TM GOLD PTY LTD

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Spring Hill Gold Project

Addendum to the Mining Management Plan:
Waste Processing and Mullock Rehabilitation
## Limitations of this Report

Client: TM Gold Pty Ltd
Prepared by Northern Resource Consultants (NRC)

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Introduction

1. Addendum to the MMP

TM Gold Pty Ltd (TM Gold) recognises the importance of managing legacy mining issues before commencement of stage one mining of the Spring Hill Gold resource. Currently, there are exposed stopes, legacy mullock heaps and waste dumps around the mining lease. The estimated volume of oxide waste in the mullock heaps and waste dumps around site. Initial sampling of the dumps indicates this waste material is mineralised and contains economic quantities of gold.

TM Gold proposes the following:
- Collection and central stockpiling of mullock heaps and rock dumps
- Crushing of that stockpiled material at the ROM pad
- Loading of economically viable material onto trucks for transfer offsite to the Union Reefs processing plant
- Where material is not viable, it will be backfilled to residual stopes, thereby mitigating the risk posed by these open voids.

On-site infrastructure associated with the project will be minimal. There will be:
- A ROM pad
- Office area combined as a single disturbance with the ROM pad. Offices and facilities will be demountable buildings.
- A 10,000 litre self bunded mobile fuel storage tank will supply fuel to mobile plant and machinery and the diesel generators powering the site offices.
- Waste hydrocarbons will be stored temporarily on-site and appropriately bunded as per Australian standards.
- Onsite haul road.

This submission is an addendum to the MMP submitted to the Department of Mines and Energy (DME) on 13 April, and as amended on 22 June 2016. As such, the only detail included in this submission is that directly relating to the proposed addendum activities of waste processing and mullock heap rehabilitation. All other environmental commitments can be assumed to be the same as those in the original MMP.
Operational Activities

1. Overview

The proposed project is focused on the movement of legacy waste material from the heaps where it was left up to 100 years ago. This material will be assayed for economically viable mineralisation, and then either transferred to a mobile crusher where it will be crushed and loaded onto trucks for haulage to a toll milling plant, or backfilled to one of numerous dry stopes in the vicinity of the project. The stopes nominated for backfilling will be dry, to ensure there is no risk of interaction with groundwater from backfilled material.

The stopes to be backfilled will provide a net benefit in terms of environmental impact, through the reduction of potential environmental harm to fauna and livestock posed by interaction with these unfenced stopes.

2. Geology and Geochemical Characteristics

Spring Hill is located centrally within the Pine Creek Geosyncline, which comprises early Proterozoic sediments which were folded and metamorphosed to greenschist facies approximately 1800 million years ago. This sequence, which is dominated by mudstones, siltstones, greywackes, sandstones, tuffs and limestones, has been intruded by preorogenic dolerite sills and mainly postorogenic granites. Largely undeformed Middle Proterozoic to Mesozoic strata unconformably overlie the Early Proterozoic sequence. Detailed descriptions of the geology of the Pine Creek Geosyncline can be found in Needham et al. (1980) and Nicholson et al. (1994) (Sheldon et al., 1994).

Mullock heaps and waste dumps within ML23812 at Spring Hill originated as a result of historical mining operations. Mullock heaps are made up of mineralised material from which gold has been extracted. In addition to gold, the Spring Hill project area is prospective for a range of base metals including tin, copper, silver and lead. It is highly likely that the mullock contains leachable trace metals. The waste rock dumps have also been examined by TM Gold and determined to be mineralised.

3. Groundwater

Open stopes proposed to be backfilled as part of this project were inspected during a field visit in June 2016. They do not hold water and as such, due to the depth of regional groundwater table, are not expected to intersect groundwater.

According to Sheldon (1994), the water table below the Main to East Lodes is very deep — almost always being deeper than 100m. In some localised areas, it is deeper than 135m. At this area, the base of complete oxidation occurs from 20-100m depth, with the majority of cases between ~60 and 80m depth.
The depth of the water table has been noted to increase to the north of the Hong Kong Central prospect with depths of between 45m and 75m encountered to the south of 9775mN. In this area, the base of complete oxidation varies between 27 and 60m to the south of 9700mN to between 60 and 107m north of 9700mN. A depth to water of 15m was measured in a drill hole in a gully at 9575mN. Further north of 9775mN, depths of >100m were encountered. Areas and their typical water table depths are shown in Error! Reference source not found. of this report.
Figure 1: Typical depths to water tables recorded during past drilling campaigns
Regionally, groundwater is known to occur in fractures within the Mt Bonnie and Koolpin formation of the South Alligator Group. These formations are made up of greywacke, siltstone, shale, tuff, chert and dolomite which form several important local aquifers in the Pine Creek region. The zones of highest permeability appear to occur along prominent faults. Bore yields of up to 10 L/s are possible in such zones, but are not typical. Yields of 0.5 to 2 L/s are obtainable outside major structural features (McGowan 1989).

Four registered bores located within the mining lease at Springhill were examined during field visits in mid-2016. In addition, a number of exploration bores located on the elevated hilltop were examined. Out of 12 exploration holes examined, only three had water. However, based on the water levels measured in registered bores as well as exploration bores, the elevation of the water table in the area ranges from 140-160mAHD. In the event of waste rock material being used for backfilling, the incremental risk to groundwater from any leachate generated from this backfilled material is expected to be minimal.

4. Material Movement

Each identified dump will be excavated using an excavator and hauled by truck to the central ROM pad. At the ROM pad, material will be crushed using a portable track mounted jaw crusher. Re-assaying and visual assessment of the waste rock will take place from the crusher belt to produce an accurate assay grade for each dump.

Viable quantities of commercial ore will be loaded onto 40t articulated trucks and freighted off site. An existing track will be re-established to form a haul road from the ROM pad to Mt Wells Road.

5. Backfilling

The existing stopes will be backfilled with mullock material as part of the proposed operations; however, as these disturbances are pre-existing these works have not been incorporated into the financial provisions. Rehabilitation of the stopes will involve material movement via machinery and placement within the voids. Prior to rehabilitation the General Manager and those involved in the rehabilitation earthworks must undertake an inspection of each void prior to commencement of backfilling. The following items need to be checked prior to the rehabilitation/backfill works:

- Ensure that the void does not contain water (voids are relatively shallow and straight, given these were primarily hand cut up – the bottom of the void is visible from the surface using a bright torch, or a dipper or other device can be lowered to test for water).
- Ensure that no fauna is present, e.g. roosting bats – surveys by Low Ecology identified the presence of Orange Horseshoe Bats in a large adit off lease some years previously; however, that adit has since collapsed and there is no current evidence of roosting bats in the stopes targeted for backfilling.
- Ensure detritus that may obstruct the void (e.g. fallen branches) is cleared wherever possible and safe to do so before backfilling.
Material will dumped into the void slowly using an excavator bucket to ensure maximal fill with few gaps. When material height within the void is sufficient to be safely reached with the excavator bucket, the bucket can be used to compact the material and each subsequent layer will be compacted. This compaction will decrease the risk of future subsidence and water infiltration.

Due to the minimal surface area of each adit natural revegetation is proposed, and this would likely occur during the 2016/2017 wet season.

6. **Offsite Haulage**

There is an existing, well-maintained road into Spring Hill that TM Gold will utilise for the transport of supplies, equipment and personnel. An existing access track running east off Spring Hill directly to Mt Wells Road will be upgraded to a 4m wide single land haul road and maintained during the project. Transport of ore will be via this haul road and Mt Wells Road.

7. **Workforce Description and Demography**

The workforce for the proposed project will comprise a mining contractor retained to manage construction of the project site, excavation of waste rock and mullock heaps, management and operation of the crusher and loading and transporting ore to the Union Reefs plant. TM Gold will have a General Manager present at the site to oversee compliance with this MMP and any conditions included in the Authority for the project. The approximate number of people at site at any one time will be 10.

Site hours of operation will be 7am – 6pm, seven days a week from construction through to project closure. The workforce will be accommodated locally at Emeeral Creek or Pine Springs as appropriate, but individual members of the workforce may commute from farther afield at start and end of shift.

8. **Project Schedule**

The intended start date for the waste processing and mullock rehabilitation project is 1 September 2017, dependent on approvals.

Approximately 1.8km of haul road from the ROM pad leading to Spring Hill Road and on to Mt Wells Road needs to be re-established, and this work in addition to construction of the ROM pad and office areas is scheduled to take two weeks.

The subsequent demobilisation will take 2-3 weeks, allowing completion of the rehabilitation works in time for the onset of the wet season. A table indicating the tasks and lead times for the project is included below.

Table 1: Project schedule for waste processing and mullock rehabilitation at Spring Hill
## Operational Activities

<table>
<thead>
<tr>
<th>MILESTONE</th>
<th>DATE</th>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Submission of the MMP</td>
<td>15 July 2016</td>
<td></td>
</tr>
<tr>
<td>Approval for the project</td>
<td>30 August 2016</td>
<td>*Subject to approval timeframes</td>
</tr>
<tr>
<td>Mobilisation to site</td>
<td>1 September 2016</td>
<td></td>
</tr>
<tr>
<td>Restoration and construction on the haul road</td>
<td>1-30 September 2016</td>
<td>*Timeframes indicative – time may be shorter</td>
</tr>
<tr>
<td>Construction of ROM pad, offices and workshop area</td>
<td>1-30 September 2016</td>
<td>*Timeframes indicative – time may be shorter</td>
</tr>
<tr>
<td>Material movement and crushing</td>
<td>1-21 October 2016</td>
<td>*Timeframes indicative – time may extend</td>
</tr>
<tr>
<td>Backfilling stopes and mullock heap rehabilitation</td>
<td>Late September – late October</td>
<td>Activity to run concurrently with material movement and crushing activities</td>
</tr>
<tr>
<td>Demobilisation</td>
<td>22-12 November 2016</td>
<td>Demobilisation to include rehabilitation of disturbance areas associated with the project (rehabilitation of mullock heaps will be completed as part of a previous phase).</td>
</tr>
<tr>
<td>Project close</td>
<td>Mid November 2016</td>
<td>TM Gold aims to be off site with disturbances rehabilitated by mid-November, in time for wet season rains to assist in establishment of revegetation.</td>
</tr>
</tbody>
</table>
Environmental Management

1. Environmental Commitments

1.1 Commitments Contained in this MMP

The environmental commitments are those concerned exclusively with new environmental risks posed by this project and are additional to the commitments identified in the drilling MMP and associated information submitted in April 2016 and modified on 22 June 2016.

1.2 Establishing Environmental Commitments

In order to identify environmental commitments appropriate to the Spring Hill waste processing and mullock rehabilitation project, TM Gold conducted an environmental risk assessment for the activities inherent to the project. That risk assessment process is included in the section of this report titled Risk Assessment on page 10 of this report.

The commitments relate directly to the environmental risks assessed for the project. Where a risk is identified, mitigation strategies are detailed in Table 7 of this report. The environmental commitments are a step further in the risk assessment process – a commitment to not allow the identified impact take place.

All other associated risks and environmental commitments are included in the original MMP submitted in April 2016 and modified on 22 June 2016.
<table>
<thead>
<tr>
<th>COMMITMENT REFERENCE</th>
<th>ENVIRONMENTAL MANAGEMENT ISSUE</th>
<th>COMMITMENT</th>
<th>DUE DATE</th>
<th>PERFORMANCE AGAINST COMMITMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>WMRehab_01</td>
<td>Adverse effects on local/regional air quality as a result of airborne dust associated with the proposed project.</td>
<td>TM Gold will implement speed limits on haul roads, site roads and access tracks and run water carts during operations to reduce the intensity of vehicle-generated dust.</td>
<td>Ongoing during the life of operations.</td>
<td>No environmental nuisance complaints received by TM Gold in relation to dust or airborne contaminants. Dust suppression is undertaken during operations. Vehicles and machinery will be maintained as per the manufacturer’s instructions and maintenance logs will be available for inspection if required.</td>
</tr>
<tr>
<td>WMRehab_02</td>
<td>Access to the site by tourists or members of the public following the established Pine Creek Gold Mining Heritage Trail.</td>
<td>All reasonable measures to restrict public or tourist access to the site will be implemented, including gates, exclusion earthworks, signposts at site and signage at local hosteries.</td>
<td>From the outset of construction up to project closure.</td>
<td>Exclusion means will be implemented around the site to prevent unauthorised access from the outset of construction.</td>
</tr>
</tbody>
</table>
1.3 Identification of Environmental Aspects and Impacts

The proposed activities are low impact with the potential for a net environmental benefit. The removal of heaped waste material from unbunded areas around the mine lease will remove the risk of environmental harm from that heaped material. Backfilling mullock material to dry stopes again reduces the risk of further oxidation of that material, limits the exposure of the material to further weathering and creates a safety benefit. The stopes presently are unfenced, not signposted and not bunded and pose a safety hazard to humans, wildlife and livestock.

Specific risks posed by the proposed project activities are identified in the next section on Risk Assessment. These risks and the associated controls have inspired the environmental commitments in Table 2 of this document.

