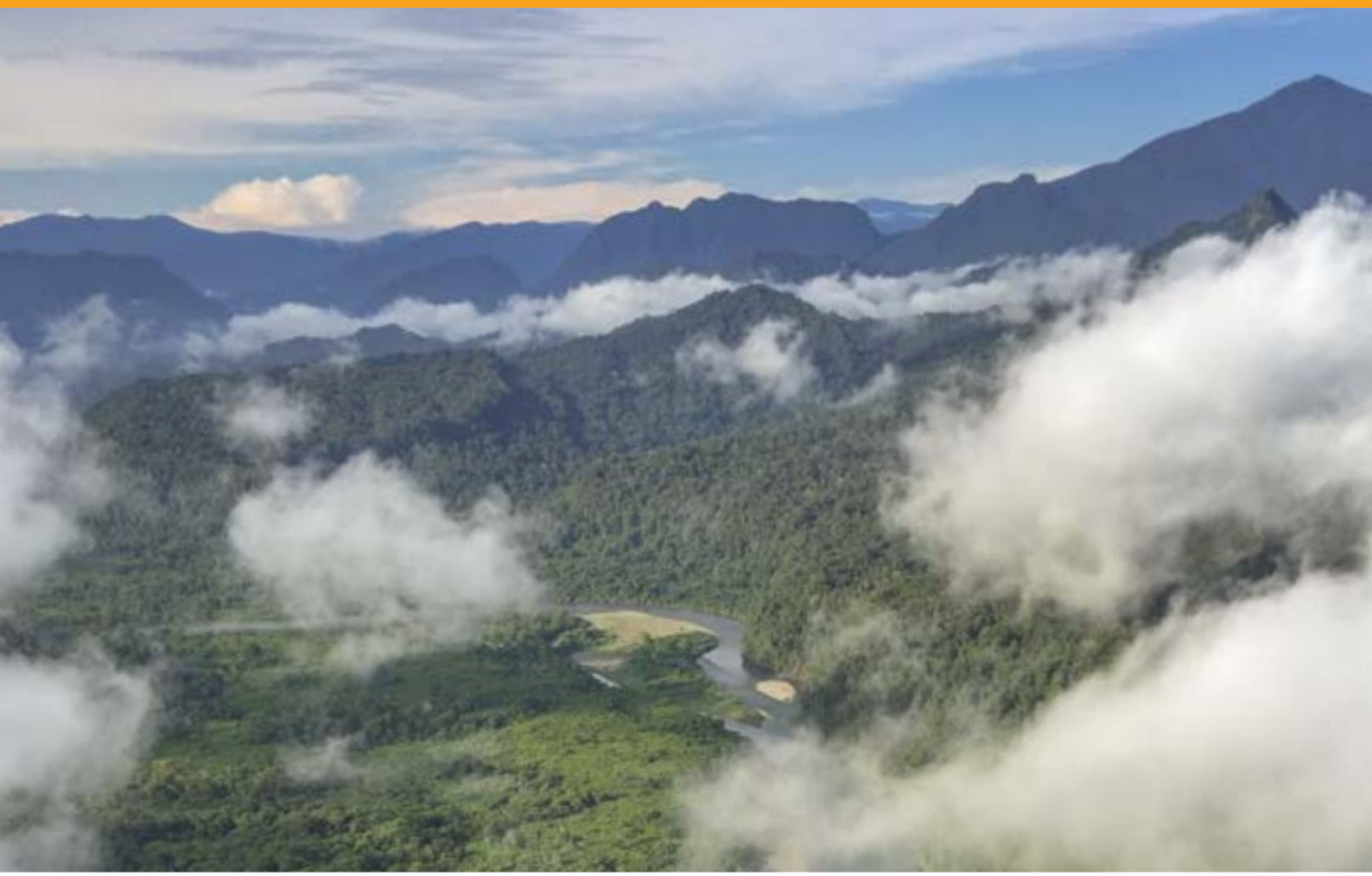
FRIEDA RIVER

Frieda River Limited
Sepik Development Project
Environmental Impact Statement

Attachment 2a – Frieda River Copper-Gold Project Environmental Management and Monitoring Plan

SDP-6-G-00-01-T-003-003



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Frieda River Limited

Frieda River Copper-Gold Project

Environmental Management and Monitoring Plan

Construction

Environmental Management and Monitoring Plan
Frieda River Copper-Gold Project
Construction

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1. Introduction

Coffey has prepared this Environmental Management and Monitoring Plan (EMMP) on behalf of Frieda River Limited (FRL) to set out the environmental management, monitoring, auditing and reporting program that will be implemented by FRL in managing environmental impacts during the construction phase of the Frieda River Copper Gold Project (FRCGP).

A subsequent EMMP will be prepared addressing the operations phase of the FRCGP.

1.1 Project overview

1.1.1 Background

FRL is proposing to develop the Sepik Development Project, located in the Sandaun and East Sepik provinces, comprising of four interdependent components (Figure 1-2):

- Frieda River Copper-Gold Project (FRCGP).
- Frieda River Hydroelectric Project (FRHEP).
- Sepik Infrastructure Project (SIP).
- Sepik Power Grid Project (SPGP).

This EMMP only covers the management and monitoring during the construction phase of the FRCGP. A subsequent EMMP addressing the operation phase of the FRCGP will be prepared and submitted to CEPA no less than six months prior to commissioning. The EMMP takes into account the commitments made in this EIS, which will be updated to incorporate the relevant conditions of the environment permit, once granted.

Construction and operation activities associated with the FRHEP, SIP and SPGP are covered in separate EMMPs.

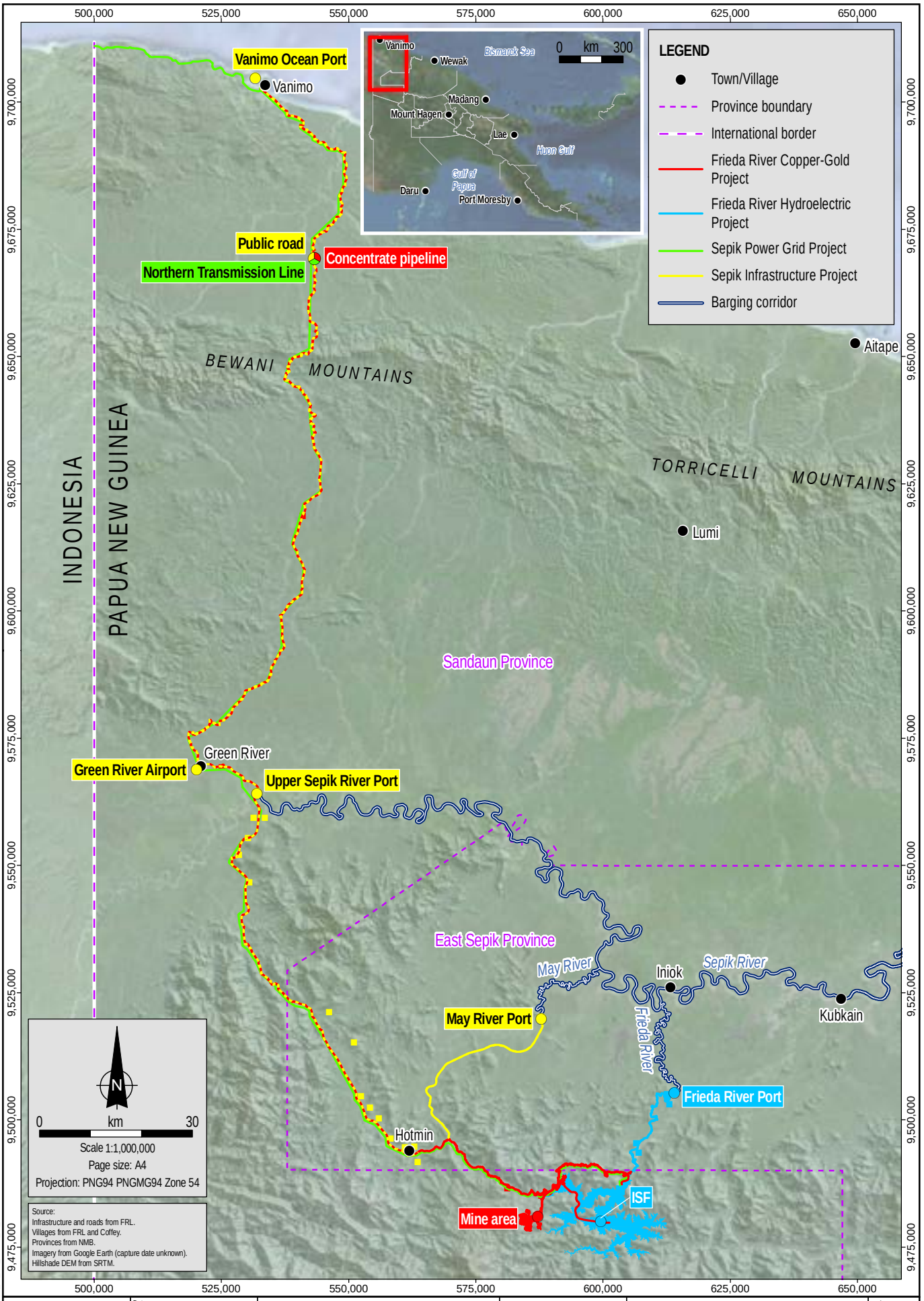
The FRCGP is located in the northern foothills of the New Guinea Highlands (Central Range) in Sandaun Province, with key infrastructure including the concentrate pipeline located in the East Sepik Province (Figure 1-1). It lies in a remote area approximately 200 kilometres (km) from the northern coast and 50 km from the Sepik River. The pronounced topographic expression and equatorial climate have resulted in a deeply incised land surface. Annual rainfall exceeds 8,000 millimetres (mm).

The FRCGP is based on the Horse-Ivaal-Trukai, Ekwai and Koki (HITEK) porphyry copper-gold deposits which contain an estimated total combined Measured, Indicated and Inferred Mineral Resource (JORC classifications) of over 2.6 billion tonnes at an average grade of 0.44 percent (%) copper and 0.23 grams per tonne gold. Copper mineralisation was first identified at Frieda River in 1966/67 and the long history of exploration and study activities undertaken by several companies has resulted in an extensive database.

