received appropriate waste rock training.

3.7. Evaluation Of Compliance

DEVELOP will conduct periodic evaluation of compliance with the following reported within the Annual Review.

- An overview of waste rock extracted from the underground mine.
- On overview of the amount of potential acid-forming waste rock extracted and the procedures implemented to ensure emplacement in designated areas.
- Results from waste rock and water samples.
- Actions undertaken, if required, to ensure potential acid-forming waste rock material does not impact on water quality in the surrounding area.

4. ACID FORMING MATERIAL

4.1. Management of acid leachate

The Woodlawn Mine operates as a nil discharge site. Other than clean water diversions, water storages on site tend to be acidic and metal rich.

The main sources of acid drainage are historic including the old tailings dams, Evaporation Dams (ED) and Rehabilitated Waste Rock Dump (RWRD). The latter receives water draining from the original overburden emplacement formed during the open cut development which also contained PAF material. The ongoing management of acid mine drainage and leachate control is summarised below:

- The leachate from the historical Rehabilitated Waste Rock Dump (RWRD) is collected in a purpose built dam referred to as the Waste Rock Dam (WRDAM). Collected water is pumped to ED1/ED2 via a dedicated pump and delivery pipeline. The dam does not discharge and has been successful in managing acid leachate from the now rehabilitated waste rock dump for in excess of 30 years.
- Existing tailings dams will remain nil discharge. These will be progressively rehabilitated when complete.
- Existing evaporation dams will remain nil discharge.
- Existing groundwater monitoring bores located downstream of acid water storages will continue to be monitored in accordance with the EPL and TARPs within the Water Management Plan.
- The surface water monitoring program will continue in accordance with the EPL and Water Management Plan.

4.1.1. RWRD Seepage

Condition 3 of Schedule 4 of the Project Approval requires DEVELOP to identify an appropriate passive treatment system which can be implemented to provide long term treatment of acid leachate without the need for active management such as pumping. The implementation of the passive treatment system needs to be functional and operational prior to final mine closure.

As the current collection and pumping system has been in operation for 30 years, there is a great deal of monitoring and operational details which can be utilised in the design. Leachate volume from the emplacement is quite small and generally only occurs following prolonged rainfall. Therefore the pumping system operates on a very intermittent basis, and in some cases has not been required for several months at a time. During these periods, evaporation losses are greater than inflows. The water quality within the dam has also not varied significantly over time indicating that the acid load has peaked. The pH has remained relatively stable at just over pH 3 although has increased to 6.3 during heavy rainfall periods. The water contains high sulphates and metals. Conductivity is high however this is predominantly the result of the sulphate content.

Passive treatment using limestone, aeration and settlement followed by passage through an artificial wetland is considered the most appropriate long term treatment method. This method is proven in documented examples while failure of these systems is usually the result of a dramatic change in water quality and/or volume. These failure modes would not apply at Woodlawn. The main elements of the passive treatment system would be as follows:

- Establish a permanent drainage collection system utilising the existing collection dam (RWRD). The collection system may include existing and new channels leading into the RWRD.
- Establish a protected spillway and limestone aggregate lined channel down the slope of the RWRD. The length of the channel will be governed by the calculated acid load. This process also provides a cascade aeration system.
- Construction of an additional collection pond for settlement of solids and metal precipitates.
- Construction of an artificial high organic wetland either in the downstream area below the RWRD or in the area above the RWRD. The design of the wetland will include composted material from Veolia's MBT Plant.
- Construction of an exit point from the wetland which will be designed to deliver treated water safely to the existing natural creek. Natural remediation will be enhanced by additional tree planting along the creek line.