1.4 Risk Assessment

Risk Assessment Matrix

The risk assessment matrix used for the Spring Hill project is based on the sample provided in the Template for the Preparation of a Mining Management Plan. The key prompt to assessing a risk is the likelihood that a particular event or issue will take place. The definitions of the likelihood of an occurrence are included in Table 3 of this report.

Table 3: Definitions of likelihood of an incident occurring at the Spring Hill project

<table>
<thead>
<tr>
<th>MEASURE OF LIKELIHOOD</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Almost Certain</td>
<td>Expected to occur in most circumstances.</td>
</tr>
<tr>
<td>Likely</td>
<td>Will probably occur in most circumstances.</td>
</tr>
<tr>
<td>Possible</td>
<td>Might possibly occur at some time.</td>
</tr>
<tr>
<td>Unlikely</td>
<td>Could occur at some time.</td>
</tr>
<tr>
<td>Rare</td>
<td>May occur only in exceptional circumstances.</td>
</tr>
</tbody>
</table>

As the likelihood of each event is assessed, so is the potential consequence of the event taking place. The definition of the consequences used in this risk assessment is included in Table 4 of this report.

Table 4: Definitions of consequence as it applies to risk assessment for the Spring Hill waste processing and mullock rehabilitation project

<table>
<thead>
<tr>
<th>MEASURE OF CONSEQUENCE</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Catastrophic</td>
<td>Environmental disaster.</td>
</tr>
<tr>
<td>Major</td>
<td>Severe environmental damage.</td>
</tr>
</tbody>
</table>
MEASURE OF CONSEQUENCE

<table>
<thead>
<tr>
<th>Measure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moderate</td>
<td>Contained environmental impact.</td>
</tr>
<tr>
<td>Minor</td>
<td>Some environmental impact.</td>
</tr>
<tr>
<td>Insignificant</td>
<td>Low environmental impact.</td>
</tr>
</tbody>
</table>

The likelihood and consequence of an event, combined, result in a risk rating for that event. A numerical rating is attributed to both the scale of likelihood and the scale of consequence of a potential event. A matrix that demonstrates the combined scores from those scales is presented in Table 5. Scoring risks allows them to be ranked in order of magnitude in terms of their need for mitigation. The need for action on a potential event ranked by its risk score is presented in Table 6.

Table 5: Risk assessment matrix used for the Spring Hill project

<table>
<thead>
<tr>
<th>LIKELIHOOD OF OCCURRENCE</th>
<th>SEVERITY OF CONSEQUENCES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Catastrophic (5)</td>
</tr>
<tr>
<td>Almost certain (5)</td>
<td>10</td>
</tr>
<tr>
<td>Likely (4)</td>
<td>9</td>
</tr>
<tr>
<td>Possible (3)</td>
<td>8</td>
</tr>
<tr>
<td>Unlikely (2)</td>
<td>7</td>
</tr>
<tr>
<td>Rare (1)</td>
<td>6</td>
</tr>
</tbody>
</table>

Table 6: Assessment of risk scores for the Spring Hill risk assessment

<table>
<thead>
<tr>
<th>RISK SCORE</th>
<th>RISK RATING</th>
<th>ACTION REQUIRED</th>
</tr>
</thead>
<tbody>
<tr>
<td>9 – 10</td>
<td>Extreme</td>
<td>Immediate.</td>
</tr>
<tr>
<td>7 – 8</td>
<td>High</td>
<td>Action plan required. Senior management attention.</td>
</tr>
<tr>
<td>5 – 6</td>
<td>Moderate</td>
<td>Specific monitoring or procedures required.</td>
</tr>
<tr>
<td>2 – 4</td>
<td>Low</td>
<td>Management through routine procedures.</td>
</tr>
</tbody>
</table>

Results of the Environmental Risk Assessment for Spring Hill

The risk assessment conducted for Spring Hill breaks risk into potential sources of environmental harm in a number of ways. In order to assess risk, the proposed project is broken into three phases: construction, operation and post-closure. Each of these project phases is presented in a separate table within this report. Within each table, risk is broken into potential receptors of environmental harm, including:
Environmental Management

- Flora and Fauna
- Topsoil and Subsoil
- Waste Rock
- Surface Water
- Groundwater

This division ties into the categorisations used in the environmental commitments table included as Table 2 of this report. Within the risk assessment tables, potential impact events are identified within each of the above subsections. The risk rating is described and the control strategy is then identified.
### Table 7: Risk assessment for the Spring Hill waste processing and mullock rehabilitation project. (L) = likelihood, (C) = consequence, (T) = total risk rating

<table>
<thead>
<tr>
<th>POTENTIAL IMPACT EVENT</th>
<th>RISK RATING</th>
<th>CONTROL STRATEGY</th>
<th>RESIDUAL RISK RATING</th>
<th>MONITORING AND MANAGEMENT PROCEDURE</th>
<th>DEADLINE FOR IMPLEMENTATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Quality</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adverse effects on local/regional air quality as a result of airborne dust associated with mining operations</td>
<td>3</td>
<td>2</td>
<td>5</td>
<td>Nearest sensitive receptor approximately 10km from the site. Speed limits to be enforced on haul roads and site roads and access tracks to reduce the intensity of vehicle-generated dust. Dust suppression by the use of water trucks on the haul road.</td>
<td>2</td>
</tr>
<tr>
<td>Site Access</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The cultural heritage features at the project site form part of the Pine Creek Gold Mining Heritage Trail, which allows unrestricted vehicle/tourist access into these sites and inadvertent access into the area of the proposed project. There is a risk of injury or death to members of the public accessing the site.</td>
<td>4</td>
<td>5</td>
<td>9</td>
<td>Access routes to the site will be clearly signposted. Signposts will forbid unauthorised access, require vehicles be escorted and provide a UHF channel for mine site communications. Where practical, secondary access routes to the site leading from established tourist areas will be obstructed by earthworks or gates as well as signposted to ensure no tourist vehicles can access the area (e.g. in proximity to the old gold battery). Signage will be provided to local hostels advising of the change in access, and staff informed so they can communicate same to tourists.</td>
<td>1</td>
</tr>
</tbody>
</table>
Environmental Management Plans

1. Erosion and Sediment Control

ESC will be managed in accordance with the Erosion and Sediment Management Plan (TM Gold, 2016) submitted to DME in June 2016.

2. Weed Management Planning

Weed management will be conducted in accordance with the Weed Management Plan (TM Gold, 2016) submitted to DME in June 2016.

3. Soil Management Plan

3.1 Management of the Soil Resource at Spring Hill

There are minimal soils at Spring Hill project because of its location at the top of a series of local hills. Therefore, any soils that have developed in-situ are a valuable resource that must be preserved to ensure successful rehabilitation of the operation.

The presence and depth of the soil profile at Spring Hill is dependent on the location within the landscape. All operations occur on the top of hill crests and subsequently soil development is minimal. Soil development is partially related to slope as areas with lower slope are expected to have a reduced volume of concentrated runoff, therefore retaining additional soil particles. Subsequently the ground cover across the greater area is generally highly weathered bedrock with soil developing between cracks. Areas of good soil development are extremely limited, and where present, have a high percentage of rockiness (Figure 2).
Figure 2: Representative photograph showing bare ground cover of the area

Soil exploration holes were installed over the area of disturbance in order to characterise the depth and quality of topsoil resource. The proposed ROM, stockpile and office area is on the crest of a local ridge line with a maximum slope of approximately 18% prior to development. A soil hole was installed in this area (Soil 04 – Appendix A – Maps) and revealed 0.3m of topsoil before auger refusal due to high rockiness. Soils encountered were a powdery clay loam and are generally considered good for stripping and stockpiling for use in any rehabilitation works requiring topsoil. A topsoil stripping depth of approximately 0.3m is recommended for implementation across the ROM, office and stockpiling area. Material stripped should be stockpiled in long, rectangular stockpiles no more than 1.5m in height to limit wind erosion and soil sterilisation. Further works to manage topsoil stripping (where applicable) at Spring Hill are outlined in Table 8 below.
### Table 8: Spring Hill topsoil and subsoil management matrix

<table>
<thead>
<tr>
<th>Objective</th>
<th>Target</th>
<th>Management and Mitigation</th>
<th>Measurement</th>
<th>Effectiveness</th>
<th>Non-conformance and Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum retention of soil resource for reuse in rehabilitation</td>
<td><strong>Topsoil and subsoil to be stripped simultaneously</strong></td>
<td>Prompt stockpiling of topsoil will avoid the risk of loss of soil from cleared areas through erosion from weather events.</td>
<td>Soil stockpiles should be identified and clearly delineated on a survey map.</td>
<td>Volumetric calculations of stripped and stockpiled soils should reveal sufficient resource for rehabilitation.</td>
<td>Stockpiles identified as poorly located should be relocated only if absolutely necessary, as repeated handling of soil increases the risk of damage to the soil's structure. Loss of stockpiled soil through erosion should be promptly identified and corrective action taken to prevent such loss, e.g. installation of diversion bunding for stormwater runoff. If stockpiled soils are not seen to be productive within three weeks of fire, they should be seeded with a suitable grass seed mix appropriate to the region.</td>
</tr>
<tr>
<td></td>
<td><strong>Soil to be cleared from hilltops downwards to ensure maximum capture</strong></td>
<td>Stockpiles must be shaped to indicated heights (1.5m) and batter angles to preserve the resource.</td>
<td>Soil stockpiles must conform to maximum height restrictions (1.5m). Soil should be added to a stockpile the same day it has been stripped.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Soil to be cleared promptly after vegetation clearance</strong></td>
<td>Destination locations for stripped soil stockpiles should be identified before stripping begins, with consideration given to other planned site disturbances to ensure the stockpiles will not be impacted by other site activities and will not need to be moved until use in rehabilitation.</td>
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<tr>
<td></td>
<td><strong>Stripped soil to be stockpiled promptly and not left sitting in transport machinery</strong></td>
<td>Destination locations for stripped soil stockpiles must conform to maximum height restrictions (1.5m).</td>
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<tr>
<td></td>
<td><strong>Soil to be stockpiled in windrows of no more than 1.5m in height</strong></td>
<td>Stockpiles should be allowed to revegetate from within their own seed bank to help reduce erosion potential.</td>
<td>Stockpiles should be fully vegetated within a month of stockpiling.</td>
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<tr>
<td></td>
<td><strong>Soil to be stripped efficiently with minimal compaction, wastage or contamination from vehicle movement.</strong></td>
<td>Stripping should be undertaken by the excavator standing on the surface of the topsoil, digging the topsoil and subsoil to its maximum depth and loading into a transport vehicle positioned and travelling mostly on the basal layer under the subsoil.</td>
<td>Topsoil stripping should be supervised to ensure stripping and stockpiling is conducted appropriately.</td>
<td>Soil will be stockpiled appropriately in the correct locations.</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Preserve the strength and integrity of the stripped soil.</strong></td>
<td>Soil gains strength and becomes resistant to damage as it dries. Soil should be stripped in the driest possible conditions. If sustained heavy rainfall (e.g. greater than 10mm in 24 hours) is received, stripping should be suspended until at least 24 hours after the cessation of rain, or until the ground has had a chance to dry.</td>
<td>Rainfall should be monitored during stripping operations, and stripping suspended if more than 10mm of rain falls in 24 hours.</td>
<td>Stripping will be suspended in the event of rainfall exceeding 10mm in 24 hours.</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Stockpiles must be protected from fire.</strong></td>
<td>Fire breaks should be cleared around stockpiles.</td>
<td>Fire breaks should be kept clear of obstructions and properly maintained during the life of the project.</td>
<td>If fire impacted, stockpiles should be inspected weekly for signs of recovery e.g. regeneration of vegetation. If fire impacts stockpiles, TM Gold should consider widening fire breaks for the remainder of mine life. If fire impacted stockpiles are not seen to be productive within three weeks of fire, they should be seeded with a suitable grass seed mix appropriate to the region.</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Quality of soil in the stockpiles to be preserved</strong></td>
<td>Stockpiles should be allowed to revegetate from within their own seed bank to help reduce erosion potential.</td>
<td>Stockpiles should show signs of vegetation regrowth within three weeks of stockpiling.</td>
<td>If stockpiled soils are not seen to be productive within three weeks of stockpiling, they should be seeded with a suitable grass seed mix appropriate to the region.</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>The seed bank integrity should be retained.</strong></td>
<td>Stockpiles should be located from within their own seed bank to help reduce erosion potential.</td>
<td>Stockpiles should be fully vegetated within a month of stockpiling.</td>
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<td></td>
</tr>
<tr>
<td></td>
<td><strong>Preserve the soil structure and integrity.</strong></td>
<td>Stockpiles should be appropriately located from the outset, so there is minimal handling of soil.</td>
<td>There should be a soil stockpile map prepared before stockpiling begins.</td>
<td>Stockpiles should not be moved unless absolutely necessary. If it is necessary to move a stockpile for reasons other than use in rehabilitation, the destination site should be carefully selected to ensure the risk of repeated movement is minimal.</td>
<td></td>
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</tbody>
</table>