The FRCGP comprises a large-scale open-pit operation feeding ore to a comminution and flotation process plant producing a copper-gold concentrate for export to custom smelters. Mining inventory comprises 1,492 Mt of mill feed. The average annual metal in concentrate production will be

175,000 tonnes (t) of copper and 230,000 ounces (oz.) of gold. The project will have a mine life of approximately 33 years preceded by a seven-year implementation period. The large HITEK porphyry copper-gold deposits together with additional known deposits and exploration targets provide the potential for mine life extension. Figure 1-3 shows the general project layout around the open-pit and supporting infrastructure. The mine site will be accessed via a new 39-km road from Hotmin. A new road from Hotmin to Green River will connect the existing road to Vanimo, which will be constructed as part of the SIP. The majority of the workforce will access the site from the upgraded airport at Green River as part of the SIP, which will be linked to the mine site by road.

The copper-gold concentrate will be transported from the process plant via a buried 325 km-long concentrate pipeline to the Vanimo Ocean Port where it will be dewatered, stored and loaded to ocean-going vessels for shipment to overseas markets (see Figure 1-1).

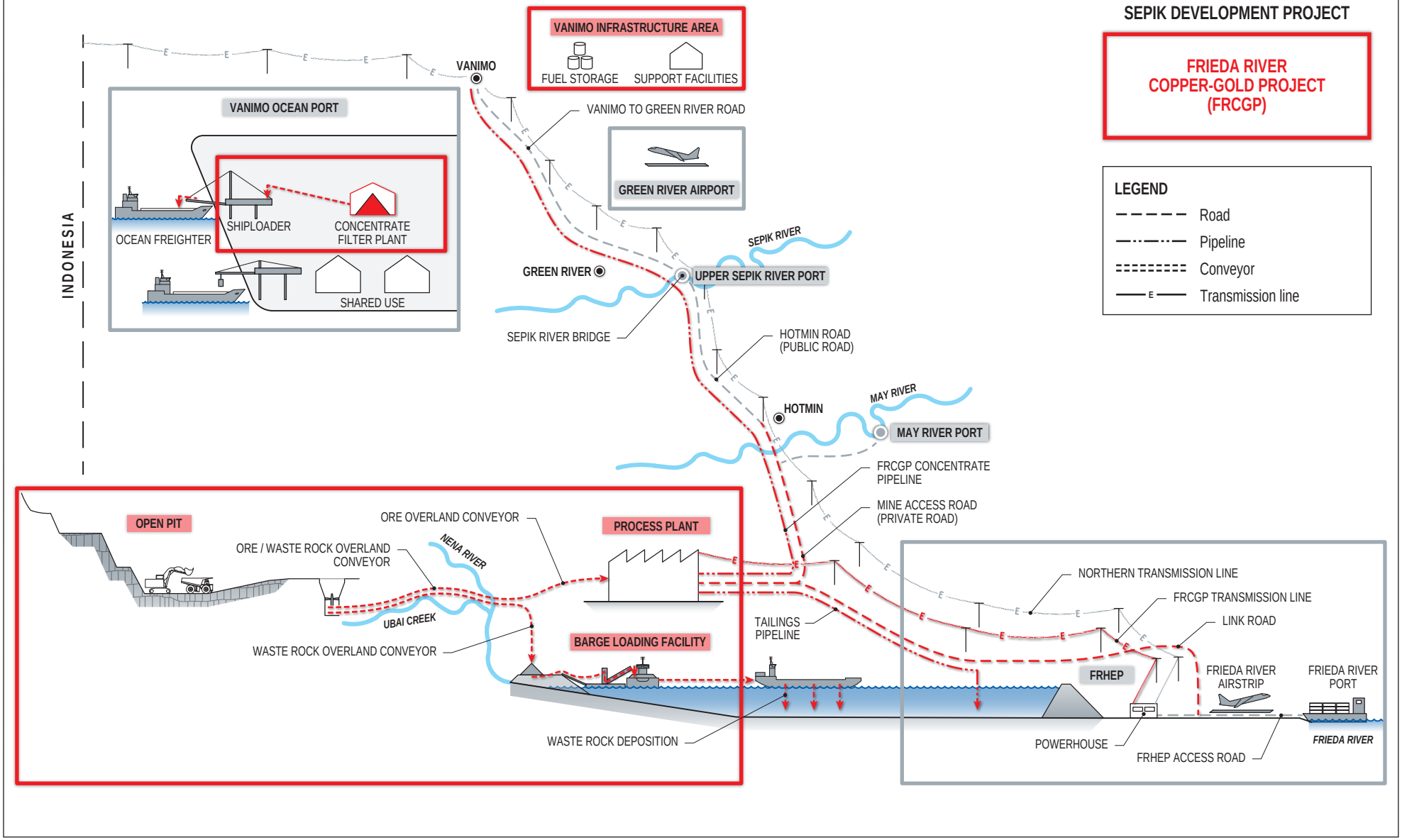


MXD Reference: 11575B_11_BM_GIS001_v0_13

coffey A TETRA TECH COMPANY	Date: 07.09.2018 Project: 754-ENAUABTF11575B File Name: 11575_22-1_F01-01_GIS	Frieda River Limited Sepik Development Project	FRIEDA RIVER	Sepik Development Project location	Figure No: 1-1

SEPIK DEVELOPMENT PROJECT

FRIEDA RIVER
COPPER-GOLD PROJECT
(FRCGP)



LEGEND

- Road
- Pipeline
- Conveyor
- Transmission line

Source: Adapted from Frieda River Project Battery Limit Diagram, FRP-2-A-00-01-T-028-001.dwg, FRL

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Project: 754-ENAUABTF11575B
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Frieda River Limited

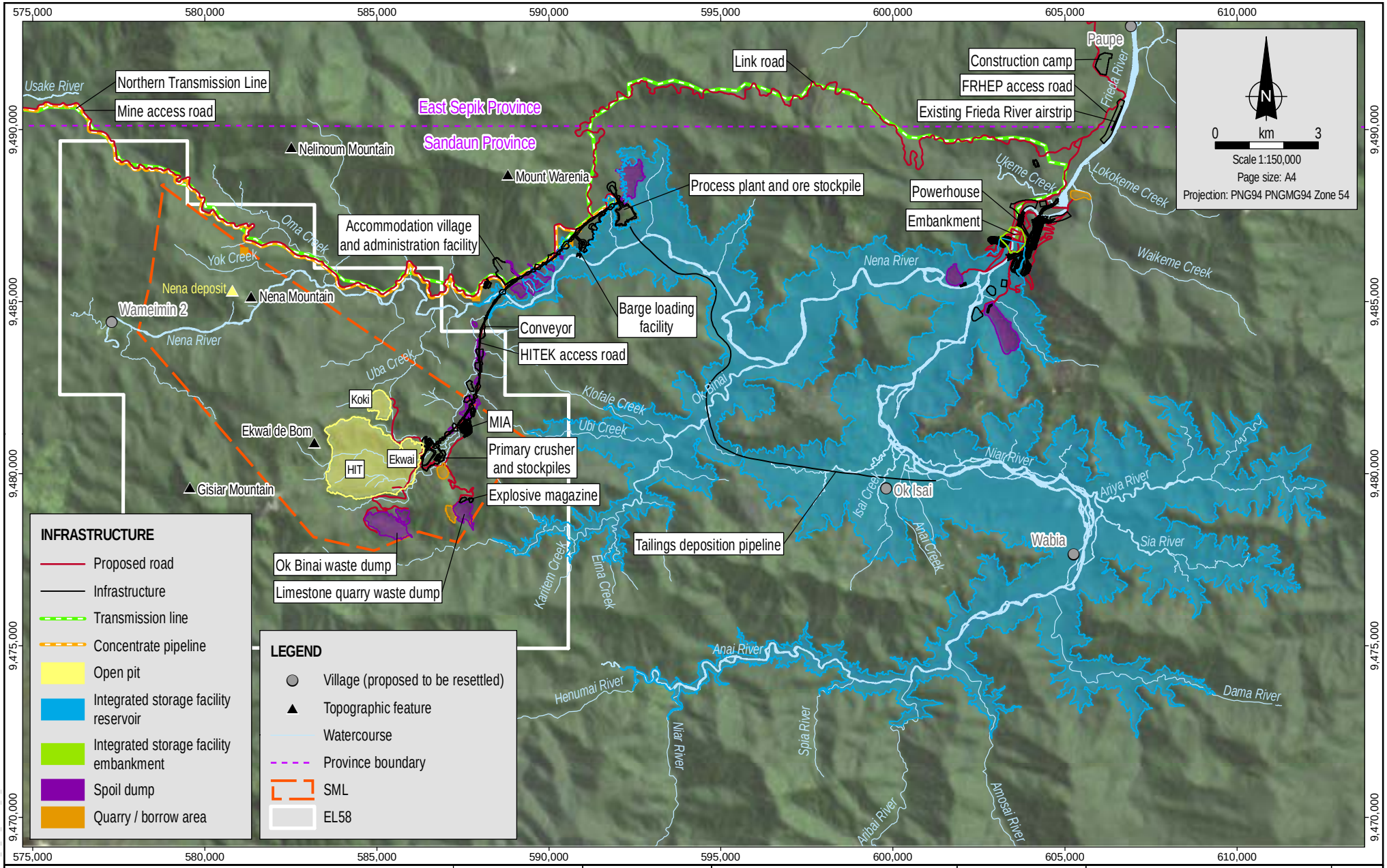
Sepik Development Project

FRIEDA RIVER

Components of the Sepik Development Project assessed in EIS

Figure No: 1-2

AI Reference: 11575_22_GRA001.ai_5



Source:
Infrastructure, roads and tenements from FRL.
Villages, topographic features, watercourses and water bodies from FRL and Coffey.
Provinces from NMB.
Landsat satellite imagery from FRL (capture date unknown).
Hillshade DEM from SRTM.