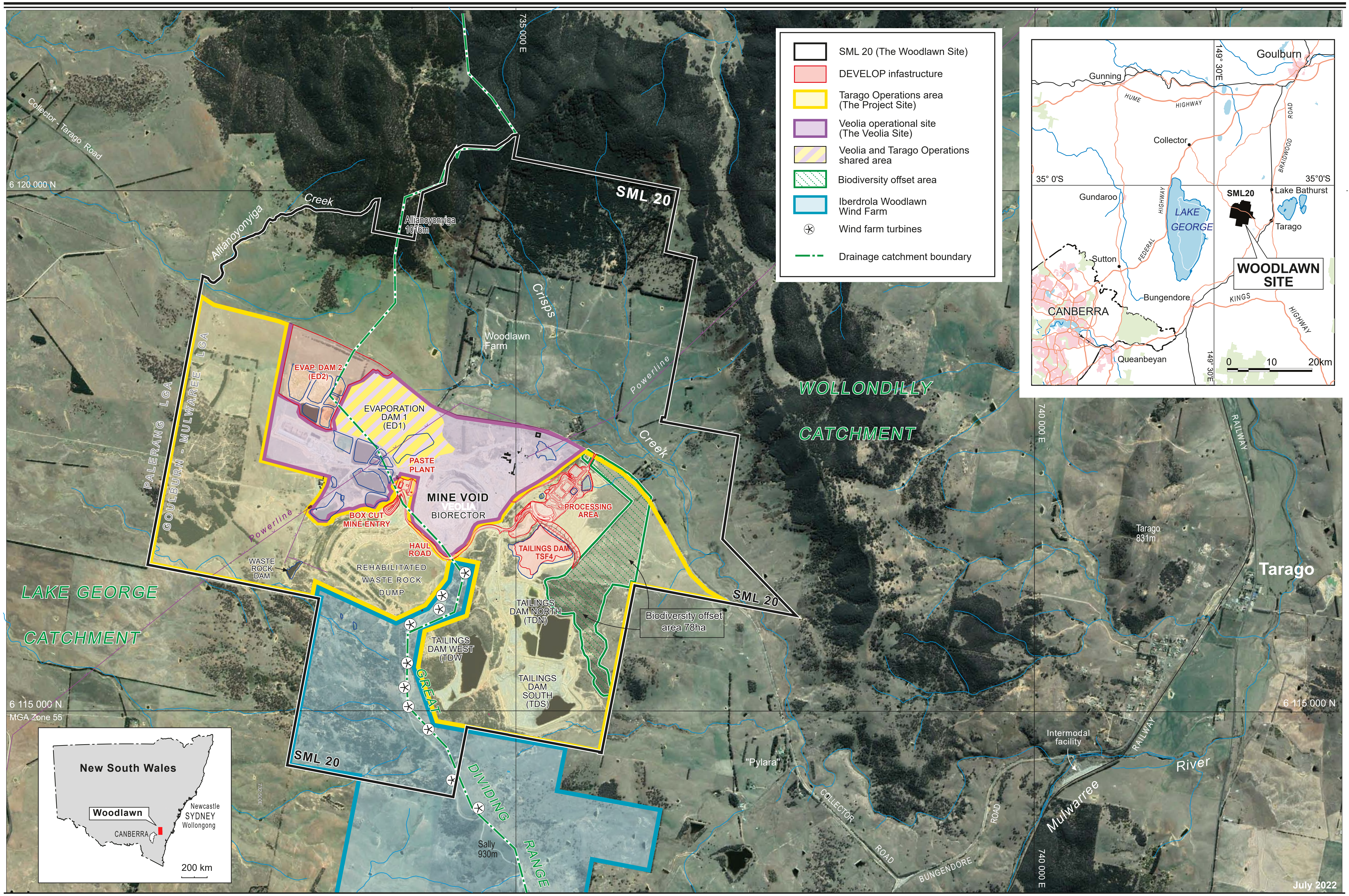
The design of the system will require trials which will occur at least two years prior to closure. As the system necessarily would require discharges from the site to occur it cannot be implemented until final closure. The final closure process will involve at least two years of ongoing monitoring prior to lease relinquishment in line with normal rehabilitation status monitoring. Fine tuning of the passive treatment system will occur during this period.

4.2. Monitoring

Natural background water quality has been demonstrated to be heavily influenced by geology. The volcanogenic massive sulphide deposit forms part of a wider regional north-west plunging syncline which not only hosts metal rich ore lenses but also a range of metamorphosed sedimentary rocks of both marine and volcanic origin.

Monitoring of surface water and groundwater will continue to be undertaken to determine whether mine activities are causing adverse impacts upon the surrounding environment. The resulting analytical data will be used to provide a first indicator of the presence of additional acid formation over and above the influence of natural geological conditions. The water management plan includes specific details on the locations, frequency and analytes being tested. The results will continue to be reported in the Annual Review and compared with historical data.