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**Note:** This table is part of the Environmental Management Plans prepared by Northern Resource Consultants Pty Ltd.
<table>
<thead>
<tr>
<th>Objective</th>
<th>Target</th>
<th>Management and Mitigation</th>
<th>Monitoring and Measurement</th>
<th>Effectiveness</th>
<th>Non Conformance and Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stockpiles should remain weed free.</td>
<td>Stockpiles should be inspected for weed occurrence, and weeds treated in situ.</td>
<td>Stockpiles should be inspected before reuse for weeds.</td>
<td>No more than 10% of vegetation cover on a stockpile should be weed species.</td>
<td>Stockpiles discovered to have greater than 10% weed infestation must be promptly treated with a suitable herbicide, and treated again in a timeframe indicated by the herbicide manufacturer to ensure effective weed control.</td>
<td></td>
</tr>
<tr>
<td>Stockpile fertility should be suitable for rehabilitation</td>
<td>Test samples from soil stockpiles at least three weeks before rehabilitation work commences.</td>
<td>Soil quality testing of stockpiles.</td>
<td>Samples of stockpiled soil should display the following characteristics before use in rehabilitation: - pH between 5 and 9 - CEC of at least 4meq/100g - Total organic carbon value of 1.2-1.7% at least, (or higher) - Exchangeable sodium of &lt;6%</td>
<td>Remedial measures should be considered where stockpiles do not meet the criteria outlined in the effectiveness section of this plan. These may include application of fertiliser or mixing with other material to achieve the minimum standards for effective rehabilitation.</td>
<td></td>
</tr>
<tr>
<td>Stockpiles should be shaped for maximum integrity.</td>
<td>Soil to be stockpiled in windrows of no more than 2m in height</td>
<td>Stockpiles will be constructed to the maximum height indicated.</td>
<td>Stockpiles will not be constructed higher than 2m.</td>
<td>Incorrectly sized stockpiles will need to be reshaped promptly.</td>
<td></td>
</tr>
<tr>
<td>Stockpiles should be protected from runoff erosion.</td>
<td>Diversion bunding should be used to protect soil stockpiles from runoff erosion</td>
<td>Stockpiles should be inspected monthly to ensure protection bunding is appropriate.</td>
<td>Bunding should be sufficient to divert stormwater runoff around stockpiles.</td>
<td>If a lack of protection bunding is identified in inspections, bunding should be installed promptly.</td>
<td></td>
</tr>
<tr>
<td>Stockpiles should not pose a risk to surface water.</td>
<td>Stockpiles should not be located near drainage channels, and if location near a channel (e.g. &lt;20m) is inadvertent, an exclusion bund should be constructed between the stockpile and the drainage channel. Stockpiles should not be located on steep slopes.</td>
<td>Stockpiles will not be located near drainage channels, and if they are there will be exclusion bunding in place. Stockpiles will not be located on steep slopes.</td>
<td>Stockpiles will be a suitable distance from drainage channels and not located on steep slopes.</td>
<td>Stockpiles inspected and deemed to pose a risk of infiltration to drainage channels will be managed as follows: - Exclusion bunding is preferable to rehandling of the stockpile - Handling and relocation of the stockpile will take place if exclusion bunding is impractical or potentially ineffective.</td>
<td></td>
</tr>
</tbody>
</table>
4. Hazardous Material Management Plan

Hazardous materials at site will be managed in accordance with the controls in Table 10: Identification of Environmental Aspects and Impacts in section 6.6 of the MMP submitted in April 2016 and modified on 22 June 2016.

5. Land Clearance Procedure

5.1 Strategies and Methodologies for Land Clearing

Efficient and strategic land clearance for the project is key to minimising environmental harm from the outset of the project, and critical to effective rehabilitation at the end of the project. The small disturbance footprint presents a further opportunity for this to be a low impact project that can be rehabilitated smoothly at project closure. Adhering to best practice land clearance management as per the NT government will benefit the project’s rehabilitation success.
### Table 9: Spring Hill Land Clearance Procedure

<table>
<thead>
<tr>
<th>OBJECTIVE</th>
<th>TARGET</th>
<th>MANAGEMENT AND MITIGATION</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Conduct land clearance in an efficient manner that maximises retention of resources reusable in rehabilitation</td>
<td>All clearing must be permitted</td>
<td>Ensure permits to clear are lodged and approved in time for clearing works</td>
<td>Land clearance planning must include lead times for permitting.</td>
<td>Permitting will be in place for clearing.</td>
<td>Clearing performed without the necessary permits must be reported to the relevant government authority.</td>
</tr>
<tr>
<td></td>
<td>Clear during the most appropriate season for the region</td>
<td>Ensure clearing takes place in April / May to meet the end of wet season / start of dry season target for effective clearing.</td>
<td>Clearing should be conducted in line with the proposed activity schedule for the mine.</td>
<td>Clearing will be conducted at the most appropriate time of year.</td>
<td>If clearing cannot be conducted as scheduled, clearing methodologies will be assessed against the prevailing conditions and modified where necessary.</td>
</tr>
<tr>
<td></td>
<td>Clear only areas that are required to be cleared</td>
<td>Mark the areas to be cleared before clearing.</td>
<td>GPS equipment should be used by surveyors to mark out areas to be cleared, and clearing should be supervised to ensure no ‘out of bounds’ clearing takes place.</td>
<td>Approved clearing sites should be well flagged to avoid confusion and unnecessary and illegal removal of native vegetation.</td>
<td>If the supervisor sees clearing taking place outside designated areas, all machinery movement should be halted and the clearing plan reviewed.</td>
</tr>
<tr>
<td></td>
<td>Avoid unnecessary environmental damage through soil compaction</td>
<td>Access to the site should be managed to prevent introduction of weed species or unnecessary compaction of soils by vehicles.</td>
<td>Site access should be signposted clearly and unauthorised vehicles apprehended.</td>
<td>Soil compaction should be minimal.</td>
<td>Clearing methodologies should be reviewed with contractors / machine operators if compaction is deemed to be excessive. Unauthorised vehicles should be apprehended promptly and asked to leave the area.</td>
</tr>
<tr>
<td></td>
<td>Minimise impacts to soil integrity and composition</td>
<td>Clear felling or chaining techniques should be used to facilitate clean pushovers of larger vegetation and reduce vehicle movements across the site. Timing should be closely managed to ensure large areas of soil are not left exposed without being promptly stripped for stockpiling.</td>
<td>Clearing will be conducted in accordance with this plan.</td>
<td>Clearing will be conducted efficiently, soil compaction will be minimised and vehicle movements across site restricted.</td>
<td>Clearing methodologies should be reviewed with contractors / machine operators if compaction is deemed to be excessive.</td>
</tr>
<tr>
<td></td>
<td>Maximise retention of material for reuse in rehabilitation</td>
<td>Post-clearing debris should be stockpiled in windrows running down the contour to minimise loss of material through stormwater runoff. Stockpiles should be inspected for form and vegetation condition.</td>
<td>Stockpiles should be constructed in accordance with this plan.</td>
<td>Stockpiles that are inappropriately situated should be relocated.</td>
<td>Stockpiles that are inappropriately situated should be relocated. Firebreaks should be maintained through the life of the operation.</td>
</tr>
<tr>
<td></td>
<td>Manage bushfire risk appropriately</td>
<td>Debris should be stockpiled away from native vegetation and away from other infrastructure. Stockpiles should be constructed in accordance with this plan.</td>
<td>Stockpiles should be constructed in accordance with this plan.</td>
<td>Stockpiles that are inappropriately situated should be relocated. Firebreaks should be maintained through the life of the operation.</td>
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<td>Post-clearing debris should be stockpiled in windrows running down the contour to minimise loss of material through stormwater runoff. Stockpiles should be inspected for form and vegetation condition.</td>
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<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Vegetation should be left intact on steep slopes where practicable and vegetation condition reviewed at rehabilitation.</td>
<td>Vegetation will be left intact where practicable and vegetation condition reviewed at rehabilitation.</td>
<td>Steep slopes will not be cleared.</td>
<td>Where steep slopes have been cleared, ESC infrastructure must be implemented.</td>
</tr>
<tr>
<td></td>
<td>Minimise erosion risk</td>
<td>Post-clearing debris should be stockpiled in windrows running down the contour to minimise loss of material through stormwater runoff. Where this is not possible, diversion bunding should be used to divert stormwater away from smaller debris at high risk of washing away in a storm event. Stockpiles should be inspected for form and placement.</td>
<td>Stockpiles should not erode in a rainfall event.</td>
<td>Improperly formed or positioned stockpiles should be reshaped and/or moved.</td>
<td></td>
</tr>
</tbody>
</table>
### OBJECTIVE

**Minimise impacts to fauna**

Maximise habitat connectivity through the use of native vegetation buffers.

While vegetation should not be cleared from steep slopes that do not form part of the disturbance footprint for erosion control reasons, it is important to provide buffers between areas of retained vegetation and disturbance areas to maintain functional habitat linkages.

If retained vegetation is left in small, isolated pockets, it will rapidly lose the most sensitive species and decrease in biodiversity value.

The short-term nature of the project will mitigate much of this decrease, but buffers should be retained where possible.

If retained vegetation is left in small, isolated pockets, it will rapidly lose the most sensitive species and decrease in biodiversity value. The short-term nature of the project will mitigate much of this decrease, but buffers should be retained where possible.

**Direction of clearing must provide egress for fauna species**

Clearing should be conducted directionally in a manner that allows fauna species the best opportunity to relocate to native habitat. Clearing must be undertaken progressively, downhill, over a number of days to allow fauna the opportunity to relocate away from the disturbance.

Clearing must be supervised to ensure the direction allows a means of egress.

Fauna will be able to escape the clearing where possible.

If the supervisor declares the clearing to be improperly conducted, the clearing will be stopped and processes reviewed before resumption of the activity.

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<table>
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</tr>
</thead>
<tbody>
<tr>
<td>Minimise impacts to fauna</td>
<td>Maximise habitat connectivity through the use of native vegetation buffers</td>
<td>While vegetation should not be cleared from steep slopes that do not form part of the disturbance footprint for erosion control reasons, it is important to provide buffers between areas of retained vegetation and disturbance areas to maintain functional habitat linkages. If retained vegetation is left in small, isolated pockets, it will rapidly lose the most sensitive species and decrease in biodiversity value. The short-term nature of the project will mitigate much of this decrease, but buffers should be retained where possible.</td>
<td>Remaining vegetation should be inspected at rehabilitation for condition and noted in the baseline rehabilitation reporting.</td>
<td>Habitat connectivity will be maximised where possible.</td>
<td>Due to the short-term nature of the project, issues with connectivity will be rectified on rehabilitation.</td>
</tr>
<tr>
<td>Direction of clearing must provide egress for fauna species</td>
<td>Clearing should be conducted directionally in a manner that allows fauna species the best opportunity to relocate to native habitat. Clearing must be undertaken progressively, downhill, over a number of days to allow fauna the opportunity to relocate away from the disturbance.</td>
<td>Clearing must be supervised to ensure the direction allows a means of egress.</td>
<td>Fauna will be able to escape the clearing where possible.</td>
<td>If the supervisor declares the clearing to be improperly conducted, the clearing will be stopped and processes reviewed before resumption of the activity.</td>
<td></td>
</tr>
</tbody>
</table>
6. Waste (Domestic and Industrial) Management Plan

The Spring Hill waste processing and mullock rehabilitation project is a relatively short term project with an intended low environmental impact. As such, the company will not maintain an on-site landfill. All domestic and industrial waste will be stored and labelled appropriately before removal from site by a licensed contractor (if classified as regulated waste).
<table>
<thead>
<tr>
<th>OBJECTIVE</th>
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<th>MANAGEMENT AND MITIGATION</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Minimise environmental impacts associated with the generation and disposal of waste from mining activities</td>
<td>Generate less waste where possible.</td>
<td>Volumes of waste being generated should be recorded.</td>
<td>Waste storages should be inspected weekly.</td>
<td>Volumes of waste generated versus volumes of waste recycled</td>
<td>Waste storages should be inspected weekly to ensure nothing that can be recycled is being disposed of.</td>
</tr>
<tr>
<td></td>
<td>Recycle more waste where possible.</td>
<td>Volumes of waste being generated should be recorded.</td>
<td>Waste storages should be inspected weekly.</td>
<td>Volumes of waste generated versus volumes of waste recycled</td>
<td>Waste storages should be inspected weekly to ensure nothing that can be recycled is being disposed of.</td>
</tr>
<tr>
<td></td>
<td>Segregate domestic and industrial waste</td>
<td>Waste types must be labelled in storage, through use of colour coded bins or through use of labelling on containers.</td>
<td>Waste storages should be inspected weekly.</td>
<td>Waste will be segregated according to type.</td>
<td>Waste storages should be inspected weekly to ensure nothing that can be recycled is being disposed of.</td>
</tr>
<tr>
<td>Promote the efficient use of resources</td>
<td>Promote recycling</td>
<td>Promote recycling of material where possible on site. Investigate the availability of recycling contractors for site pick up of waste.</td>
<td>Volumes of waste should be recorded.</td>
<td>The site will recycle as much material as possible.</td>
<td>Where recycling facilities are available and are not used, a waste management toolbox session should be delivered at the next pre-start meeting.</td>
</tr>
<tr>
<td>Educate staff on correct waste disposal</td>
<td>Make sure all staff understand the different waste streams on site</td>
<td>Include waste disposal instructions in the site induction</td>
<td>Impact waste disposals to ensure waste is being properly segregated.</td>
<td>Waste will be segregated according to type.</td>
<td>Where waste is being disposed of inappropriately, a toolbox session should be delivered at the next pre-start meeting.</td>
</tr>
</tbody>
</table>
7. Dust, Noise and Vibration Management Plan

The nearest populated sensitive receptor to the Spring Hill operation is the Emerald Springs Roadhouse, approximately 10km (in a straight line) from the site. Based on the activities proposed under this MMP and the offsite processing while considering the distance of the site from Emerald Springs it is highly unlikely the minimal residents of the Roadhouse would be negatively impacted by dust, noise and vibration from the operation.