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Frieda River Limited

Sepik Development Project

FRIEDA RIVER

Mine and ISF area

Figure No: 1-3

MXD Reference: 11575B_11_BM_GIS002_v0_11

Over the life of the mine approximately 2.9 billion tonnes (Bt) of mine waste will be produced; approximately 50% as tailings and 50% as waste rock. To limit the potential for this material to generate acid and metalliferous drainage, best practice waste management will include subaqueous deposition of the mine waste rock and tailings in an engineered integrated storage facility (ISF) located in the Frieda River Valley downstream of the mine site (see Figure 1-3). The ISF will have a capacity of 10.8 billion cubic metres (Bm^3), with a maximum waste rock and tailings storage capacity of 3.5 Bm^3 (approximately 4.9 Bt), providing a surplus capacity of 2 Bt. The construction of the ISF embankment is covered by a separate EMMP and is not discussed within this EMMP.

Power during construction will be provided by diesel generators located at major infrastructure locations including the open-pit, mine infrastructure area (MIA) and process plant. Power supply to the mine during operation will be via a 22-km, 132 kV transmission line from the hydroelectric powerhouse to the process plant. Power supply to the offsite facilities will be provided by the Northern Transmission Line as part of the SPGP (see Figure 1-2).

1.1.2 FRCGP activity

The FRCGP components are spread across the Sandaun and East Sepik provinces. The mine area and process plant are located within the Sepik River catchment, in Sandaun Province. A concentrate pipeline will transport the copper-gold concentrate from the process plant along the infrastructure corridor to a concentrate dewatering, storage and export facility located at Vanimo Ocean Port.

The construction phase of the project will comprise the following activities and infrastructure developments:

- Mine area – includes the open-pit, process plant, power generation facilities, access roads, site accommodation village and other ancillary infrastructure (see Figure 1-3).
- Concentrate pipeline – a buried 325-km-long pipeline providing transport of concentrate to the Vanimo Ocean Port.
- Concentrate export facility – located at Vanimo Ocean Port where concentrate will be dewatered, stored and loaded to ocean-going vessels for shipment to overseas markets.

During construction, freight will be imported via existing ports at Wewak, Lae and Madang and barged upstream along the Sepik River to the Frieda River Port (part of the FRHEP) or May River Port until upgrade of the Vanimo to Green River Road has been completed (part of the SIP). Freight will then be trucked from Vanimo to Green River and barged from the Upper Sepik River Port downstream along the Sepik River. Once the main access road from Green River to the mine is complete all freight will be trucked to site.

1.2 Rationale for environmental management and monitoring plan

1.2.1 Regulatory requirement

Section 53 of the *Environment Act 2000* (the Environment Act), requires that an Environmental Impact Statement (EIS) is submitted to the Conservation and Environment Protection Authority (CEPA) to gain an environment permit to construct and operate the project. FRL plans to lodge the

EIS with the CEPA in Quarter 4 2018. The Environment (Amendment) Act 2014 includes amendments to the Environment Act, some of which relate to changes to the environmental impact assessment process, however Part 1 of this act is not yet in operation.

Certain conditions for the granting and setting of conditions of permits are provided in sections 65, 66 and 67 of the Environment Act. The preparation and implementation of an environmental management program is required under Section 66 (1), Condition 4 of the Environment Act. This EMMP has been prepared to comply with the requirements of the Environment Act and set out the environmental management program that will be implemented by the proponent in managing environmental impacts during the construction phase of the FRCGP.

Issue-specific management sub-plans describe the environmental objectives and management measures that will be implemented to mitigate impacts that may occur. These sub-plans are described in Section 1.3.

Two operational sub plans (Water Management Subplan and Acid and Metalliferous Drainage, Waste Rock and Tailings Management Subplan) are included in this EMMP as the implementation of the management measures they contain are fundamental to the outcomes of the environmental impact assessment. These sub plans provide the measures to manage potential environmental and social impacts associated with acid and metalliferous drainage and waste rock and tailings.

A subsequent EMMP will be prepared addressing the operations phase of the FRCGP.

1.2.2 Purpose

The objectives of this EMMP are to outline the management and monitoring activities that will be implemented during the construction phase of the FRCGP, and describe the proposed organisational structure under which these activities will be carried out. The EMMP aims to:

- Document the more general aspects of FRL's approach to environmental management, such as the schedule for environmental management, and organisational structure and responsibilities.
- Describe how environmental and social impacts will be addressed for the FRCGP. FRL's management measures will be based on a hierarchical approach prioritising avoidance of the impact, and mitigation where avoidance is not possible.
- Outline the proposed environmental and socio-economic management for the project to ensure a framework is in place to achieve the project's environmental and socio-economic objectives. This framework will:
    - Validate and monitor impact predictions made in the EIS.
    - Identify unforeseen effects and the need for additional management, mitigation or remedial measures.
- Document auditable commitments made by FRL for reference in future internal and external audits.
- Ensure project construction activities comply with environment permit conditions.
- Provide guidance to on-site staff.

Standard operating procedures to be followed in the day-to-day management of project construction activities will be developed by FRL staff and its contractors. These will set out the roles and responsibilities for FRL staff and contractors, and will be designed to achieve the commitments set out in this EMMP. Furthermore, service agreements for contractors will include environmental and social responsibilities.

1.3 Structure of this EMMP

This EMMP has been prepared with two main components: introduction and context; and management sub-plans. These are described below.

1.3.1 Introduction and Context

This is the main body of the EMMP. The format of the EMMP is:

- Section 1 (this section) – Introduction: FRCGP overview and an outline of the objectives of the EMMP.
- Section 2 – Regulatory framework: outline of the regulatory framework for environmental and socio-economic management for the project.
- Section 3 – Existing environment: description of the existing environment.
- Section 4 – Construction activities: Description of planned construction activities.
- Section 5 – Environmental management framework: description of the environmental management system framework for the project.
- Section 6 – Environmental monitoring: outline of the environmental monitoring program (further detail on monitoring is provided in each individual management sub-plan).
- Section 7 – References.

1.3.2 Management sub-plans

The management sub-plans describe the environmental objectives and management measures that will be implemented to mitigate impacts as identified in the EIS that may occur during construction activities. The following management sub-plans are included in this EMMP (listed in order of arrangement):

1. Acid and Metalliferous Drainage, Waste Rock and Tailings Management Sub-plan.
2. Air Quality, Noise and Vibration Management Sub-plan.
3. Biodiversity Management Sub-plan.
4. Cultural Heritage Management Sub-plan.
5. Emergency Response and Fire Management Sub-plan.
6. Erosion, Sediment and Soils Management Sub-plan.
7. Hazardous Materials, Fuel Handling and Spill Response Management Sub-plan.
8. Rehabilitation Management Sub-plan.
9. Traffic and Transport Management Sub-plan.
10. Waste Management Sub-plan.
11. Water Management Sub-plan.

12. Weed, Pest and Quarantine Management Sub-plan.

The layout of each of the management sub-plans includes:

- Definition of the element/issue that is being addressed.
- Brief background to the sub-plan.
- Objectives for environmental management for the particular aspect.
- Nominated responsible person(s) for undertaking specific tasks/ actions.
- Outline of the procedures to be undertaken to meet the objectives.
- Details of any reporting requirements of the tasks/ actions and the responsible parties.
- Monitoring to determine the success (or otherwise) of the management measures and compliance (or otherwise) with permit conditions.

2. Regulatory framework

2.1 Statutory context

The environmental and socio-economic aspects of the FRCGP are regulated primarily by the Environment Act. CEPA is the government agency responsible for administering the Environment Act. *The Environment (Amendment) Act 2014* documents amendments to the Environment Act, including some changes to the environmental impact assessment (EIA) process, however Part 1 of this act is not yet in operation. The following sections describe the EIA process for the FRCGP.

Under the Environment Act, the preparation of an EIA is a three-step process involving:

- Registration of intention to undertake preparatory work on Level 2 and Level 3 activities (Section 48 of the Act).
- Submission of an EIR (Section 52 of the Act).
- Submission of an EIS (Section 53 of the Act).

The FRCGP is a Level 3 activity under the *Environment (Prescribed Activities) Regulation 2002*, for which an EIS is required to be submitted to CEPA. FRL is in the process of obtaining all approvals and permits required for the commencement of construction for the project. This includes submission of an environment inception report (EIR) on 20 December 2017 and an EIS and an environment permit application to CEPA for a Level 3 activity in Quarter 4 2018.

This EMMP has been prepared to cater for the conditions outlined in Section 66 (1) of the Act and covers the full construction activities of the project (as outlined in Section 4).

2.2 National legislation

Other relevant PNG national legislation and regulations associated with the environmental aspects of the project include:

- *Conservation and Environment Protection Authority Act 2014.*
- *Conservation Areas Act 1978 (Chapter 362).*
- *Fauna (Protection and Control) Act 1966* (Chapter 154).
- *International Trade (Fauna and Flora) Act 1979* (Chapter 391).
- *National Cultural Property (Preservation) Act 1965 (Chapter 156).*
- *Marine Pollution Act 2013 (including Ships and Installations Regulations Act 2013, Liability and Cost Recovery Act 2013, Ballast Water Control Act 2013, Sea Dumping Act 2013, Preparedness and Response Act 2013).*
- *Mine (Safety) Act 1977 (Division 5).*
- *Environment (Council's Procedure) Regulation 2002.*
- *Environment (Permits) Regulation 2002.*
- *Environment (Prescribed Activities) Regulation 2002.*
- *Environment (Water Quality Criteria) Regulation 2002.*
- *Environment (Fees and Charges) Regulation 2002.*
- *Public Health (Drinking Water) Regulation 1984.*

Other PNG legislation and regulations will be relevant to varying degrees. The most pertinent of these more general acts, regulations and bills cover commercial, professional, land ownership and health issues, and include:

- *Explosives Act 1953.*
- *Fire Service Act 1962 and Fire Service Regulation 1966.*
- *Industrial Safety, Health and Welfare Act 1961 and Industrial Safety, Health and Welfare Regulation 1965.*
- *Inflammable Liquid Act 1953 and Inflammable Liquid Regulations 1968.*
- *Plant Disease Control Act 1953.*
- *Plant Disease and Control Regulation 1956.*
- *Quarantine Regulation 1956.*
- *Land Act 1996.*
- *Roads Maintenance Act 1971.*

During planning of the project other applicable legislation will be determined in consultation with the relevant authorities.

3. Existing environment

3.1 Physical and biological setting

This section provides an overview of the biophysical setting of the FRCGP as context for the individual management sub-plans in the EMMP. This section is based on information provided in the EIS and supporting documents.