Appendix 1 Plans



Projection: Long/Lat . Image source : Google Earth

0 500 1000 1500 2000 metres

N

Woodlawn Site Location Map

Appendix 2 Comments from DPE

Condition	Action Required	Where Addressed
19(a) of Sch 4	Provide evidence of consultation with EPA, DRG and DPI-Water	Correspondence provided separately
19(b) of Sch 4	No further action	Noted
19(c) of Sch 4	No further action required	Noted
19(d) of Sch 4	Table 5 Monitoring Parameters and Testing Frequency include testing parameters for waste rock prior to it being brought to the surface (as detailed in section 3.2). The plan states that waste rock may be stored in the Waste Rock Emplacement for up to 2 years. It is recommended that the plan include details of how the relocation of potential acid forming material from the Waste Rock Emplacement to suitable underground locations will be prioritised prior to oxidation. Confirm if other measures will be used in addition to blending to prevent waste rock emplaced underground from further oxidising. Provide trigger levels for any material that has oxidised to the extent that it cannot be placed underground without impacting groundwater quality, and procedures for adequate capping and sealing of such material at the surface. Discuss the frequent testing of parameters currently indicated as “sufficient for full characterisation”, how the site geologist will determine that full characterisation has been achieved and what the frequency of testing will be following characterisation.	Clarification provided in Table 6 Section 3.2.3 Section 3.2.4 Tables 7 and 10 Section 4.2
3(d) Sch 4	It is recommended that the requirements of Schedule 3 Condition 19 (d) be reflected in the plan. In particular:	Table 10

Condition	Action Required	Where Addressed
	• trigger levels for the parameters tested in on-site leachate storages and management or treatment actions;	Table 7
	• trigger levels in groundwater or downstream surface water to trigger incident reporting or management actions;	Table 7
	• surface water and groundwater values (e.g. ecosystem, stock watering) in the water sources potentially impacted by the mine.	
	• Proposed controls to contain leachate;	Section 3.4
	• how proposed groundwater and surface water monitoring programs are designed to monitor the effectiveness of controls to contain leachate in leachate storages;	Section 4.2 Section 4.3
	• the status of historic contamination of groundwater (if any) and trends in groundwater quality in relation to leachate management.	Section 3.4
3 of Sch 4	Provide an estimated timeframe for the commencement of trials using the passive leachate treatment system. Please provide evidence of consultation with DRG on the passive system to treat seepage from the existing Waste Rock Dump.	Section 3.3 Correspondence provided separately
Condition 3(c) of Sch 6	No further Action	Noted

Appendix 3 Laboratory results terms

Acid Producing Potential (APP)

APP is a measure of the total acid producing potential of a material, irrespective of whether that material may also have the potential to produce alkali. APP is determined from the analysis of total sulphur in the sample and is calculated assuming a total conversion of sulphur to sulphuric acid. APP is reported as kg H_2SO_4 per tonne. This test is quick and useful for an initial screening of acid potential.

Acid Neutralising Capacity (ANC)

ANC measures the capacity of a sample to neutralise any acid that is produced. In the ANC analysis a finely ground sample is reactive with a known amount of hydrochloric acid. The resultant solution is back titrated to pH 7.0 with sodium hydroxide to determine the amount of acid neutralised by the carbonates and other acid consuming minerals present in the original sample. ANC is reported by the laboratory as either Kg $CaCO_3$ or Kg H_2SO_4 equivalent per tonne. This test is useful when blending or co-disposal of acid forming materials with non-acid forming materials in order to achieve a non-acid forming final blend for disposal.

Net Acid Production Potential (NAPP)

NAPP gives a theoretical prediction of whether the acid production potential of a material is greater than its acid consumption capacity. The results are usually provided as either a positive or negative number. NAPP is a worst-case scenario test and is therefore useful for screening purposes. It tends to over predict the acid production potential because it does not differentiate between acid producing and non-acid producing forms of sulphur.

Net Acid Generation (NAG)

NAG, also referred to as net acid production (NAP) is a static method using hydrogen peroxide to oxidise any sulphides present in the sample. NAG testing determines the balance between the acid producing and acid consuming components the sample. The acid produced from the oxidation reaction may subsequently be partially or totally consumed by acid neutralising components of the sample. Any remaining acidity is determined by back titration to both pH 4.5 and pH 7.0 and reported as NAG. It is expressed in kg H_2SO_4 equivalent per tonne. NAG results provide the acid rock drainage characteristics based on the complete oxidation of the sample's sulphide content (as well as ferrous iron from siderite dissolution). Acid that is produced by oxidation is consumed by carbonates and/or other acid consuming components of the material. The pH of the solution is measured (NAG pH). The acid remaining after the reaction is titrated with standardised NaOH to determine the net acid generated.

Kinetic Testing

Free draining kinetic leach columns are used to compliment environmental geochemical investigations on mine rock and waste materials and are used to determine drainage chemistry. Free draining leach columns simulate field weathering conditions to provide information on a range of issues including sulphide reactivity, oxidation kinetics, metal solubility and the leaching behaviour of the test materials.