In order to reduce the risk of impact to environmental receptors, this dust, noise and vibration management plan aims to control dust generated by traffic related to the project, and also reduce noise and vibration caused by mining activities.
<table>
<thead>
<tr>
<th>OBJECTIVE</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Prevent dust from becoming a nuisance</td>
<td>Minimise dust from construction and mining activities</td>
<td>Use dust suppressing water carts on the site roads and the haul road to Union Reefs.</td>
<td>Dust generation will be monitored visually and suppression water carts used in dry periods.</td>
<td>Depositional dust should remain below nuisance dust limits, which on a visual inspection would be sufficient to create a visible layer of dust on a parked car or outdoor furniture in one day.</td>
<td>An excess of depositional dust will prompt an increase in the use of water for dust suppression.</td>
</tr>
<tr>
<td>Minimise noise and vibration from operational activities</td>
<td>Limit machinery noise</td>
<td>Install sound proofing and noise abatement controls on machinery where applicable.</td>
<td>Where noise abatement controls exist for a machine, they must be installed and used.</td>
<td>Machinery noise will be limited.</td>
<td>When machinery is inspected, lack of sound proofing should be noted and rectified.</td>
</tr>
<tr>
<td></td>
<td>Ensure vehicles are maintained as per manufacturer’s instructions</td>
<td>A vehicle maintenance register must be kept.</td>
<td>There will be a vehicle maintenance register that shows up to date maintenance actions.</td>
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</tr>
<tr>
<td></td>
<td>Limit blasting noise</td>
<td>Limit blasting to daylight hours only.</td>
<td>TMI Gold will maintain a noise complaints register.</td>
<td>There will be no complaints on the register.</td>
<td>Any complaints received should be acknowledged within 24 hours and a resolution targeted within 7 days of receiving the complaint.</td>
</tr>
<tr>
<td></td>
<td>Limit noise impacts on staff</td>
<td>Ensure staff utilise hearing protection on site where appropriate.</td>
<td>Provide hearing protection for staff.</td>
<td>Staff will wear hearing protection where required.</td>
<td>Any staff complaint on noise exposure must be acknowledged within 24 hours and an investigation initiated within 48 hours of receiving the complaint.</td>
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<tr>
<td></td>
<td>Install signs in areas where hearing protection is required.</td>
<td>Conduct spot checks to ensure staff are wearing appropriate hearing protection.</td>
<td>Staff will wear hearing protection where required.</td>
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<td></td>
</tr>
<tr>
<td>Operate a complaints process to ensure stakeholder feedback is handled promptly and issues resolved satisfactorily</td>
<td>Deal with complaints promptly and resolve issues in a satisfactory fashion.</td>
<td>Maintain a complaints register and communicate that register to staff and the local stakeholders.</td>
<td>Review the register for complaints monthly.</td>
<td>Complaints received will be dealt with successfully.</td>
<td>If on review, complaints were found to not be acknowledged or resolved promptly, an investigation must be undertaken into the reason for this.</td>
</tr>
</tbody>
</table>

**Table 11: Dust, noise and vibration management matrix**
Water Management Plan

1. Operational Requirements

Site water management requirements for the proposed waste processing and mullock rehabilitation project are minimal. There is no proposed processing of material on site, and subsequently no operational water requirements other than for dust suppression and potable water for the site offices and ablution facilities. Dust suppression has been calculated at a required rate of 4L/m²/d for dry periods, which based on the site and haul road disturbance footprint equates to approximately 0.1ML. This equates to a maximum total water requirement on site of 100,000L/day of water. Water for dust suppression will be sourced either from the raw water tank or from local bores.

2. Site Offices and Amenities

Based on a water consumption rate of 160L/person/day, the 10-person operation will require 1,600L daily through the RO plant for the site offices and ablution facilities. Raw water will be sourced from local groundwater bores and pumped to a raw water storage tank located adjacent to the site offices. This water will be processed through a small reverse osmosis plant to provide potable water to the offices and amenities.
Rehabilitation Planning and Activities

1. Expected Disturbance Areas

The site layout involves the following major infrastructure components:
- ROM, plant, admin offices – 0.62ha
- Existing waste rock dumps/stockpiles (to be reprocessed under this MMP) (0.19ha)
- Access tracks/ haul road – 2200m of haul road to be cleared at 4m wide (0.88ha)
- Total disturbance area is 1.69ha

The new infrastructure disturbance areas at the Spring Hill site as proposed under this MMP have been mapped and maps of the proposed site layout and the haul road are included in Appendix A of this report.

2. Rehabilitation Domains

To assist in planning for rehabilitation the Spring Hill site has been segregated into the following mine domains:
- Domain 1: Associated infrastructure, including; site office, ROM pad, mobile crusher and tracks/roads
- Domain 2: Existing waste rock and mullock heaps, to be reprocessed and rehabilitated through the proposed operations under this MMP.
- Domain 3: Existing stopes, to be rehabilitated via the backfilling of mullock heaps as proposed under this MMP.

Domains 1 and 2 are considered to be additional disturbance proposed to the Spring Hill area (Domain 2, footprints of stockpiles once removed and reprocessed) and will require rehabilitation works and associated costing for rehabilitation liability. A map of these domains is provided in Appendix A of this report. In the case of the existing stopes, these will be rehabilitated as part of the proposed operations via backfilling with mullock material. Backfilling these stopes is not included in the rehabilitation liability.

3. Post-Operations Land Use

In developing the proposed final land for the Spring Hill Site a hierarchy approach has been applied as follows:
1. Reinstate ‘natural’ ecosystems to be as similar as possible to the original ecosystem.
2. Develop an alternative land use with higher beneficial uses than the pre-mining land use.
3. Reinstate the pre-mining land use.
4. Develop an alternative land use with beneficial uses other than the pre-mining land use.

While the Spring Hill lease is located within the Mary River West pastoral lease, the land across the ML is extremely steep and unsuited to grazing. There is no pastoral activity occurring in the vicinity of the proposed project. The land in the vicinity of the proposed disturbance is native vegetation, albeit heavily disturbed by the fire regime of the region.

Based on this, the proposed post operational land use for the site will be to reinstate ‘natural’ ecosystems to be as similar as possible to the original ecosystem. This will be achieved through seeding of native species during rehabilitation works.

4. Rehabilitation Implementation

4.1 Implementation Strategy

TM Gold will engage appropriately qualified earthworks contractors to undertake the material movement and the bulk of rehabilitation and final earthworks at the site.

The works will be undertaken with the supervision of management and in accordance with this MMP. Given the short nature of the proposed reprocessing project, the opportunity for progressive rehabilitation will be limited as disturbance will also be limited; however, TM Gold will be willing to implement rehabilitation activities on areas as they become available should they not be required for future operations.

4.2 Rehabilitation Tasks for Specific Domains

Domain 1 – Associated Infrastructure

The associated infrastructure domain includes the ROM pad footprint incorporating the mobile crusher, offices and fuel storage and the additional disturbance proposed by the widening of the haul road. This covers a combined area of 1.85ha.

Works required for rehabilitation of infrastructure areas will include removal of:
- Administration offices (demountable)
- Fuel storage tanks
- Mobile Crusher
- Generators

When all infrastructure is removed associated disturbance areas including the ROM footprint and the haul road will undergo rehabilitation. This will involve the following tasks:
- Treatment/removal of localised contamination (i.e. hydrocarbon spillages)
- Reshaping of disturbed surfaces
- Spreading of topsoil on reshaped surfaces and deep ripping
- Contour ripping to assist with water infiltration and surface water control
- Seeding of ripped and topsoiled surfaces.
The breakdown of tasks required and the implementation of these works is provided in the rehabilitation task register provided later in this plan.

**Domain 2 – Existing Waste Rock and Mullock Heaps**

The existing waste rock and mullock heaps to be reprocessed or backfilled under this MMP have a disturbance footprint of approximately 0.19ha. Rehabilitation of these footprints once all material is removed will be to blend the area with the surrounding landscape. This will be achieved by:

- Trimming and deep ripping of disturbance footprints,
- Topsoil where available to a depth of 0.2m over the disturbance footprints,
- Seeding and application of fertiliser.

**Domain 3 – Existing Stopes**

The existing stopes will be backfilled with mullock material as part of the proposed operations; however, as these disturbances are pre-existing these works have not been incorporated into the financial provisions. Rehabilitation of the stopes will involve material movement via machinery and placement within the voids. Prior to rehabilitation the General Manager and those involved in the rehabilitation earthworks must undertake an inspection of each void prior to commencement of backfilling. The following items need to be checked prior to the rehabilitation/backfill works:

- Ensure that the void does not contain water (voids are relatively shallow and straight, given these were primarily hand cut up – the bottom of the void is visible from the surface using a bright torch, or a dipper or other device can be lowered to test for water).
- Ensure that no fauna is present, e.g., roosting bats – surveys by Low Ecology identified the presence of Orange Horseshoe Bats in a large adit off lease some years previously; however, that adit has since collapsed and there is no current evidence of roosting bats in the stopes targeted for backfilling.
- Ensure detritus that may obstruct the void (e.g., fallen branches) is cleared wherever possible and safe to do so before backfilling.

Material will dumped into the void slowly using an excavator bucket to ensure maximal fill with few gaps. When material height within the void is sufficient to be safely reached with the excavator bucket, the back of the bucket can be used to tamp down and compact the material and each subsequent layer will be compacted in this way. This compaction will decrease the risk of future subsidence and water infiltration.

Due to the minimal surface area of each adit, natural revegetation is proposed, and this would likely occur during the 2016/2017 wet season.

**4.3 Closure and Rehabilitation Task Register**

The proposed re-processing activities are expected to be completed on site by November 2016 on completion of activities TM Gold will implement rehabilitation works in areas not deemed to be required for future operations.
The following schedule of rehabilitation and closure tasks is provided in the event that no additional activities are proposed or approved at the Spring Hill Site. Should this occur the register would be followed by TM Gold.

Table 12: TM Gold closure and rehabilitation task register for Spring Hill

<table>
<thead>
<tr>
<th>TASK</th>
<th>EXPECTED COMPLETION DATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>DOMAINE 1 – ASSOCIATED INFRASTRUCTURE</td>
<td></td>
</tr>
<tr>
<td>Removal of infrastructure including buildings, fuel tanks, machinery, concrete pads etc.</td>
<td>Late October to mid-November 2016</td>
</tr>
<tr>
<td>Removal of any localised contaminated soil offsite.</td>
<td>Late October to mid-November 2016</td>
</tr>
<tr>
<td>Ripping, topsoiling and seeding of all areas of disturbed land within the associated infrastructure domain including roads.</td>
<td>Late October to mid-November 2016</td>
</tr>
<tr>
<td>DOMAINE 2 – EXISTING WASTE ROCK STOCKPILES/DUMPS</td>
<td></td>
</tr>
<tr>
<td>Trim, deep rip if required of disturbance footprints once reprocessed and backfilled to stopes.</td>
<td>Late October 2016</td>
</tr>
<tr>
<td>Topsoil 0.2m over the disturbance footprints.</td>
<td>October 2016, possibly extending into early November for final rehab works.</td>
</tr>
<tr>
<td>DOMAINE 3 – EXISTING STOPEs</td>
<td></td>
</tr>
<tr>
<td>Backfilling of existing stopes with mullock material.</td>
<td>October 2016</td>
</tr>
</tbody>
</table>

5. Rehabilitation and Revegetation Monitoring

The monitoring objective for rehabilitation at the Spring Hill Site is to provide evidence that the designed landscape is stable, with nutrient cycling and vegetation indices equal to or above those of the control transect within the analogue site. The results of rehabilitation monitoring program will be the primary mechanism by which government departments and agencies, determine rehabilitation success (or otherwise).