3.1.1 Climate

The climate of the region is dominated by two main seasons. The northwest monsoon (wet) season occurs annually between November and April (the austral summer), when north-westerly winds bring in low-pressure troughs that result in heavy rainfall. The southeast monsoon (dry) season occurs annually between May and October (the austral winter) and is characterised by south-easterly trade winds.

The average annual rainfall in the mine area is between 7,700 mm and 8,600 mm, with the average daily rainfall approximately 23 mm. The average annual temperature in the mine area is 22.9°Celsius (C).

The infrastructure corridor, which the concentrate export pipeline will run through, spans over 325 km, intersecting a range of landforms and elevations. Site specific meteorological data is limited and has been inferred from climatic patterns in the mine area, on the Sepik River (i.e., Iniok and Moruapie) and Vanimo.

The hill zones of the infrastructure corridor, including the northern slopes of the Central Range and the Bewani Mountains, are predicted to have higher rainfall than the lowland zone of the Sepik River floodplain and the coastal plain between the Bewani Mountains and the northern coast. The Sepik River floodplain receives approximately 4,000 mm per year and the northern coast approximately 2,500 mm per year.

Temperatures show an inverse pattern with elevation, i.e., generally increasing with decreasing elevation. As such, temperatures are generally higher in the lowland zone of the Sepik River floodplain and northern coast compared to the hill zones of the central and the northern coastal range by up to 3°C throughout the year (based on climatic patterns in the mine area and Vanimo).

The other significant difference between the hill and lowland zones along the infrastructure corridor is that the lowland zone experiences a more pronounced dry period from May to October.

3.1.2 Regional tectonic setting and seismicity

PNG is bounded by several major tectonic plates and is one of the most seismically active regions in the world (SKM, 2008). The high level of seismic activity is a result of ongoing crustal deformation from collision of the Pacific and Australian tectonic plates initiated 34 to 55 million years ago. The FRCGP is located on the northern portion of the Indo-Australian Plate, while the Vanimo Ocean Port is located on the South Bismarck Plate. The Indo-Australian Plate is moving in a north-easterly

direction at approximately 11 centimetres (cm) per year and is colliding with the south-westerly-moving Pacific Plate, which lies to the north and east of the Indo-Australian Plate (Bechtel, 2010).

Due to the high degree of seismic activity in the region, PNG is subject to earthquakes, volcanos and tsunamis. A total of 12 earthquakes with a magnitude of 7.0 on the Richter scale or greater occurring in PNG since 1998 (USGS National Earthquake Information Centre, 2018). Between 2010 and 2017, there were five earthquakes with magnitudes greater than 6.0 (Richter scale) within a 200-km radius of the mine area and infrastructure corridor. Five volcanoes are located east of Vanimo (three are active, and two are inactive). The closest active volcano to the concentrate export facility is located offshore in the Bismarck Sea approximately 320 km east of Vanimo. Since 1768, 182 tsunamis have been recorded for the PNG region, 120 of which have had wave heights recorded. The average recorded wave height is 3.1 metres (m), with the maximum being 15 m at Arop, approximately 30 km northwest of Aitape in 1998 (NOAA, 2011). In 1970, an earthquake with a magnitude of 7.0 generated a 3-m-high tsunami along the coastline north of Madang and, on 17 July 1998, a series of tsunamis struck the north coast of PNG near Aitape and two near Vanimo; wave heights of approximately 8 m were estimated (NSR, 1999).

3.1.3 Landform, geology, and soils

3.1.3.1 Landform

Mountainous terrain dominates the landscape of the mine area. All of the HITEK deposits, and approximately one quarter of the concentrate pipeline sits within mountains and hills. These areas are of high relief (some areas greater than 100 m) with large ridges and straight slopes, which are irregularly cut by small streams and gullies.

Narrow alluvial floodplains with flanking terraces meander through the lower slopes of the mine area. These landforms are made up of unconsolidated sedimentary rocks from alluvial deposits containing recent detrital material from active depositional processes. These areas are subjected to periods of short flash flooding.

Mountains extend from Hotmin, north through the infrastructure corridor to within approximately 20 km south of Green River. Within this mountainous landscape, narrow tracts of depositional landforms weave between the mountains until the villages of Idam are reached. The infrastructure corridor traverses much of these alluvial landscapes on its way from Hotmin to Idam.

From the villages of Idam, through to Green River and travelling further north to the southern side of the Bewani Mountains (e.g., the Sepik River floodplains), composite alluvial plains dominate the landscape, with sections of back swamps also present. The drainage regime in this area can vary widely depending on the local conditions.

Within the Bewani Mountains, poor soil structure and steep terrain dominates the landscape. As the infrastructure corridor traverses the Bewani Mountains, a maximum elevation of approximately 700 m is reached before descending to approximately 150 m in the village of Sumumini, on the northern outskirts of the mountain range. From Sumumini to Vanimo, the terrain is gentler in relief,

with a mix of hilly terrain with weak or no structural control to composite alluvial flood plains stretching out towards the northern coastline near Vanimo.

3.1.3.2 Geology

The mine area is predominantly made up of mixed or undifferentiated metamorphics including diorites and andesites. The geology near the HITEK deposits are dominated by the older intrusive suite including Koki diorite, Frieda diorite porphyry, and Horse microdiorite (classified as Tmo units), and a younger intrusive suite including Flimtem trachyandesite and Knob diorite (classified as Tmy units). A deep weathering profile has developed through *in-situ* weathering of the underlying intrusive rock units. The weathering profile has been classified into three key types, including zones of total and partial oxidation and a gypsum-anhydrite transition zone (GpAh). Weathering within the ore body has been observed to extend to depths of 50 m.

The geology within the infrastructure corridor is dominated by alluvial geological formations made up of gravel, sand, silt, mud and clay.

3.1.3.3 Soil

The soils found in the mine area are mostly made up of Haplorthox soils. These are predominantly acid red to brown clay soils, which are poorly structured, highly erodible with low fertility. Smaller areas of Dystropepts and Troporthents soils also occur in the mine area (less the 10 % of the area). These soils are generally slowly permeable containing moderate organic matter.

Within the mountainous terrain between the mine area and Green River, along the upper and mid slopes, Tropofluvents and Troperthents soils are dominant. These soils are moderately erodible, moderately fertile and well drained. The lower slopes are typically made up of Dystropepts.

Within the infrastructure corridor from Green River to Vanimo, the soils largely reflect the landform type. Soils are a mosaic of Dystropepts, Fluvaquents and Tropofluvents along the lower slopes of the landscape. Dystropepts dominate the soils found along the eastern fringes of the Border Mountains. These soils give way to poorly draining Fluvaquents in the lower lying areas east of the Border Mountains, south of the Bewani Mountains.

Large sections of Rendolls are located in the northern section of the infrastructure corridor, just south of Vanimo. These soils have a shallow depth generally between 15 and 30 cm, which lie on calcareous parent rock, with low erodibility.

The probability of acid sulphate soil (ASS) occurring on the lowland zone is high, however, the origin of ASS is still uncertain. The majority of soil analyses shows that ASS is unlikely to be from a sulphide source, but more likely to be from acidic soils possibly of volcanic origin, with a lower potential to produce acid drainage. Soil samples indicating ASS were recorded as either dark brown or dark grey clay or gravelly clay. Given the shallow depth of samples used for investigations to date, it cannot be determined whether ASS of a sulphidic nature underlie those areas beneath the one metre depth limit of the Golder (2011) investigation. In terms of FRCGP components, only the infrastructure corridor coincides with high risk areas for ASS, which generally occur in low-lying floodplain areas.

3.1.4 Groundwater

The groundwater environment is divided into two areas:

- Mine area: comprising the open-pits, ISF, process plant and other ancillary infrastructure).
- Downstream area: comprising the Frieda and Sepik river floodplains below the confluence of the Nena and Frieda rivers, extending to the confluence with the Sepik River.

The minimum depth to groundwater in the mine area is greater than 70 m below ground level at ridgelines; greater than 40 m below ground level mid-slope; and, less than 10 m below ground level in the valleys.

The watertable is approximately coincident with the ground surface at watercourses, which are essentially surface expressions of the local groundwater flow system.

In the mine area, the Ekwai Creek groundwater system is expected to be a localised groundwater flow system. Less than 10 km separates recharge and discharge areas, there is a relatively small storage capacity, and the flow system responds relatively quickly to rainfall events and discharges to surface relatively quickly. The mine area surrounding the orebody is expected to have low permeability.

Groundwater levels in the downstream area are generally close to ground level. These groundwater systems are expected to be reasonably consistent with those occurring in the mine area, although it is possible that less-localised (i.e., intermediate) groundwater flow systems are active. Not all of the groundwater discharges as baseflow within the downstream study area catchments. The distance between recharge and discharge areas is typically 10 to 100 km and the storage capacities of the systems are likely to be larger than those of local groundwater flow systems.

In the lowlands, the groundwater flow systems are likely to range from intermediate to regional. The distances between recharge and discharge areas are typically greater than 100 km and the response time between these areas is long and storage capacities are very large.

In the mine area, active recharge (where surface water, including rainfall and rivers, is added to groundwater) is expected in the foothills of the downstream area, but the lowlands will be evaporative discharge zones, where groundwater is expressed at the surface and is subject to evaporation, particularly in swampy areas.

3.1.5 Terrestrial ecology

Vegetation in the Sepik River basin is varied and includes mangrove forest, herb swamps, tall lowland rainforest, cloud forest and alpine heaths. The region contains a high diversity of terrestrial fauna, in particular mammals and frogs, in comparison with other remote areas of the PNG highlands. As such, the Sepik River basin rates as a globally significant area of biodiversity, as demonstrated by the nomination and tentative listing of part of the basin as a world heritage area, and the establishment of the Hunstein Range Wildlife Management Area (WMA). Of the flora species recorded during field surveys, 16 IUCN red list flora taxa were documented (IUCN, 2011). Seventeen PNG Forest Inventory System (FIMS) vegetation communities were documented in the Terrestrial

Biodiversity Study Area. In addition, a new formation previously undocumented in PNG was recorded.

Sixty-eight fauna species of conservation significance occur and/or are likely to occur within the Sepik Development Project area. This includes, 20 mammals, 42 birds, 4 butterflies, 1 reptile and 1 dragon fly. Of these 68 species, 64 are IUCN red list species and 37 are protected under the PNG Fauna Act.