Landscape Function Analysis

Tongway and Hindley (2004) developed the Landscape Function Analysis (LFA) also known as Ecosystem Function Analysis (EFA) as the CSIRO’s principal method for mine rehabilitation assessment within the arid zone. LFA is based on and is an indicator-based monitoring procedure that evaluates soil surface processes to examine how well a landscape is working as a biophysical system in relation to disturbance or rehabilitation.
LFA monitoring methods comprise assessing a suite of parameters at different landscape positions on each site, namely on flats, slopes and in troughs. Repeated edaphic (soil properties) and biological measurements are taken over time for various parameters that indicate changes in ecosystem function as rehabilitation proceeds. The goal of rehabilitation is to achieve a self-sustaining landscape. A self-sustaining ecosystem would not need further additions of nutrients, seed, water or other management inputs. The CSIRO LFA method, as detailed by Tongway and Hindley (2004), would be used to inform the monitoring program design; however, some modification to this method will be required to address the site specific variables at Spring Hill.

LFA is typically conducted as an annual monitoring event and TM Gold has made this commitment to rehabilitation monitoring post closure. The results of the LFA monitoring and recommendations will be discussed in the Operational Performance Reports presented following rehabilitation and completion of site activities.

In general, the LFA method would involve monitoring of the following three groups of sites:

- Natural site(s):
  - Disturbed analogue(s) may be utilised due to the presence of stock (grazing pressure) to consider the impact of stock.
- Rehabilitated sites:
  - Reference sites for rehabilitation performance, successful or otherwise.
- Disturbance sites:
  - ROM pad
  - Roads and tracks
  - Footprints of waste stockpiles/dumps

Analogue sites would be chosen as close as possible to the rehabilitated area so that the same climatic and environmental conditions existed at both sites to the extent possible.

Specific LFA monitoring sites are yet to be selected; however, the LFA methodology would be applied to the ROM pad, roads and offices area, which would be treated as a single site, the existing waste rock stockpiles footprints. This program would survey the entire rehabilitated area, due to the comparative small size of these areas and record percentage of plant cover, identify plant species present and note the development of erosional features in comparison to a neighbouring analogue site.
References


Appendix summary

Appendix A  Maps
Appendix B  Spring Hill Waste and Mullock Rehabilitation Project Security Calculation
Appendix A

Maps
Including:
1. Site location
2. Proposed haul route
3. Conceptual design of ROM area
Spring Hill Gold Project

Response to RFI

Authorisation Number 0871-01
August 2016

prepared for
TM Gold Pty Ltd

Final version for release as approved by TM GOLD
Limitations of this Report

Client: TM Gold Pty Ltd

Prepared by Northern Resource Consultants (NRC)

This disclaimer brings the limitations of the investigations to the attention of the reader.

The information in this report is for the exclusive use of TM Gold Pty Ltd. TM Gold Pty Ltd is the only intended beneficiary of our work.

We cannot be held liable for third party reliance on this document. The information within this report could be different if the information upon which it is based is determined to be inaccurate or incomplete.

The results of work carried out by others may have been used in the preparation of this report. These results have been used in good faith, and we are not responsible for their accuracy.

This report has been formulated in the context of published guidelines, field observations, discussions with site personnel, and results of laboratory analyses.

NRC's opinions in this document are subject to modification if additional information is obtained through further investigation, observations or analysis. They relate solely and exclusively to environmental management matters, and are based on the technical and practical experience of environmental scientists.

They are not presented as legal advice, nor do they represent decisions from the regulatory agencies charged with the administration of the relevant Acts.

Any advice, opinions or recommendations contained in this document should be read and relied upon only in the context of the document as a whole and are considered current as of the date of this document.
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Response to RFI

1. Purpose of this document

On 18 July 2016, TM Gold Pty Ltd (TM Gold) submitted an addendum to the MMP submitted to the Department of Mines and Energy (DME) on 13 April and amended on 22 June 2016. The addendum focuses on the collection and crushing of legacy mullock heaps and waste dumps scattered around the mining lease.

On 11 August 2016, DME issued a Request for Information (RFI) associated with the addendum to the MMP and informed by a site visit conducted on 9 August 2016 by Michelle Kassman and Edel O’Connor of DME, accompanied by Ashley Pattison of TM Gold and Marty Costello of Northern Resource Consultants (NRC).

This technical note responds to the matters raised in Attachment A of the RFI.

2. Erosion and sediment control

DME requested further information on erosion and sediment control planning for the project as follows:

Provide an Erosion and Sediment Control Plan (ESCP) specific to the proposed work detailed in the MMP Amendment. In particular address possible erosion of the ROM pad, access tracks, waste rock dumps and areas created following removal of mullock heaps.

This ESCP may be provided as an appendix to the MMP and should be supported by maps/diagrams.

Two maps detailing erosion and sediment control infrastructure for the project have been included in Appendix A of this report. One shows ESC infrastructure across the disturbance area and the second zooms in on the key operational locations, e.g. the ROM pad and prospect areas. A table to accompany these maps and detail each of the controls is included in this report as Table 1.
Table 1 Detailed erosion and sediment control measures, as represented in maps in Appendix A of this document

<table>
<thead>
<tr>
<th>NAME OF CONTROL MEASURE</th>
<th>APPLIED TO</th>
<th>DESIGN SPECIFICATIONS</th>
<th>CONFIGURATION</th>
<th>INSTALLATION SEQUENCE</th>
<th>INSPECTION</th>
<th>MAINTENANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sediment Basin</td>
<td>ROM</td>
<td>10% AEP 72hr</td>
<td>0.5ML</td>
<td>Prior to earthworks</td>
<td>Immediately following rainfall event</td>
<td>Desilting and spillway repair</td>
</tr>
</tbody>
</table>
| ROM Bund                       | ROM        | 10% AEP 30min event    | **Drain:** 2m wide base; 1:3 batters  
**Bund:** 1m height; 1m width at top | Following completion of ROM Area construction | Immediately following rainfall event | Desilting |
| Stockpile Area Capture Bunds  | Mullock Heaps | 1m height          | 1m height | Prior to removal of waste rock | Immediately following rainfall event | Repair if eroded |
| Rock Check Dams               | Drainage Lines | At locations nominated | 50cm minimum height  
provide a spillway  
use competent rock  
trench dam 20cm into ground | Prior to earthworks | Immediately following rainfall event | Repair if damaged |
<p>| Mullock Heap Areas            | Mullock Heaps | Shape into a general depression with an earthen bund around the perimeter and seed | N/A           | Following removal of material for processing | Upon finalisation of earthworks | N/A |</p>
<table>
<thead>
<tr>
<th>NAME OF CONTROL MEASURE</th>
<th>APPLIED TO</th>
<th>DESIGN SPECIFICATIONS</th>
<th>CONFIGURATION</th>
<th>INSTALLATION SEQUENCE</th>
<th>INSPECTION</th>
<th>MAINTENANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table Drain</td>
<td>Haul Road</td>
<td>Flat bottomed trapezoidal channel</td>
<td>2m wide base; 1:3 batters</td>
<td>During haul road installation</td>
<td>Following each rainfall event</td>
<td>Repair if erosion rills present</td>
</tr>
<tr>
<td></td>
<td></td>
<td>50% AEP 30min event</td>
<td>Rock lining where drain gradient &gt;10%. Rock size $D_{so} = 40(v)^2$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Drain depth 25% top width</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whoa Buoy</td>
<td>Haul Road</td>
<td>1 whoa buoy every 10m vertically along the haul route</td>
<td>45-60cm height</td>
<td>During installation of the haul road</td>
<td>Weekly during operations</td>
<td>Repair if damaged</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1:4 approach batter</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Cross-road fall of 10-25cm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Discharge to rock lined drain or stable vegetation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level Crossing</td>
<td>Haul Road</td>
<td>Haul road to be level with base of drainage line</td>
<td></td>
<td>During installation of the haul road</td>
<td>N/A</td>
<td>Repair if rills or channelisation present</td>
</tr>
<tr>
<td>Haul Road Design</td>
<td>Haul Road</td>
<td>Outfall road with cross drainage at Whoa Buoys</td>
<td></td>
<td>Installation of Haul Road</td>
<td>N/A</td>
<td>Repair rilling if present. Possibly install additional whoa boys</td>
</tr>
</tbody>
</table>
3. Flora and fauna

DME requested further information on flora and fauna as follows:

As discussed on site; provide the information obtained from Low Ecological Services following the flora and fauna survey undertaken earlier this year to ensure no endangered or threatened species are present in the areas proposed for clearing. The absence of previously present orange horseshoe bats should in particular be demonstrated.

Low Ecological Services has visited site a number of times since the 1995 survey, as detailed in Table 2.

Table 2: Flora and fauna surveys since 1995

<table>
<thead>
<tr>
<th>DATE</th>
<th>DURATION</th>
<th>DETAILS</th>
</tr>
</thead>
</table>
| January 2016  | One day, Jeremy Snowdon-James | Site familiarisation during NOI production  
                             General observations over whole site |
| October 2013  | Half day, Nicola Hanrahan | Site familiarisation while updating the 2011 and 1995 reports.  
                             Tour of site by Thor site manager.  
                             Observation of drilling operations and cleared areas and former main adit entrance.  
                             General observations of birds and vegetation |
| September 2011| One day, Bill Low and Angela Stewart | Site visit to assess if any significant changes to the site had occurred since the 1995 visit.  
                             All tracks driven at a slow pace.  
                             Lower main adit examined in detail on foot and found blocked completely with water trickling out through blocked entry area.  
                             Items of interest such as threatened flora, potential weeds or erosion were examined on foot and photographs taken.  
                             All fauna observed, heard or identified by tracks or scats were noted. |

In the reporting from Low Ecological Services based on the terrestrial ecology survey effort conducted to date, the 'main adit' is the only location where the Orange Leaf-nosed Bat (*Rhinonicteris aurantia*) (Orange horseshoe bat) has been recorded. This species is listed as near-threatened under the Territory Parks and Wildlife Conservation Act. Site visits conducted in recent years have identified that a landslide following the heavy regional rains in 2011 covered the 'main adit' entrance and it is no longer accessible as a roost for any bats.

The stopes to be impacted by the proposed project range in depth from around 10m or less to deeper stopes up to 30m. Low Ecological Services recognise the deeper stopes could be used by microbats; however, many are too shallow for stress period day time roosts.

A pre-clearance fauna survey will be conducted by suitably qualified ecologists prior to the commencement of backfilling waste material to the existing stopes in the operational area for
the proposed action. The pre-clearance survey will involve targeted survey effort to identify any stopes that currently represent habitat for bat species. Focus will be given to determining if any stopes are currently occupied by threatened or near-threatened bat species such as the Orange Leaf-nosed Bat. Should any stopes be identified as currently occupied roosting habitat for the Orange Leaf-nosed Bat, these stopes will be flagged as not suitable for backfilling, and backfilling activities will be restricted to non-inhabited stopes.

Depending on the findings of the pre-clearance survey, a Threatened Species Management Plan will be produced if required and circulated to staff and contractors on site, including:

- photographs and points of note to assist in the identification of threatened species
- instructions on how to report a sighting, and
- management strategies for avoiding species that are confirmed as present on site.

The results of this pre-clearance survey and the Threatened Species Management Plan will be sent to DME prior to commencement of earthworks on site.

4. Cultural heritage

DME requested further information on cultural heritage as follows:

Has a recent heritage survey been undertaken to ensure stopes identified for backfilling and the prospect areas do not have heritage listing?

4.1 Recent heritage surveys

In early 2016, cultural heritage consultants EarthSea Pty Ltd surveyed the Spring Hill site and issued a report dated June 2016, which was included in the appendices of the original MMP submitted on 13 April and amended on 22 June 2016.

The survey report highlights that no sacred sites have been recorded or identified within ML23812. There are some European and Chinese cultural heritage sites identified and mapped in the Earthsea report. In particular, site SH5 – Hilltop Workings identifies a number of Chinese cultural heritage sites from the turn of the last century and into the early 1900s. EarthSea recommended that site SH5 be avoided by a 10m buffer. Details on the management strategies for each of the individual areas identified within SH5 are provided in the Earthsea report (2016).

Two of the identified sites within the Hilltop Workings, SH5-025 and SH5-026, are in close proximity to mullock heaps or waste rock dumps with material targeted to be moved. TM Gold proposes to operate within the suggested 10m exclusion buffer for these sites; however, it is vital to note that the identified item of cultural heritage is not the mullock heap or waste rock in proximity to the site.

Site SH-025 is described as a partially collapsed stone forge, which is described as being of low significance. There is no included photograph. Coordinates are provided for the forge.

Site SH-026 is described as a partially intact flagstone floor, with the site shown in Figure 1.
4.2 Management objectives

These sites are not heritage listed; however, both sites are identified in the Earthsea report as to be conserved in-situ and re-evaluated if likely to be impacted by mining. The proposed project will not impact upon these sites, but may encroach upon the suggested buffer zones of both sites.