The presence of introduced and invasive species encountered during the surveys was directly correlated to human presence and infrastructure.

3.1.6 Aquatic ecology

The pH of upland creeks and rivers within the mine area is typically between pH 7 and 8, except for Ekwai Creek where pH ranges from pH 3.6 to 4.4. This acidity is attributed to the natural occurrence of acid and metalliferous drainage (AMD) at this location, which is the area of mineralisation where the open-pit will be developed. The pH of mid-catchment and lowland rivers is generally in the range of pH 7 to 8. The pH of Lake Warangai is highly variable but tends to be acidic, with pH ranging between 3.8 and 8.4 (median pH 6.3). Alkalinity measurements showed there to be a low to moderate amount of buffering capacity available in most of the sampled creeks and rivers.

The dominant major ions are calcium and carbonate, reflecting the influence of limestone within the catchment. Concentrations of metals in the mine area streams are generally low, except in Ekwai Creek where the occurrence of naturally occurring AMD has resulted in an elevation of dissolved metals. Turbidity and total suspended solids (TSS) levels are highly variable in mid-catchment and lowland rivers within the mine area and infrastructure corridor, but are generally quite low. Levels of TSS and turbidity in the Sepik River are higher and increase downstream.

The aquatic flora of the clear-water upland rivers and creeks is typically dominated by diatoms, periphyton and benthic algae, with larger submerged macrophytes being limited or absent. In the turbid rivers and streams, there is more limited aquatic flora and no macrophytes. Non-native species have also been observed throughout the lower catchment. Seventeen species of fish that have been reported in the Sepik River are of conservation significance due to being assessed as threatened or potentially threatened, or because they are endemic. A further 15 endemic species of fish have also been recorded that are either endemic to northern New Guinea or locally endemic to the Sepik-Ramu River system. Two New Guinea-endemic species of freshwater turtles are known to occur in the Sepik–Ramu River system, the frog-faced softshell turtle, *Pelochelys signifera*, and the spotted or New Guinea snapping turtle, *Elseya novaeguineae*. Two crocodiles, the freshwater *Crocodylus noveaguineae*, and the saltwater crocodile, *Crocodylus porosus*, occur in the Sepik River system. While neither species is listed as threatened by the IUCN, both are of local conservation significance.

3.1.7 Air quality and greenhouse gas emissions

The villages in the mine area and infrastructure corridor are remote from major industrial sources. Due to the high rainfall, low wind speeds and well-vegetated nature of the area, background

concentrations of pollutants such as sulphur dioxide, nitrogen oxides and suspended particulate matter, can be expected to be negligible. Minor elevations in particulate concentrations may occur around villages in the lowlands due to emissions from cooking fires.

The air quality in the villages adjacent to the Vanimo Ocean Port (Wesdeco and Cis Point) has not been monitored but is expected to be influenced by the proximity to Vanimo town. These sources include, vehicle emissions, port and airport operations, commercial/industry operations, power generation and domestic sources (e.g., rubbish and cooking fires and generators). Air emissions from nearby agricultural activity may also contribute to the local air quality.

3.1.8 Nearshore marine

The nearshore marine environment includes the nearshore marine and coastal areas surrounding the proposed Vanimo Ocean Port, including Lido Village, the inner harbour of Vanimo (known as Dakriro Bay), the area surrounding Cis Point, the shoreline near Wesdeco and the logging port, and the east shoreline close to the hospital, within Daumlinge Bay. These areas contain intertidal, tidal, shallow marine and reef zones.

Surface water quality of the marine environment is typical of marine waters, characterised by warm (approximately 30°C), alkaline (pH 8.2) waters and low concentrations of suspended sediments, nutrients and metals/metalloids.

Sediment is comprised mainly of unconsolidated sediments of sands and muds, with clays found in the middle of Dakriro Bay and on the coastal foreshore. During the characterisation study (BMT WBM, 2018) metal and metalloid concentrations were below Australian and New Zealand ISQGs described in ANZECC/ARMCANZ (2000) and updated in Simpson et al (2013), with the exception of nickel.

Marine habitats consist of sandy beaches, subtidal sands, fringing coral reefs, and seagrass meadows. Reefs throughout the nearshore marine environment appear to be heavily affected by anthropogenic activities, with stressors including thermal bleaching, sea-level rise, over-fishing, physical damage, rubbish and low water quality as a result of stormwater and deforestation.

Thirty-one IUCN red list aquatic fauna species may in the nearshore marine environment. These include 14 whales, 7 dolphins, 6 turtles, 2 clams, 1 dugong, and 1 shark.

3.2 Socio-economic setting

This section provides an overview of the socio-economic setting of the FRCGP area as recorded during surveys conducted in 2009 to 2011, 2015 and 2017.

3.2.1 Community layout and amenity

Villages visited in the mine area show a high degree of uniformity, many having a focal point around either a church or community ‘haus win’ (meeting place). The built environment in the mine area villages is typical of remote PNG villages. Houses are generally constructed using bush material, however, in Ok Isai and Wabia, elevated houses of sawn timber framing on steel posts with

corrugated iron roofs are present. The developments of housing amenities, particularly in Miyan communities, is noticeable, and includes the addition of windows with insect screening and the use of battery powered solar lights. Public infrastructure in the mine area is extremely limited.

Villages along the infrastructure corridor from Hotmin to Vanimo are sprawled out. Villages are very remote, particularly in the south of the corridor, yet as you move north, access to infrastructure and services increases, particularly between the northern foothills of the Bewani Mountains and Vanimo. Almost all houses (over 75 %) within the infrastructure corridor are semi-improved, i.e., built from a mix of bush materials and iron roofing.

The township of Vanimo is the capital of Sandaun Province. Housing density is higher in Vanimo compared with other parts of the FRCGP area with 2,370 households recorded in Vanimo Town in 2011. Residents of Vanimo also have better access to public infrastructure and basic amenities compared to other parts of the FRCGP area, such as a police station and general hospital.

3.2.2 Demography and population

The total population of the mine area communities at the end of 2017 was approximately 2,000 persons, with an annual growth of around 60 persons per year. The total population of the 13 villages surveyed within infrastructure corridor in 2017 was 4,904 persons. The population within the Vanimo/Green River District grew by 2.9 % between 2000 and 2011. The highest growth rate was observed in the Bewani/Wutung Onei Rural Local Level Government (LLG), the closest LLG to Vanimo. In 2011, the township of Vanimo had a population of 13,970.

3.2.3 Land and water resource use

Villages within the mine area and infrastructure corridor predominantly live a subsistence based lifestyle, relying on the land and natural water resources for growing crops, hunting and fishing. Villages along the northern section of the concentrate pipeline (within and near Vanimo) are less reliant on subsistence based lifestyles and participate more readily in the cash economy to meet their lifestyle needs.

Within the mine area, the most common crops grown are banana, corn and taro. Although excess agricultural products are sometimes sold for income, cash crops are uncommon in the area. Hunting occurs infrequently but is nonetheless an important supplementary source of protein. Hunting is undertaken largely by men and includes target prey such as wild pig, cassowary, bird, bandicoot, cuscus, possum and, in the more mountainous areas, tree kangaroo.

Within the infrastructure corridor, the most common crops grown are sago, banana, coconut and taro. Fishing in the Sepik River, and near Vanimo along the northern coastline, as well as hunting throughout the infrastructure corridor are important practices for sourcing dietary protein.

There is no large-scale cash cropping or logging land uses within the infrastructure corridor, however, logging operations have increased in the past 10 years. Rubber, once an important cash crop, has been substantially neglected in recent years.

For communities situated on the coastal plains of Vanimo, fishing is conducted for subsistence, selling at the local market and commercial purposes. Marine resources, such as invertebrates, are typically harvested daily.

3.2.4 Economy

The remoteness of the mine area and the ensuing lack of access to markets and services, or to retail or employment opportunities, has resulted in a predominantly subsistence, largely informal economic environment. Those who participated in formal employment worked mainly in:

- Education.
- Trades.
- Law enforcement.
- Health.
- Government administration.
- Transportation.
- FRCGP (those living in villages in the mine area).

Alluvial gold mining in the mine area villages is an important income generating activity, with an estimated 600 people engaged in alluvial mining, including 27 dredge operators and 128 dredge workers from Ok Isai and Wabia. Selling gold from alluvial mining generated income for 90 % of families within Ok Isai and Wabia.

Household expenses within the mine area are (classified from most to least expensive for households):

- School fees.
- Medical costs.
- Food.
- Clothes.
- Church donations, wantok gifts and bride price (in many cases these payments are made in increments and only when there was available cash).

Villages within the south of the infrastructure corridor are characterised by their remoteness and their low level of participation in the cash economy. Some villages have markets, but restricted access and high transport costs limit participation in the cash economy. The economy is more developed in the north of the infrastructure corridor, particularly near Vanimo and Aitape, where logging operations provide employment and royalty opportunities. In Vanimo, cash income is generated through work in forestry and oil palm plantations. Income is also gained through selling fresh food such as garden produce, fish, seafood and betel nut at market places in Vanimo town Centre, and the settlements of Wesdeco and Cis Point.

3.2.5 Health

Environmental health results, while differing markedly between villages, were linked to the degree of isolation and historical health service provision.

3.2.5.1 Mine area

In the mine area communities, a number of aid posts are present (Ok Isai, Paupe, Sokamin, Wabia and Wameimin 2) but none of these are fully functional and most lack trained aid post orderlies. Most villages do not have access to any government maternal health services and women deliver their children without medical assistance, relying on the FRL healthcare personnel in the case of serious complications. Many of the household survey respondents reported being ill in the month prior to the survey, and many were unable to receive treatment of any kind because of a lack of services. The most common illnesses experienced are reported to be diarrhoea and malaria, followed by respiratory problems and general aches and pains. Malaria was found to be hyperendemic in all of the surveyed communities. Alcohol consumption was largely restricted to adolescent and adult males in all of the communities. Anthropometric measurement data gave a profile of above average nutritional health in the mine area. Child malnutrition was low with little wasted (low weight-for-height ratio), stunted (low height-to-age ratio) or underweight children under five years of age.

3.2.5.2 Infrastructure corridor

Current health services within the infrastructure corridor are minimal, with inadequate equipment and resources to service the needs of the population. Of the 8 villages surveyed between Hotmin and Green River, two have an aid post (Green River and Idam 2), meaning some villages, such as Wokomo 1, are 24 hours away from the nearest aid post, and further from a hospital. Access to health services, particularly in the south is also made difficult by high transport costs and the lack of transport infrastructure. Villages north of the Bewani Mountains, have better access to health care services as they can access services in Vanimo including Vanimo General Hospital (1-hour travel time from Imbrinis).

The common illnesses experienced by people living in villages along the infrastructure corridor are similar to those in the mine area, and include, malaria, diarrhoea, upper respiratory tract infections, fever and skin and eye infections. Rates of admissions to health care facilities for malaria, malnutrition, anaemia, pneumonia other respiratory illnesses are high within the infrastructure corridor compared to many other parts of PNG.

Increases in substance abuse, including alcohol, within the infrastructure corridor has been reported by residents in villages in the north of the infrastructure corridor.

3.2.5.3 Vanimo

Health services in Vanimo are more prevalent compared to other parts of the mine area and include Vanimo General Hospital and Dapu Urban Clinic. These services often lack adequate supplies and labour.

The main illness experienced by people living within Vanimo is malaria (Coffey, 2017). Other illnesses such as fever and skin infections are also prevalent in the nearby settlement of Wesdeco.

3.2.6 Education

Education levels within the communities is low, with about 48% of the mine area population and 42% of the communities surveyed in the infrastructure corridor having received no education as at 2015 and 2017 respectively. No high schools, tertiary institutions or vocational training centres are present in the mine area or infrastructure corridor communities, although some primary schooling is available. As a result of the poor education and training base, only a small proportion of the population in the area could be considered employable for occupations in any roles other than unskilled jobs. Approximately 7% of the total number of residents surveyed in the mine area communities reportedly had English-speaking skills. In most cases, the majority of the population reportedly spoke Tok Pisin.

Communities along the infrastructure corridor between Hotmin and Green River, have low levels of literacy, with 86% of survey respondents in 2017 reportedly illiterate. Literacy rates within the northern section of the infrastructure corridor from Green River to Vanimo is estimated at 65%, based on 2011 NSO census data for the Vanimo/Green River District. Tok Pisin is widely spoken within communities along the infrastructure corridor.

Within Vanimo, all seven wards have elementary and primary schools, and there is one high school. There are no tertiary or vocational training centres in Vanimo. School attendance levels in Vanimo are not surprisingly highest in elementary and primary schools, compared to high school attendance. Literacy rates within the Vanimo Urban LLG population is estimated at 78% based on 2011 NSO census data. The highest level of education achieved within Vanimo Town was reported as Grade 10 (Coffey, 2017).

3.2.7 Governance, law and order

No formal police (i.e., police who are trained and paid by the government) are stationed at any of the villages surveyed within the mine area and infrastructure corridor. Generally, village magistrates, village councillors, community leaders and, in some cases, church leaders provided authority and administered law and order.

Alcohol was considered a significant contributor to the incidence of crime (including domestic violence, physical abuse and public nuisance) across many of the communities. Domestic violence was recorded across all communities surveyed within the mine area, as acknowledged by both male and female participants. Villages in the more remote locations along the infrastructure corridor generally experience a safe environment, however, face difficulty when access to services is needed.

Vanimo has a police station, court house and corrections service near Cis Point. Increasing law and order issues reportedly being experienced within Vanimo relate to unsettled youth, rising drug and alcohol abuse, gambling and stealing (Coffey, 2017).

3.2.8 Infrastructure

3.2.8.1 Mine area

Transportation and communication infrastructure within the mine area was completely absent in most cases or was in poor state of repair. River transport provided the most accessible and effective transport corridor for residents living in the area. No village has access to mobile phones; however, all have access to radio communication with the Frieda River Base Camp or church headquarters. Villages at Wabia, Ok Isai and Paupe situated on rivers have access to motorised canoe transport without built landing facilities. Airstrips were observed at Ok Isai and Wabia.

Only two villages in the mine area, Sokamin and Wabia, have a community meeting hall, and sporting facilities such as playing fields and volleyball courts are rare and, where present, were generally not maintained to a good standard. Access to mains electricity was limited, although a small number of communities ran communal generators when they had the fuel to do so.

3.2.8.2 Infrastructure corridor

Within the infrastructure corridor, there is little to no government services or public infrastructure. There is a small number of community halls and recreational facilities, which are generally not maintained when present. Access to electricity is rare, and where present, is through diesel generators or solar panels.

3.2.8.3 Vanimo

Infrastructure and public services in Vanimo include an airport, ocean port, a general hospital, educational institutions, banks, postal services, recreation areas and supermarkets.

Most road infrastructure in the Vanimo is in poor condition, and road connections to other main towns are limited. Mobile phone systems were installed in Vanimo in 2006 yet respondents to social surveys (Coffey, 2017) had mixed views on the level of mobile phone coverage.

3.2.9 Domestic water use and sanitation

3.2.9.1 Mine area

Within the mine area villages, domestic water supplies, used for drinking, cooking and washing, are mainly from surface water sources including rivers, creeks, springs, and streams. Some villages have communal or household water tanks that provided seasonal water during the wet season. Many of these tanks appeared likely to be contaminated.

Sewerage reticulation or treatment did not exist at any community included in the surveys. Some households used pit latrines and often one toilet was shared amongst several households. Sanitary waste was often discharged to the river and/or surrounding environment.

3.2.9.2 Infrastructure corridor

Water supply infrastructure is nearly non-existent within the infrastructure corridor south of the Bewani Mountains, where almost all water is sourced from rivers, lakes, natural springs or bore water, and is untreated prior to consumption.

Sanitation infrastructure is varied across the infrastructure corridor. Some villages have good access to latrines, including Amini, Sumumini, Hotmin, Uramesin 2, Temsapmin and Bisiabru in. Other villages primarily use the bush for sanitation purposes.

3.2.9.3 Vanimo

Key sources of water for residents of Vanimo Urban LLG are rainwater tanks, local creeks and rivers (Vanimo Urban LLG, 2014). In the nearby settlements of Cis Point and Wesdeco, domestic water supply is obtained from dug wells or tanks, which vary in condition (Coffey, 2017).

3.2.10 **Culture and customs**

Cultural heritage within the FRCGP area can be categorised into tangible and intangible heritage, as defined below.

- Tangible forms of cultural heritage include moveable or immovable objects, property, sites, structures or groups of structures, which have archaeological, paleontological, historical, cultural, artistic values, or religious values, as well as unique natural features or tangible objects that embody cultural values, such as lakes, ponds, outcrops, rocks and waterfalls.
- Intangible forms of culture heritage include (but are not limited to) knowledge, innovations, religious ceremonies, values, beliefs, and the continuing practice of traditional lifestyles.

Seven tangible cultural heritage sites are located within the FRCGP area. The locations of these sites are detailed in Figure 4-1 of the Cultural Heritage sub-plan.

Within the mine area villages, cultural knowledge among the current generation of adults was strong, though accompanied by an acknowledgement that elements of culture have been evolving since initial contact with the Australian colonial administration.

Villages within the infrastructure corridor continue to practice traditional cultural activities while also adopting non-traditional practices into their society. Due to their isolation, low population density and the absence of demand for access to their land for industrial agriculture, communities south of the Bewani Mountains through to Hotmin have been able to maintain their cultural identity and traditions. Areas close to Vanimo are more susceptible to experiencing cultural change due to the influence of non-traditional practices in and around the urban setting.

Within Vanimo, cultural identity and traditions in communities are challenged by pressures such as an increasing population and commercial activities. Customary practices still take place on a daily basis for families in the settlements of Wesdeco and Cis Point (Coffey, 2017; Si and Lahe-Deklin, 2015), such as catching seafood in traditional ways. However, as the economic hub of Sandaun Province, Vanimo is exposed to culturally diverse practices and people, which impact on residents ability to maintain cultural traditions.

4. Construction activities

Construction activities associated with the FRCGP will occur in three distinct zones:

- Mine area: includes the open-pit, process plant, power generation facilities, access roads, site accommodation village and other ancillary infrastructure (see Figure 1-3).
- Concentrate pipeline – a buried 325-km-long pipeline providing transport of concentrate to the Vanimo Ocean Port.
- Concentrate export facility – located at Vanimo Ocean Port where concentrate will be dewatered, stored and loaded to ocean-going vessels for shipment to overseas markets.

Transport of materials to support construction activities will include barging freight from Wewak, Lae and Madan ports upstream along the Sepik River and to the Frieda or May River ports until upgrade of both the Vanimo Ocean Port and the Vanimo to Green River Road have been completed. Once complete freight will be transported by road from Vanimo to Green River and barged from the Upper Sepik River Port downstream along the Sepik River to the May or Frieda River Ports. Once the main access road from Green River to the mine is complete all freight will be trucked to site.

4.1 Mine area

The mine area includes the open-pit, process plant, haul and access roads, waste spoil dumps, barge loading facilities, tailings pipeline, mine infrastructure facilities, quarries, conveyor, construction camp and other ancillary infrastructure such as communications. The open-pit will not be included in construction activities and has therefore not been described here (noting that the pre-strip of vegetation in preparation for the open-pit is included as part of the construction).

4.1.1 Process plant

Ore will be processed in a process plant using conventional comminution (i.e., crushing and grinding) and flotation technology to produce a copper-gold concentrate slurry. Given the lack of flat land near the mine site, the construction of the process plant will require considerable bulk earthworks to level a pad of sufficient size and geotechnical strength to support the necessary large infrastructure. The process plant will have an average processing rate of 45 Mt/year with a peak of 65 Mt/year in Year 8.

The main operations associated with the process plant are:

- Primary crushing, conveying, ore storage and reclaim.
- Primary grinding and pebble crushing.
- Flotation.
- Concentrate thickening and pumping.
- Tailings thickening.
- Storage and use of reagents and consumables.

4.1.2 Mine access and haul roads

Access roads for the mine comprise:

- Mine access road – a 39-km-long, dual lane, unsealed road (nominally 7.5 m wide) will run from the termination point of the public access road on the eastern side of Hotmin to the site accommodation village.
- Link road – a 33-km-long, dual-lane, unsealed road (nominally 7.5 m wide) will run from the site accommodation village to the FRHEP powerhouse.
- HITEK open-pit access road – a 6-km-long, dual-lane, unsealed road (nominally 7.5 m wide) will run parallel with the overland conveyor from the site accommodation village to the HITEK open-pit.