The management objectives for sites SH-025 and SH-026 are as follows:
- Cause no damage to the identified sites as part of the proposed project
- Allow no damage to be caused to the identified sites as a result of the activities of the proposed project

Cause no damage during the proposed project

TM Gold propose the following approach to these two nominated sites:
- Both sites to be inspected by the General Manager and machinery operators prior to the introduction of excavation machinery.
- Exclusion areas to be identified and marked off with flagging tape.
  - Where possible, if sites can be fenced off with temporary fencing, they should be.
- Machinery operators to be briefed and walk the site on foot before operating machinery in proximity to the site.
- If a haulage vehicle is required for loading waste material, this vehicle should be positioned away from the cultural heritage site.
- Excavation of mullock and waste rock to be supervised from the ground by a spotter in constant radio contact with the machine operator.
- Before and after photographs of the sites to be taken either side of material movement.

Allow no damage to be caused as a result of project activities

TM Gold will implement an ESC Plan as described in section 2, Erosion and sediment control, to prevent impacts to the designated sites after the removal of the nearby mullock and waste rock heaps. Additionally, TM Gold will promptly implement rehabilitation activities on the disturbed footprints of the mullock and waste rock heaps to encourage revegetation and minimise the change of sediment movement from the disturbance footprints into the designated sites.

4.3 Measurable criteria

The success of the tasks completed to achieve the management objectives can be measured through:
- Inspection of the before and after photographs of the designated sites
- Inspection of the ESC infrastructure before and after a rain event
- Inspection of the progress of the rehabilitation works completed on the mullock and waste rock disturbance footprints

Given these cultural heritage sites have been in situ for decades with no protection from the elements or interference from the public, TM Gold does not consider the proposed project activity, conducted in accordance with the process outlined in this document, to pose a high risk of impact to these sites.

5. General – consultation with the Department of Transport

DME requested further information on consultation undertaken to date with the Department of Transport as follows:

| Demonstrate that consultation with the Department of Transport regarding the use of public roads for the purpose of hauling has been undertaken? Provide details of truck movements per day. Is the public road adequate for this activity? |
| Mt Wells Road is not a load or axle restricted public road. TM Gold propose to run conventional double road trains which are not over size or over mass. TM Gold have consulted with NT Transport to confirm the above, and are using a well-established civil contractor for the haulage element of the proposed project. A Transport Management Plan is being finalised and will be forwarded to the department in due course. |

6. General – waste rock characterisation

DME requested further information on characterisation of waste rock on site as follows:
As per discussions on site; what is the character of the waste rock? Provide analysis.
Demonstrate that the waste material proposed for backfilling is benign.

Based on a number of standard laboratory analyses carried out on 53 representative waste rock samples, the following conclusions have been derived:

- There is no risk of acidic or saline drainage from inherent acidity of the waste rock material proposed to be backfilled into historic shafts. This is based on the results obtained from paste pH and paste EC tests.
- There is practically no risk of acid generation from the waste rock material that is proposed to be backfilled into stopes at site. This is based on the results of ABA and NAG tests which indicated that only two out of 53 waste rock samples are capable of producing acidic drainage and that a vast majority of waste rock samples (73.5%) are acid consuming.
- There is no risk of metalliferous drainage due to enrichment of trace metals in the waste rock samples. Comparison of total trace element concentrations to the median soil content indicates an enrichment of arsenic. However, leachate testing on the waste rock samples indicate no risk of leaching of arsenic into the waters coming in contact with the waste rock.

Backfilling the economically unviable waste material to the stopes on site poses no geochemical risk of environmental harm. A waste rock characterisation technical note illustrating the findings prompting these conclusions is included as Appendix C of this report.

7. Contact information

DME requested formalisation of contact details:

This MMP lists Marty Costello of Northern Resources Consultants Pty Limited as a contact; if TM Gold Pty Ltd wish the Department to liaise with Mr Costello regarding this project, an Authority to Appoint Agent form should be completed and submitted. This form can be found on our website: https://minerals.nt.gov.au/mining/about-mining

A completed authority to appoint an agent will be completed by TM Gold and NRC and submitted to the Department in due course.

8. Introduction

DME requested further information on stockpiling:

1. Addendum to the MMP

"Collection and central stockpiling of mullock heaps and rock dumps"
Confirm that stockpiling is wholly within the proposed ROM.

The project intention is to stockpile all material within the proposed ROM. Mullock heaps and waste rock piles have been assayed and identified to contain economically viable quantities of gold. Each identified dump will be excavated using an excavator and hauled by truck to the
central ROM pad, where the material will be stockpiled. At the ROM pad, material will be crushed using a portable track mounted jaw crusher. Re-assaying and visual assessment of the waste rock will take place from the crusher belt to produce an accurate assay grade for the material.

9. Operational activities – material movement and backfilling

DME requested clarification on operational activities as follows:

4. Material Movement
   Provide details of the construction of the ROM pad. This may be supported by diagrams.

6. Backfilling
   How many stopes are at this location? Will all stopes be backfilled? Indicate the locations of all stopes within the prospect areas on a map/diagram.

9.1 Construction of the ROM pad

In accordance with the ESC planning section of this report, work to construct the ROM pad area will commence after construction of the ROM sediment basin.

The proposed ROM pad will be cleared in accordance with the land clearance procedure included on pages 18-20 of the submitted addendum to the MMP. Topsoil will be scraped and stockpiled in accordance with the soil management plan included on pages 15-17 of the submitted addendum to the MMP. A grader and where necessary an excavator will be used to level the ROM pad. The cleared pad will be compacted by track rolling. ESC infrastructure as described in the ESC planning section will be constructed around the ROM pad.

9.2 Backfilling

There are some 37 stopes in the vicinity of the proposed project, some with a maximum depth of 20-30m. Other stopes are considerably more shallow with depths around 10m or less. The stopes for the most part are associated with a nearby mullock heap or waste rock dump. Locations of stopes are shown on a map in Appendix A of this document. It is as yet unclear whether there will be sufficient waste material to backfill all of the identified stopes, as this is dependent on the progressive assaying of material. Stopes will be inspected during material movement and flagged for order of backfilling. Priority will be given to the deepest stopes first to ensure maximal safety benefit from the backfilling process. In an instance where a stope may have future benefit, i.e. be part of the main shaft that connects to the underground adit in the future proposed mining project, this stope will not be backfilled. However, it will be chain fenced for safety.
10. Operational activities – groundwater and project schedule

3. Groundwater
Registered bores are discussed in this section and again in the Water Management Plan. Following the site inspection, the Department is aware that the operator no longer intends to use these bores for the proposed work. Update the MMP to reflect this change.

9. Project Schedule
"The intended start date for the waste processing and mullock rehabilitation project is 1 September 2017, dependent on approvals."
Clarify if this should be 1 September 2016.

10.1 Groundwater
On page 25 of the originally submitted addendum to the MMP, in section 2, Water Management Plan, TM Gold proposed: ‘Raw water will be sourced from local groundwater bores and pumped to a raw water storage tank located adjacent to the site offices’. This will be modified within the addendum document to read ‘Raw water will be delivered to site and pumped to a storage tank located adjacent to the site offices’.

10.2 Project Schedule
The intended start date for the project is 1 September 2016, subject to the relevant approvals.

11. Closure and rehabilitation task register
Table 12 indicates that seeding and application of fertiliser of Domain 2 will be carried out from November 2016 - December 2017. Clarify and update this completion date.

Seeding and application of fertiliser is intended to take place within a window of two months, not fourteen months. The date range should be November-December 2016. January 2017 remains in place as a contingency deadline for all seeding and fertiliser applications. Table 12 in the MMP has been revised as follows:
Table 3: TM Gold closure and rehabilitation task register for the Spring Hill waste processing and mullock rehabilitation project.

<table>
<thead>
<tr>
<th>SPRING HILL – CLOSURE AND REHABILITATION TASK REGISTER</th>
<th>EXPECTED COMPLETION DATE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DOMAIN 1 – ASSOCIATED INFRASTRUCTURE</strong></td>
<td></td>
</tr>
<tr>
<td>Removal of infrastructure including buildings, fuel tanks, machinery, concrete pads etc.</td>
<td>Late October to mid-November 2016</td>
</tr>
<tr>
<td>Removal of any localised contaminated soil offsite.</td>
<td>Late October to mid-November 2016</td>
</tr>
<tr>
<td>Ripping, topsoiling and seeding of all areas of disturbed land within the associated infrastructure domain including roads.</td>
<td>Late October to mid-November 2016</td>
</tr>
<tr>
<td><strong>DOMAIN 2 – EXISTING WASTE ROCK STOCKPILES/DUMPS</strong></td>
<td></td>
</tr>
<tr>
<td>Trim, deep rip if required of disturbance footprints once reprocessed and backfilled to stopes.</td>
<td>Late October 2016</td>
</tr>
<tr>
<td>Topsoil 0.2m over the disturbance footprints.</td>
<td>October 2016, possibly extending into early November for final rehab works.</td>
</tr>
<tr>
<td><strong>DOMAIN 3 – EXISTING STOPES</strong></td>
<td></td>
</tr>
<tr>
<td>Backfilling of existing stopes with mullock material.</td>
<td>October 2016</td>
</tr>
</tbody>
</table>

12. Environmental management plans

Table 9: Spring Hill Land Clearance Procedure

"Ensure clearing takes place in April / May to meet the end of wet season / start of dry season target for effective clearing"

The project schedule is from September to November. Update this table to reflect relevant information.

What considerations/mitigations will be made given clearing will occur late in the dry season?

Table 11: Dust, Noise and Vibration Management Matrix

"Limit blasting to daylight hours only"

Blasting is not discussed in any other section of this MMP; will blasting be carried out for this project?

12.1 Land clearance in the project timeline

Table 9 of the MMP has been revised to reflect the schedule of operations for the project. The section on clearing in the wet has been updated with a section on clearing in the late dry
season, and the use of a water cart for dust suppression during clearing. Table 9 of the MMP now appears as follows.
Table 4: Spring Hill project land clearance procedure

<table>
<thead>
<tr>
<th>OBJECTIVE</th>
<th>TARGET</th>
<th>MANAGEMENT AND MITIGATION</th>
<th>MONITORING AND MEASUREMENT</th>
<th>EFFECTIVENESS</th>
<th>NON CONFORMANCE AND CORRECTIVE ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>All clearing must be permitted</td>
<td>Ensure permits to clear are lodged and approved in time for clearing works</td>
<td>The required authorisation for land clearing must be identified and approval sought in a timely fashion for clearing. No clearing must take place without appropriate permits.</td>
<td>Land clearance planning must include lead times for permitting.</td>
<td>Permitting will be in place for clearing.</td>
<td>Clearing performed without the necessary permits must be reported to the relevant government authority.</td>
</tr>
<tr>
<td>Conduct land clearance in an efficient manner that maximises retention of resources reusable in rehabilitation</td>
<td>Clearing is to take place in the late dry season – minimise impacts from dust.</td>
<td>Minimise the impacts from dust resulting from clearing in the late dry season. Water carts will be used in dust suppression during clearing.</td>
<td>Clearing should be conducted in line with the proposed activity schedule for the mine. Water carts will be present and active during clearing.</td>
<td>Dust generation will be minimised during clearing through the use of water carts for dust suppression.</td>
<td>If clearing cannot be conducted as scheduled, clearing methodologies will be assessed against the prevailing conditions and modified where necessary.</td>
</tr>
<tr>
<td></td>
<td>Clear only areas that are required to be cleared</td>
<td>Mark the areas to be cleared before clearing.</td>
<td>GPS equipment should be used by surveyors to mark out areas to be cleared, and clearing should be supervised to ensure no ‘out of bounds’ clearing takes place.</td>
<td>Approved clearing sites should be well flagged to avoid confusion and unnecessary and illegal removal of native vegetation.</td>
<td>If the supervisor sees clearing taking place outside designated areas, all machinery movement should be halted and the clearing plan reviewed.</td>
</tr>
<tr>
<td></td>
<td>Avoid unnecessary environmental damage through soil compaction</td>
<td>Access to the site should be managed to prevent introduction of weed species or unnecessary compaction of soils by vehicles.</td>
<td>Site access should be signposted clearly and unauthorised vehicles apprehended.</td>
<td>Soil compaction should be minimal.</td>
<td>Clearing methodologies should be reviewed with contractors / machine operators if compaction is deemed to be excessive. Unauthorised vehicles should be apprehended promptly and asked to leave the area.</td>
</tr>
<tr>
<td>OBJECTIVE</td>
<td>TARGET</td>
<td>MANAGEMENT AND MITIGATION</td>
<td>MONITORING AND MEASUREMENT</td>
<td>EFFECTIVENESS</td>
<td>NON CONFORMANCE AND CORRECTIVE ACTION</td>
</tr>
<tr>
<td>-----------</td>
<td>--------</td>
<td>--------------------------</td>
<td>---------------------------</td>
<td>--------------</td>
<td>--------------------------------------</td>
</tr>
<tr>
<td><strong>Minimise impacts to soil integrity and composition</strong></td>
<td></td>
<td>Clear felling or chaining techniques should be used to facilitate clean pushovers of larger vegetation and reduce vehicle movements across the site. Timing should be closely managed to ensure large areas of soil are not left exposed without being promptly stripped for stockpiling.</td>
<td>Clearing will be conducted in accordance with this plan.</td>
<td>Clearing will be conducted efficiently, soil compaction will be minimised and vehicles movements across site restricted.</td>
<td>Clearing methodologies should be reviewed with contractors / machine operators if compaction is deemed to be excessive.</td>
</tr>
<tr>
<td><strong>Maximise retention of material for reuse in rehabilitation</strong></td>
<td></td>
<td>Post-clearing debris should be cleaned up using a blade and stockpiled in windrows running down the contour to minimise loss of material through stormwater runoff.</td>
<td>Stockpiling will be conducted in accordance with this plan.</td>
<td>Stockpiles should be constructed in accordance with this plan.</td>
<td>Stockpiles that are inappropriately situated should be relocated.</td>
</tr>
<tr>
<td><strong>Manage bushfire risk appropriately</strong></td>
<td></td>
<td>Post-clearing debris to be stockpiled to minimise bushfire risk</td>
<td>Debris should be stockpiled away from native vegetation and away from other infrastructure.</td>
<td>Stockpiling will be conducted in accordance with this plan.</td>
<td>Stockpiles should be constructed in accordance with this plan. Firebreaks should be maintained as described.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bushfire controls to be used</td>
<td>Fire breaks of at least 2m in width should be cleared around and stockpiled vegetation (if applicable).</td>
<td>Fire breaks will be installed in accordance with this plan</td>
<td>Firebreaks should be maintained</td>
</tr>
<tr>
<td>OBJECTIVE</td>
<td>TARGET</td>
<td>MANAGEMENT AND MITIGATION</td>
<td>MONITORING AND MEASUREMENT</td>
<td>EFFECTIVENESS</td>
<td>NON CONFORMANCE AND CORRECTIVE ACTION</td>
</tr>
<tr>
<td>-----------</td>
<td>--------</td>
<td>---------------------------</td>
<td>-----------------------------</td>
<td>---------------</td>
<td>---------------------------------------</td>
</tr>
<tr>
<td>Minimise erosion risk</td>
<td>Steep slopes that do not form part of the disturbance footprint should not be cleared</td>
<td>Vegetation should be left intact on steep slopes that lie between infrastructure areas but do not form part of the disturbance footprint. Note the importance of maximising connectivity, the next objective in this table.</td>
<td>Vegetation will be left intact where practicable and vegetation condition reviewed at rehabilitation.</td>
<td>Steep slopes will not be cleared</td>
<td>Where steep slopes have been cleared, ESC infrastructure must be implemented.</td>
</tr>
<tr>
<td></td>
<td>Post-clearing debris to be stockpiled to minimise erosion risk</td>
<td>Post-clearing debris should be stockpiled in windrows running down the contour to minimise loss of material through stormwater runoff. Where this is not possible, diversion bunding should be used to divert stormwater away from smaller debris at high risk of washing away in a storm event.</td>
<td>Stockpiles should be inspected for form and placement.</td>
<td>Stockpiles should not erode in a rainfall event.</td>
<td>Improperly formed or positioned stockpiles should be reshaped and/or moved.</td>
</tr>
</tbody>
</table>
### OBJECTIVE
Minimise impacts to fauna