The main haul road will be established for haul trucks to transport ore and waste from the open-pit to the ROM pad, the Ok Binai waste dump and waste rock crushing facility. The haul road will be an unsealed 7 km dual lane road with a formation width (road reserve) of 40 m and a road carriageway of 29 m, suitable for 220 t dump trucks. The haul road will require approximately 4.2 million cubic metres (Mm^3) of cut and 2 Mm^3 of fill material with the excess material disposed to the dedicated spoil dumps.

Road construction materials will be sourced from new quarries to be developed adjacent to the road corridor and from the diorite quarry.

The access roads will require approximately 2.7 Mm^3 of cut which will either be sidecast (60%) or disposed to the dedicated spoil dumps (40%).

4.1.3 Spoil dumps

Spoil material from foundation excavations and road cuttings, as well as vegetation and organic material from construction stripping, will be placed in dedicated spoil dumps. The spoil dumps will be located within the ISF catchment and will generally be designed with stormwater and sediment management infrastructure to prevent fugitive sediment release from the construction site.

Two eroding dumps will be located in the Ok Binai catchment (the Ok Binai waste dump and the limestone quarry waste dump). The Ok Binai waste dump will also be used to store non-acid forming waste rock, predominantly from the Year-1 pre-strip.

4.1.4 ISF barge loading facility

A barge loading facility will be established for the transport of all waste rock (other than organic waste reporting to the Ok Binai waste dump) from the mine site to the ISF during operations. At the ISF barge loading facility, the waste rock will be stockpiled, reclaimed and loaded into 5,000 t barges and deposited into the ISF during operations.

4.1.5 Tailings pipeline

During operations tailings will be delivered to the ISF from the process plant via a floating 10 km pipeline system consisting of a carbon steel section and a high-density polyethylene pipe section.

The pipeline will be extended by 6 km in approximately Year 5. The pipeline will be designed to handle the required pressure and volume and will have pressure transmitters and flow meters to detect leaks or blockages.

4.1.6 Mine infrastructure area (MIA) facilities

The MIA will be located close to the HITEK open-pits. The MIA will consist of the following major facilities:

- Workshops.
- Warehouse.
- Muster, training and dining areas.
- Bulk fuel storage.

4.1.7 Power generation facilities

Power during construction will be provided by diesel generators located at major infrastructure locations including the open-pit, MIA and process plant.

During operations, the mine's power will be supplied by the FRHEP. The transmission line from the powerhouse to the process plant will sit within a nominal corridor 40 m wide and will be strung on a combination of self-supporting galvanised lattice steel towers and galvanised steel monopoles. A substation will be located at the process plant and power will be distributed through 33 kV overhead lines and buried cables.

The transmission line towers will be located as close as practical to the link road between the powerhouse and the process plant main substation. Short access tracks will be constructed off the link road to service the transmission tower locations.

4.1.8 Quarries

Construction material for earthworks will be sourced from a number of quarries. This material will be used for the construction of dams, roads, water diversion bunds and infrastructure pads. Where practicable, quarries will be located within or directly next to proposed infrastructure footprints to limit haul distances and to concentrate impacts associated with their development into catchments already disturbed by the mine or other Project components.

Competent rock for the haul road construction, maintenance and blast hole stemming will be sourced from a diorite quarry located east of the HITEK open-pit.

A limestone quarry located southeast of the HITEK open-pit will provide limestone for the water treatment plant and also for the process plant. Excavated limestone will be stored in a stockpile next to the limestone quarry.

4.1.9 Conveyor

A dedicated overland conveyor system approximately 9 km in length will be constructed to transport ore from the primary crushing facility to the process plant, and waste rock from the waste rock

crushing facility to the ISF barge loading facility. The conveyors will be fitted with dust control mechanisms, belt scales to measure throughput, and metal detectors to detect and remove metal elements from ore and waste.

4.1.10 Accommodation villages

On-site accommodation will be constructed for a peak of up to 2,060 personnel during construction and 1,800 personnel during operations.

The construction camp and site accommodation village will be located on the mine access road between the process plant and the HITEK open-pit. It will be built initially to service construction and later refurbished to cater for the operations workforce. It will comprise two storey accommodation units, kitchen, dining room facilities and recreational facilities, a first aid and medical centre and training room. The village administration building will have an adjacent covered bus station and will include the central control room (integrated mine, process and logistics functions), offices, muster areas and training facilities.

Raw water will be pumped via a pipeline from the Nena River (300 kL/d) for general non-potable consumption at the site accommodation village. The potable water treatment plant, located at the highest point in the site accommodation village and administration facility, will be fed from the raw water tank and will enable gravity flow to the site accommodation village and administration area via a dedicated reticulation system. This facility will also supply the process plant and mine infrastructure area.

The sewage treatment plant will be located at the lowest point in the camp to allow gravity sewer drains to be used as much as possible within the facility. The network will consist of gravity sewers with pumped rising mains where required. The sewage treatment plant specifications will cater for 300 L/person/day based on peak personnel requirements.

4.1.11 Communications

A satellite link will be installed in the mine area for communications during construction and will be retained during operations as a back-up to a fibre optic network.

The fibre optic network will run with overhead lines and underground 33 kV power reticulation to each facility. Similarly, a fibre optic cable will run along the concentrate pipeline enabling communications between the process plant, booster pump stations and the concentrate filter plant at the Vanimo Ocean Port.

4.2 Concentrate Export Facilities

The concentrate export facilities for the FRCGP comprise the concentrate pipeline along the infrastructure corridor alignment and the concentrate export facility at Vanimo Ocean Port. These are described below.

4.2.1 Concentrate Pipeline

Concentrate will be transferred between the processing plant and the Vanimo Ocean Port through a buried 325-km-long pipeline within the infrastructure corridor. Two concentrate booster pump stations will be located along the concentrate export route. One will be located near Green River and one approximately 5 km to the southwest of Itomi.

The work methods used to construct the concentrate pipeline will vary depending on conditions along the pipeline route. Variations in conditions that may influence construction methods, include:

- Road easements.
- Areas containing parallel buried infrastructure.
- Location of powerlines.
- Road and water course crossings.

The construction of the pipeline is anticipated to commence simultaneously at four separate locations along the pipeline route, with temporary camps being used by construction workers.

Construction activities will include, but not be limited to:

- Clearing and grading.
- Trenching.
- Pipe bending and welding.
- Lowering in.
- Backfilling and restoration.

4.2.2 Concentrate Export Facility

The concentrate export facility will be developed at the Vanimo Ocean Port. This will comprise dedicated facilities for concentrate dewatering and handling upon the port apron, including:

- Concentrate thickener and filter plant.
- Concentrate storage shed.
- Ship loading facility.
- Water treatment plant.
- Bulk diesel pipeline.
- Diesel generators.

4.3 Vanimo Infrastructure Area

A multi-purpose industrial area will be established in Vanimo. The Vanimo Infrastructure Area will be adjacent to the main access road and have convenient road access to the Vanimo Ocean Port. The Vanimo Infrastructure Area will be fenced with access control and security checkpoints and will include:

- FRLs regional office with workspace for up to 50 employees (0.1 hectare (ha)).
- Permanent accommodation for senior staff including provision for 40 houses, recreation facilities and security (6 ha).

- Hotel style accommodation for night shift workers (6 ha). The accommodation village will include a small admin office, kitchen, mess, laundry and recreation facilities.
- A warehouse and laydown yard for transit freight storage. The storage area will be 2 ha and will allow for storage of 1,045 containers, including refrigerated containers.
- A maintenance workshop for the logistics haulage fleet and mobile equipment.
- Bulk diesel storage tanks (approximately 24 megalitres total capacity) located in a fully bunded area with suitable structural foundations. A truck loading system will transfer diesel from the storage tanks to tankers which will deliver the diesel to the MIA. A vehicle refuelling point will be located on a bunded concrete slab, suitable for the logistics and light vehicle fleet.

All buildings developed in the Vanimo Infrastructure Area will be reticulated with power, communications, water and sewerage. Fire water ring mains, fire hydrants, safety showers and stormwater treatment will also be provided.

5. Environmental management framework

5.1 Environmental management system

FRL is committed to compliance with the requirements of AS/NZS ISO 14001:2016. These standards provide FRL with the elements of an effective Environmental Management System (EMS) to:

- Plan, implement, review and improve FRL's sustainability policy.
- Achieve compliance with regulatory requirements.
- Achieve performance levels/control requirements specified in the EIS.
- Achieve good mining industry practice to minimise any adverse effects on the environment.
- Reduce waste generation and emissions and usage of resources.
- Satisfy the public with the company's responses to concerns or enquiries.

This EMMP will form part of the EMS.

5.2 Policy

The FRCGP will be managed by FRL under the governance of the PanAust Group Sustainability Policy. The Sustainability Policy (PanAust, 2016) is supported by established Sustainability Management Standards (PanAust, 2013) that integrate the management of health, safety, environment and social aspects.

5.3 Implementation

5.3.1 Procedures

Procedures to be followed to ensure effective environmental management of the FRCGP are detailed in the management sub-plans.

5.3.2 Responsibility

All FRL and contractor personnel are responsible for the environmental performance of their activities and for complying with the 'general environmental duty', as outlined in Section 7(1) of the Environment Act that states:

> A person shall not carry out an activity that causes, or is likely to cause an environmental harm unless the person takes all reasonable and practicable measures to prevent or minimise the environmental harm.

Specific responsibilities for the key personnel who will oversee management of environmental aspects of the project are detailed in the subsections below. Site-based implementation of the EMMP will be the responsibility of the Safety, Health and Environment (SHE) Manager. Position descriptions and conditions of contracts of employment will define individual responsibilities and accountability. Furthermore, service agreements for contractors will include environmental and social responsibilities.

5.3.2.1 Safety, health and environment manager

The FRL SHE Manager will be responsible for ensuring that all FRCGP activities are undertaken in full compliance with statutory regulations and the FRL sustainability policy, and will also be responsible for this document and its implementation.