### TARGET
Maximise habitat connectivity through the use of native vegetation buffers

### MANAGEMENT AND MITIGATION
While vegetation should not be cleared from steep slopes that do not form part of the disturbance footprint for erosion control reasons, it is important to provide buffers between areas of retained vegetation and disturbance areas to maintain functional habitat linkages. If retained vegetation is left in small, isolated pockets, it will rapidly lose the most sensitive species and decrease in biodiversity value. The short-term nature of the project will mitigate much of this decrease, but buffers should be retained where possible.

Remaining vegetation should be inspected at rehabilitation for condition and noted in the baseline rehabilitation reporting.

Clearing should be conducted directionally in a manner that allows fauna species the best opportunity to relocate to native habitat. Clearing must be undertaken progressively, downhill, over a number of days to allow fauna the opportunity to relocate away from the disturbance.

Clearing must be supervised to ensure the direction allows a means of egress.

Habitat connectivity will be maximised where possible.

Due to the short-term nature of the project, issues with connectivity will be rectified on rehabilitation.

If the supervisor declares the clearing to be improperly conducted, the clearing will be stopped and processes reviewed before resumption of the activity.
12.2 Dry season considerations for land clearance

The proposed project is scheduled to take place late in the dry season. Depending on recent rainfall, groundcover will be minimal. Clearing and stockpiling of vegetation will be conducted in accordance with the land clearance plan, with the additional use of water carts to reduce the generation of dust where required. Due to the short term nature of the project, rehabilitation will be completed in time to take advantage of the wet season, which should encourage rapid revegetation of rehabilitated areas.

12.3 Blasting

Blasting will not be carried out as part of this project. The management plans for the Spring Hill project are best practice plans prepared in accordance with the most recent industry guideline for the management area. They are designed to be universally applicable during mining operations. In this case TM Gold accept there will be no blasting and that reference has been removed from Table 11 of the MMP, the dust, noise and vibration management matrix.

13. Rehabilitation planning and activities

Provide details of the Rehabilitation of the ROM pad. This may be supported by diagrams.

The ROM pad will be rehabilitated by following a number of steps.
- All mobile plant and equipment will be removed from the ROM pad at the end of crushing.
- Residual stockpile material will be moved from the ROM pad and used to backfill stopes.
- The surface of the ROM will be visually inspected for any hydrocarbon spills, and in the event of spills the contaminated soil will be excavated and removed from site for disposal by a suitably licenced contractor.
- The cleared, inspected ROM pad surface is now ready for rehabilitation – machinery will be used to rip the surface of the compacted pad.
- Any topsoil stockpiled in the vicinity from the cleared ROM pad will be respread at this point and ripped.
- The site of the ROM pad will be reseeded with native grass species to promote establishment of vegetation and reduce the erosive impact of rainfall.
- The ESC bunds and ROM sediment trap will remain in-situ until rehabilitation of the ROM pad is complete.

The understorey of the land unit in this region was previously surveyed and identified to consist of locally dominant grass species: *Sehima nervosum* (Rats Tail Grass), *Cymbopogon obtectus* (Silky Heads), *Herteropogon contortus* (Black spear grass), *Sorghum plumosum* and *Themeda triandra* (Kangaroo Grass). Other grasses include: *Eragrostis cummingii* (Cumings Lovegrass), *Eulalia aurea*, *Pseudopogonatherum irritans*, and species of *Aristida*, *Schizachyrium* and *Eriachne*. Forb species include: *Gomphrena* spp., *Thecanthes punicea*, and *Haemodorum coccineum* (Scarlet Flower Blood Root).
Where commercially available, preference will be given to the listed grass species in rehabilitation. Given the extremely short nature of the proposed project, revegetation is also expected to strike from the existing seedbank within respread soil and active reseeding is supplementary to this.

14. Appendix A

Illustrate on a map/diagram the proposed access to and between the prospect areas the ROM pad and the haul road.

A map illustrating the proposed access tracks between the prospect areas and the ROM pad and haul road is included in Appendix A of this report.
Appendix summary

Appendix A  Maps
Appendix B  Waste Rock Characterisation Technical Note
Appendix A

Maps

Including:

1. Stope locations
2. Proposed access tracks
3. Erosion and sediment control measures across the disturbance
4. Erosion and sediment control measures around operations
STOPE LOCATIONS

Legend
- Stope Locations
- Existing road to be used as a haul road
- ROM Sediment Basin
- Proposed ROM Pad
- Existing Stockpiles
- 5m Contour (AHD)
- Mining Leases

Data supplied by State of Queensland (Department of Natural Resources and Mines) 2016.
Appendix B

Waste Rock Characterisation Technical Note
Spring Hill

Waste Rock Characterisation

August 2016

prepared for
TM Gold Pty Ltd
Introduction

1. Background

On 18 July 2016, TM Gold Pty Ltd (TM Gold) submitted an addendum to the MMP submitted to the Department of Mines and Energy (DME) on 13 April and amended on 22 June 2016. The addendum focuses on the collection and crushing of approximately 50,000 tonnes of legacy mullock heaps and waste dumps scattered around the mining lease.

On 11 August 2016, DME issued a Request for Information (RFI) associated with the addendum to the MMP. This technical note presents the geochemical characteristics of waste rock material proposed to be used for backfilling legacy mine shafts in response to comments within that RFI.

2. Geology

The gold deposit at Spring Hill is hosted in greywacke, mudstone, siltstone, chert, BIF and carbonaceous mudstone of the Mount Bonnie Formation. These rocks are overlain by the Gerowie Tuff, a sequence of siltstones, cherts and tuffaceous sediments. The economically unviable waste material from the mullock and waste rock piles proposed to be used for backfilling is a mix of rocks from the Gerowie Tuff and Mount Bonnie Formation.
Sampling and Analysis Methodology

1. Waste rock sampling

Fifty-three composite rock chip samples were obtained from nineteen exploration drill holes located within the orebody or very close to it. The location of these exploration drill holes is presented in a map in Appendix A of this report. Other details including intervals composited and the lithology of all waste rock samples is presented in Appendix B.

Lithological description, sampling depths and the location of sampled exploration drill holes confirm that the waste rock samples analysed are from the Gerowie Tuff and Mount Bonnie Formation. The economically unviable waste material from the mullock and waste rock piles proposed to be used for backfilling legacy mine shafts was also originally sourced from these two stratigraphic units.

2. Laboratory analysis

All waste rock samples were analysed in a NATA accredited laboratory for a suite of geochemical parameters that enable assessment of acid forming and leaching characteristics of the waste rock. Parameters for laboratory analysis were as follows:

Elemental Composition:
- Total major cations / anions (Total Kjeldahl N, total C, Na, K, Ca, Mg and S)
- Total trace metal analysis, acid leach, (As, B, Be, Cd, Co, Cr, Cu, Mn, Ni, Pb, Zn, V, Hg)
- HCl Extractable S

Acid Base Accounting:
- Paste pH and electrical conductivity (EC) on a one part sample to two parts deionised water ratio (1:2)
- Acid Neutralising Capacity (ANC);
- Net Acid Generating Potential (NAGP)
- Single-addition Net Acid Generation (NAG) testing;

Leachate Test (in 1:20 distilled water extracts) using the Australian Standard Leaching Procedure (ASLP):
- Trace metal analysis (As, B, Be, Cd, Co, Cr, Cu, Fe, Mn, Ni, Pb, Sn, Zn, V, Hg)
- Total Major cations / anions (NO2- / NO3-, total N, total Kjeldahl N, total C, Na, Cl, K, Ca, Mg, S as SO4)
- Alkalinity, Acidity, pH and EC
All analyses were performed on subsamples pulverised to 75 microns. The water leachate used was a mix of de-ionised water and acetic acid to achieve a residual pH of 5. The solution was combined with a portion of pulverised waste rock sample in a 1:20 mass ratio (waste rock:water). The combination (waste rock and solution), was contained within an enclosed 2 litre glass bottle and mechanically tumbled end-over-end for 18 hours at room temperature. The fluid was then pressure filtered and the liquid analysed for the elements listed above. The final pH of the solution was also recorded.
Results and Analysis

1. Inherent acidity and salinity in waste rock

1.1 Paste pH and EC

Paste pH is an indication of inherent acidity of waste material whereas paste EC is an estimate of inherent salinity of waste rock samples. It is determined by equilibrating a small amount of pulverised sample mixed with 2 parts water by weight and rested for 12 hours (Smart et al., 2002).

The pH of distilled water used in the paste is typically around 5.3. Therefore, paste pH measurement of less than 5.0 indicates the presence of net acidity in the sample at the time of analysis (Morin and Hutt, 2001). Only four out of the 53 samples tested have a paste pH lower than 5.0. Paste pH in waste rock samples varies from 4.3 to 7.6 with a median of 6.1.

All analysed samples with a paste pH lower than 5.0 have a total sulfur content below analytical detection limits. This indicates that although the samples have residual acidity, the potential for further acidification is negligible due to lack of pyrite minerals.

Paste EC of all but one waste rock sample is below 250µS/cm which indicates the inherent salinity of the waste rock is very low. The waste rock does not contain significant amounts of soluble compounds. Paste EC of all waste rock samples analysed ranges widely from 6.0-260.0µS/cm with a median value of only 14.0µS/cm.

Figure 1: Paste pH and EC of Waste Rock Samples
These results indicate that the risk of acidic or saline leachate from the waste material to be used for backfilling is extremely low. The historical shafts are open to the ingress of surficial runoff and therefore currently act similar to an infiltration basin. Water passing through these shafts comes in contact with rocks that have geochemical properties very similar to waste rock and mullock spoil proposed to be backfilled. Therefore, the risk of additional salinity in the leachate due to backfilling is negligible.

2. Potential for generation of acidic drainage

2.1 Acid Base Accounting

Acid-base Accounting (ABA) and Net Acid Generation (NAG) testing are the most widely used assessment method for determination of acid forming characteristics of waste rock (Smart et al., 2002). It involves static laboratory procedures that evaluate the balance between acid generation processes emanating from oxidation of sulfide and acid neutralisation processes.

Maximum Potential Acidity (MPA)

Total sulfur content is used to generate an estimate of MPA assuming all sulfur is present as sulfide. It is often expresses as kilograms of equivalent H$_2$SO$_4$ that can be produced by complete oxidation of pyrites contained in a tonne of waste material. Total sulfur content in the samples was analysed by two methods:

a. Using LECO furnace: A small amount of accurately measured subsample is combusted in an induction furnace and the amount of sulfur oxide in the combustion product is determined to calculate the percentage of sulfur in that sample.

b. Using Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES): In this method, a small amount of sample is completely digested in a strongly acidic solution and an aliquot is analysed for its elemental composition including its sulfur content.

Only four waste rock samples out of 53 had total sulfur content above the detection limit (0.005% for the LECO furnace method). Sulfur content in these four samples ranged from 0.009% to 0.044%. Equivalent MPA ranged from 0.27kg H$_2$SO$_4$/T to 1.3kg H$_2$SO$_4$/T, which is very low.

Forty six samples out of 53 contained total recoverable sulfur content above the detection limit of the ICP-OES method (10mg/kg or 0.001%). These values ranged from 10mg/kg to 380mg/kg (0.038%) with a median value of 14mg/kg or 0.014%.

Acid Neutralisation Capacity (ANC)

ANC is determined by a modified Sobek method (Sobek et al., 1978). In this method, a known quantity of standardised hydrochloric acid (HCl) is added to an accurately weighed representative subsample. Sufficient time is allowed for reaction to occur at an elevated
temperature. This mixture is then back-titrated with standardised sodium hydroxide (NaOH) to determine the amount of unreacted HCl.

Twenty-six of the 53 waste rock sample analysed had an ANC value above the detection limit of this method (0.5kg H$_2$SO$_4$/T). These values ranged from 0.5kg H$_2$SO$_4$/T to 3.8kg H$_2$SO$_4$/T with the median value being 0.85kg H$_2$SO$_4$/T.

Net Acid Production Potential (NAPP)

NAPP is the difference between the MPA and the ANC. It is a measure of residual long-term acid production capability of a waste rock sample. Negative values of NAPP indicate the waste rock has acid consuming capacity.

The NAPP values of 53 waste rock samples analysed ranged from -3.8kg H$_2$SO$_4$/T to 1.1kg H$_2$SO$_4$/T with the median value being -0.5kg H$_2$SO$_4$/T. Forty-nine of the 53 samples had negative NAPP values indicating the overall acid consuming nature of the waste rock at Spring Hill. This is depicted in Figure 2.

![Figure 2: Acid-Base Accounting plot](image)

### 2.2 Net Acid Generation Test (NAG)

The single addition NAG test involves oxidation of a 2.5 g subsample by 250 mL of 15% hydrogen peroxide, measurement of final pH and back-titration to pH 4.5 and 7.0 for determination of acid production capacity of the waste rock sample (Smart et al., 2002). It provides a mechanism to measure the combined mobilisation of acid potential from oxidation of sulfides and of neutralising potential from easily soluble minerals (Rousseau, 2012). A NAG test
is not suitable for waste rock samples that contain more than 5% organic matter content or greater than 1% total sulfur (Smart et al., 2002).

All waste rock samples analysed as part of this study have a total carbon content of less than 0.3% and total sulfur less than 0.044%. Therefore, the results of NAG testing on these samples are considered valid.

A final NAG pH value of less than 4.5 is considered to be indicative of long-term acid production potential of a waste rock sample. Eleven of the 53 waste rock samples analysed had a NAG pH of less than 4.5. NAG pH ranged from 2.9 to 7.0 in all waste rock samples with a median value of 4.9. NAG testing can be a very useful test, but it cannot be used unaccompanied by other tests (Price, 2009; Morin and Hutt, 2001). The AMIRA ARD test handbook (Smart et al., 2002) recommends using NAG pH along with NAPP for geochemical classification of waste rocks.

Waste rock samples are classified into the following categories:

- **Non-acid forming (NAF):** Any waste rock material that has a negative NAPP and a NAG pH of more than 4.5 is considered NAF. Materials classified as NAF are unlikely to be a source of acidic drainage.
- **Potentially acid forming (PAF):** Waste rock samples with positive NAPP and a NAG pH of less than 4.5 are considered PAF. There is a risk of generation of acidic drainage from these materials.
- **Uncertain (UC):** The uncertain classification is used when there is a conflict between NAPP and NAG results.

Figure 3 shows the format of the classification based on NAPP and NAG pH. The vast majority of waste rock samples (39 out of 53 or 73.5%) analysed from Spring Hill have been classified as NAF. Only two samples have been classified as PAF whereas 12 samples have been deemed uncertain. Eleven of the waste rock samples classified as uncertain have a negative NAPP but a NAG pH of less than 4.5. Total sulfur content in all these samples is below the detection limit of the LECO method. Therefore, it can be concluded that acidity in these samples is not due to pyrite oxidation.

Overall, the potential for acidic drainage generation from shafts backfilled with economically unviable waste rock and mullock is considered negligible.
3. Potential for generation of metalliferous drainage

3.1 Trace metal content of the waste rock

Total recoverable metals

Total recoverable content of a number of trace elements was determined by completely digesting a pulverised subsample of the waste rock in a strongly acidic solution and then analysing an aliquot for trace metal content using ICP-OES. Results of this analysis are summarised in Table 1. Boron, beryllium, cadmium and mercury content in the waste rock samples were mostly below detection limits and there is no risk of their leaching out from the waste rock. In order to determine the relative enrichment of other elements in the waste rock samples, further analysis using the geochemical abundance index (GAI) was undertaken.

Table 1: Statistical summary of trace metals in waste rock samples

<table>
<thead>
<tr>
<th>ELEMENT</th>
<th>MINIMUM (mg/kg)</th>
<th>MAXIMUM (mg/kg)</th>
<th>MEDIAN (mg/kg)</th>
<th>NUMBER OF SAMPLES ABOVE DETECTION LIMIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arsenic (As)</td>
<td>13</td>
<td>340</td>
<td>42</td>
<td>53</td>
</tr>
<tr>
<td>ELEMENT</td>
<td>MINIMUM (mg/kg)</td>
<td>MAXIMUM (mg/kg)</td>
<td>MEDIAN (mg/kg)</td>
<td>NUMBER OF SAMPLES ABOVE DETECTION LIMIT</td>
</tr>
<tr>
<td>------------</td>
<td>----------------</td>
<td>----------------</td>
<td>---------------</td>
<td>----------------------------------------</td>
</tr>
<tr>
<td>Boron (B)</td>
<td>&lt;5</td>
<td>&lt;5</td>
<td>&lt;5</td>
<td>0</td>
</tr>
<tr>
<td>Beryllium (Be)</td>
<td>&lt;0.5</td>
<td>1.3</td>
<td>&lt;0.5</td>
<td>17</td>
</tr>
<tr>
<td>Cadmium (Cd)</td>
<td>&lt;0.3</td>
<td>0.6</td>
<td>&lt;0.3</td>
<td>8</td>
</tr>
<tr>
<td>Cobalt (Co)</td>
<td>0.6</td>
<td>58</td>
<td>7.2</td>
<td>53</td>
</tr>
<tr>
<td>Chromium (Cr)</td>
<td>3.4</td>
<td>300</td>
<td>11</td>
<td>53</td>
</tr>
<tr>
<td>Copper (Cu)</td>
<td>3.2</td>
<td>99</td>
<td>16</td>
<td>53</td>
</tr>
<tr>
<td>Manganese (Mn)</td>
<td>4</td>
<td>9800</td>
<td>380</td>
<td>53</td>
</tr>
<tr>
<td>Nickel (Ni)</td>
<td>0.8</td>
<td>59</td>
<td>6</td>
<td>53</td>
</tr>
<tr>
<td>Lead (Pb)</td>
<td>3</td>
<td>19</td>
<td>6</td>
<td>53</td>
</tr>
<tr>
<td>Zinc (Zn)</td>
<td>3</td>
<td>50</td>
<td>12</td>
<td>53</td>
</tr>
<tr>
<td>Vanadium (V)</td>
<td>2.5</td>
<td>41</td>
<td>6.7</td>
<td>53</td>
</tr>
<tr>
<td>Mercury (Hg)</td>
<td>&lt;0.05</td>
<td>&lt;0.05</td>
<td>&lt;0.05</td>
<td>0</td>
</tr>
</tbody>
</table>

**Geochemical Abundance Index (GAI)**

GAI for trace metal concentrations can be used to estimate their enrichment in the waste rock sample relative to average crustal concentration. GAI is expressed on a log 2 scale. A GAI of 0 indicates the element is present at a concentration similar to, or less than average soil abundance. A GAI of 3 corresponds to a 12-fold enrichment above the average soil abundance and this is taken as a threshold for predicting potential metalliferous drainage from the waste rock material.

The GAI was developed by Förstner et al. (1993), and is defined as:

\[
GAI = \log_2\left[\frac{C}{1.5 \times B}\right]
\]

Where:

- \( C \) = measured content of element in the sample
- \( B \) = average global soil content of the element in the sample

The average global soil content or average crustal abundance of metals is based on Bowen (1979) and Berkman (1976). Apart from arsenic no other trace metal was found to be enriched with respect to the median soil content. A high concentration of arsenic does not necessarily imply that it will mobilise into the environment, but it needs to be further investigated. In this instance, static leachate analysis was carried out on the waste rock samples to quantify the risk of arsenic leaching.
Table 2: Average crustal abundance for trace metals

<table>
<thead>
<tr>
<th>TRACE ELEMENTS</th>
<th>MEDIAN SOIL CONTENT (SOURCE: BOWEN, 1979; BERKMAN, 1976)</th>
<th>NUMBER OF SAMPLES WITH A GAI &gt;3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arsenic, As</td>
<td>1.8 mg/kg</td>
<td>5</td>
</tr>
<tr>
<td>Cobalt, Co</td>
<td>25 mg/kg</td>
<td>0</td>
</tr>
<tr>
<td>Chromium, Cr</td>
<td>102 mg/kg</td>
<td>0</td>
</tr>
<tr>
<td>Copper, Cu</td>
<td>60 mg/kg</td>
<td>0</td>
</tr>
<tr>
<td>Manganese, Mn</td>
<td>950 mg/kg</td>
<td>0</td>
</tr>
<tr>
<td>Nickel, Ni</td>
<td>84 mg/kg</td>
<td>0</td>
</tr>
<tr>
<td>Lead, Pb</td>
<td>14 mg/kg</td>
<td>0</td>
</tr>
<tr>
<td>Zinc, Zn</td>
<td>70 mg/kg</td>
<td>0</td>
</tr>
<tr>
<td>Vanadium, V</td>
<td>120 mg/kg</td>
<td>0</td>
</tr>
</tbody>
</table>

3.2 Australian Standard Leaching Procedure

Although potential for acid generation is often considered the principal characterisation parameter of waste rock samples, leachable metals are also a potential source of toxicity in metal mine waste drainage. The Australian Standard Leaching Procedure (ASLP) simulates leaching of waste rock using deionised water. The ASLP is specifically suitable for assessment of leaching from waste rock material that is proposed to be either left in-situ, spread over a site and capped or disposed of in a mono cell as in these instances it allows for the use of a reagent water for the leaching medium.

Only three out of 53 waste rock samples had detectible arsenic concentration (>0.005mg/L) in the ASLP leachate extract (pH 5). The highest concentration of arsenic in ASLP leachate extract was 0.011mg/L. This concentration is lower than the ANZECC aquatic ecosystem protection trigger value for 95% species protection (0.013mg/L as As (V)). The concentration in runoff from backfilled waste rock is expected to be much lower than the ASLP leachate extract due to significantly higher dilution ration achieved. Therefore the risk of leaching of arsenic is considered to be very low.
Conclusion

Based on a number of standard laboratory analyses carried out on 53 representative waste rock samples, the following conclusions have been derived:

- There is no risk of acidic or saline drainage from inherent acidity of the waste rock material proposed to be backfilled into historic shafts. This is based on the results obtained from paste pH and paste EC tests.

- There is practically no risk of acid generation from the waste rock material that is proposed to be backfilled into stopes at site. This is based on the results of ABA and NAG tests which indicated that only two out of 53 waste rock samples are capable of producing acidic drainage and that a vast majority of waste rock samples (73.5%) are acid consuming.

- There is no risk of metalliferous drainage due to enrichment of trace metals in the waste rock samples. Comparison of total trace element concentrations to the median soil content indicates an enrichment of arsenic. However, leachate testing on the waste rock samples indicate no risk of leaching of arsenic into the waters coming in contact with the waste rock.

Backfilling the economically unviable waste material to the stopes on site poses no geochemical risk of environmental harm.
References


Appendix summary

Appendix A  Maps
Appendix B  Waste Rock Sample List
Appendix C  Laboratory Analysis Results
Appendix A

Maps