5.3.2.2 Environment superintendent

The Environment Superintendent is the FRL representative on site and will:

- Report to the SHE Manager on compliance of the EMMP and issue any necessary instruction to the construction contractors.
- Ensure that all site personnel have relevant site environmental inductions, training and awareness so that they have a clear understanding of FRL environmental requirements and procedures including their responsibilities within their areas of work.
- Ensure that weekly and monthly monitoring and inspections are undertaken, environmental reporting is compiled and submitted to CEPA and any follow up actions are closed out. The Environment Superintendent will also ensure that non-conformances and any environmental incidents are recorded and appropriate actions taken to address these.

5.3.2.3 Environment supervisors

The Environment Supervisors will provide support to the Environment Superintendent. There will be three Environment Supervisors one specific to each aspect of water, land and EMS. Each Environment Supervisor will be supported by Environment Officers, Environment Assistants or Environment Labourers. With this support Environment Supervisors will:

- Report to the Environment Superintendent on any site environmental and compliance issues with regards to implementation of the EMMP.
- Ensure that weekly inspections are conducted and internal audits are performed.
- Ensure that all necessary inductions, training and awareness is conducted appropriately and implemented on site.
- Ensure appropriate environmental control measures are put in place and maintained.
- Ensure that all site personnel are aware of appropriate environmental control measures and how to implement such measures.

5.3.2.4 Contractors

The major contractors and their sub-contractors, and any party regarded as contractors, will:

- Ensure that a contractors' environmental representative is part of its personnel.
- Ensure that all employees comply with acceptable safe environmental practices.
- Ensure that, prior to start of employment on site, all its employees go through an environmental awareness/ induction on the appropriate environmental requirements and procedures.

- Report to the FRL Environment Superintendent and senior management on environmental performance and non-conformances.

Contractors will be contractually bound to comply with the project environment permit conditions and this EMMP.

5.4 Checking and corrective action

To monitor compliance with the requirements of the EMS and this EMMP, FRL will conduct periodic and ad-hoc audits. This is to ensure that impacts are accurately measured, the effectiveness of mitigation measures are assessed, and meaningful reports are provided to stakeholders and government regulators with the overall purpose to confirm impact predictions and demonstrate compliance with regulatory permits and licences. Corrective action will be taken, where necessary, should monitoring and auditing indicate that management measures are not effective or are not being effectively implemented. The following sections describe these inspections and audits and how the results will be recorded and reported.

5.4.1 Inspections

The SHE Manager (or their delegate) will undertake regular supervision and inspections of activities to ensure that environmental management procedures are being implemented satisfactorily. The frequency of inspection will be consistent with the magnitude of risk associated with the particular hazard. Inspection results will be reported to the General Manager Operations.

5.4.2 Audits

Audits will be undertaken by the Environment Superintendent (or their delegate) on a regular basis against relevant standards and criteria to ensure compliance with the environmental management procedures and environment permit conditions and continual improvement of the management systems and processes for the project.

The purpose of the audits is to ensure:

- Correct implementation of the EMS.
- Compliance with the EMMP procedures.
- Effective management of the predicted environmental impacts of the project is provided by the implementation of the EMMP procedures.
- Implementation of PanAust Sustainability Management Standards and procedures.
- Awareness of responsibilities by all personnel.

5.4.3 Recording

The EMS and EMMP will become part of an auditable record system maintained by FRL. The record system will also include the following:

- EIS and associated documents.
- Approval documents, including the environment permit.

- Commitments register.
- Compliance inspection and audit reports.
- Incidents register.
- Grievance register, including FRL's responses to grievances.
- Consultation register and records including meeting notes.
- Training and induction records.
- Environmental monitoring data and reports.

In accordance with the principles of AS/NZS ISO 14001:2016, the above EMS documentation will be:

- Easily located and logically filed in hard copy and electronic copy form, including date of issue.
- Managed using a document control system.
- Available for all FRL personnel, contractors and consultants.
- Periodically reviewed and revised as necessary (and clearly dated) by authorised personnel.
- Removed from all points of issue when obsolete.

The Environment Superintendent will be responsible for ensuring that feedback is assessed and implications for the EMS are acted upon for continuing sustainability.

Environmental monitoring will be undertaken by the project's SHE Department and monitoring results will be presented in regular internal reports. The results will also be summarised and reported to government regulators on a regular basis, as required by applicable legislation and/or the environment permit.

5.4.4 Reporting

5.4.4.1 Environmental incidents

Based on an assessment of severity and capacity to remedy, FRL will implement a practical approach to the reporting and management of incidents. This approach will ensure all incidents, including near misses, are reported. The level of reporting and response will be based on the escalation procedure set out in Table 5-1.

Table 5-1 Escalation procedure for reporting incidents

Type of incident	Capacity to remedy incident	Reporting and remedial action requirements
Minor incident: minor temporary harm to the environment or an incident that has the potential to cause harm to the environment.	Immediate: incident is easily contained with resources available on-site; corrective action can be taken immediately.	Department manager or site Environment Supervisor to prepare an Incident Report and record incident in Incident Register noting action required to remedy situation and timeframe in which it is to occur.

Type of incident	Capacity to remedy incident	Reporting and remedial action requirements
Significant incident: serious environmental harm has occurred or is occurring.	Limited: additional resources required to contain damage, planning required to define most effective response.	Department manager to immediately notify SHE Manager, Environment Superintendent and relevant regulatory authorities.

5.4.4.2 Internal reporting

Results from monitoring activities will be recorded and regular reports (e.g., quarterly or annually) prepared by in-house staff or suitably qualified and experienced third parties. These reports will be distributed internally as required to report on compliance of activities with conditions of approval and performance against monitoring criteria. Reports will contain data to assess the effectiveness of mitigation measures, and will assist in identifying areas where environmental management measures need to be improved. Monitoring and audit reports will generally contain:

- Introduction.
- Legislative framework and standards.
- Compliance criteria.
- Monitoring methods.
- Monitoring results.
- Recommendations and corrective action.

Results from monitoring activities will also feed into formal environmental and sustainability reporting to various corporate entities.

5.4.4.3 External reporting

Monitoring reports will be submitted to CEPA and other regulatory authorities, depending on the environment permit conditions. Compliance with the EMMPs will be described in these reports as well as recommendations for corrective action. In PNG, this is typically in the form of an Annual Environment Report.

FRL will disclose the results of any additional assessments and monitoring activities to relevant stakeholders on a regular basis. This communication will take place through formal channels as determined in the FRL stakeholder engagement plan. The report will include information on:

- Surface water quality.
- Drinking water quality.
- Edibility of aquatic resources.
- Community feedback received.

FRL will establish an independent advisory committee for downstream water quality and resource use matters for the FRCGP as part of ensuring the technical rigour, accountability and transparency of environmental investigations for downriver communities. This committee will be established prior to the commencement of construction and will comprise representatives of the PNG Government,

prominent PNG citizens, expert international specialists and FRL. The committee will provide direction and technical oversight for environmental monitoring and investigations, to improve public understanding of the FRCGP's environmental issues and to review FRL's environmental performance and accountability. The findings of the committee will routinely be made public.

5.4.5 Review

This EMMP will be reviewed annually or as needed to ensure it remains valid. Sub-plan procedures will also be reviewed after any relevant incidents to ensure the management measures are effective and to identify where improvements can be made.

Reviews will be conducted to ensure that:

- Project activities are undertaken in compliance with statutory obligations.
- The environmental objectives of the project are achieved.
- The management measures are effectively implemented.
- A system of continuous improvement is established.
- Further information is incorporated into the plan as it is obtained and evaluated.

6. Environmental monitoring

6.1 Approach

An environmental monitoring program will be undertaken to monitor the impacts of the FRCGP and adapt management and mitigation measures as required.

The validity of the predicted effects of the project, set out in the EIS, depends on two conditions:

- In all relevant environmental respects, the FRCGP is constructed and operated in the manner described in the EIS.
- The understanding of the relevant environmental dynamics (and hence the derived predictions of the impacts) presented in the EIS was reasonably correct.

With regard to the first condition, FRL will notify the Government should significant changes be made to the project design subsequent to the preparation of this EMMP, particularly regarding methods for construction. The second condition will be met by the monitoring program, which is designed to allow periodic reassessment of the project's effects and subsequent review of mitigating measures and safeguards.

6.2 Program

The monitoring program will involve the following sequential steps:

- **Baseline monitoring.** Establishes a baseline for a range of aspects (e.g. physical, biological and social) requiring information which is additional to that gathered in the EIS. This will be finalised prior to construction.
- **Construction monitoring.** Ensures effective implementation of environmental management measures and ensures that construction is completed in accordance with the environment permit and other commitments outlined within the construction EMMPs. Environmental aspects to be monitored are detailed in each management sub-plan and include:
    - Landform and soils.
    - Groundwater.
    - Terrestrial flora and fauna, including pathogens, weeds and introduced species.
    - Air quality.
    - Noise and vibration.
    - Land and water resource use.
    - Freshwater environment including hydrology, water and bed sediment quality and ecology.
    - Nearshore environment including water and sediment quality and ecology.
    - Cultural heritage and archaeology.
- **Post-construction monitoring.** Conducted to validate and monitor predicted impacts from construction activities.

The operations monitoring program will be covered in the operations EMMP that will be developed by FRL and submitted to CEPA at least six months prior to commencement of operations.

6.3 Quality control

The instrumentation, sampling methods, analytical procedures and data analyses used in the monitoring program will be consistent with accepted good practice. Results will be made available to government in an agreed reporting format. Laboratory sample analyses will be performed by National Association of Testing Laboratories (NATA) or Papua New Guinea Laboratory Accreditation Scheme (PNGLAS) registered laboratories, or other laboratories approved by CEPA that have recognised quality control systems in place.

All monitoring will be carried out to a high level of scientific rigour to allow future comparison of the data. The design of the monitoring program will incorporate statistical considerations related to the end use of the data. Sampling methods will be objective, repeatable and standardised to minimise differences attributable to different or successive operators. A quality assurance/quality control (QA/QC) program will be designed and implemented prior to commencement of construction, this will continue to be implemented in association with monitoring that is undertaken during the operations and closure phases of the project. The major components will include:

- Definition of the roles to be filled by each of the parties involved in sampling, transportation, analysis and reporting, and the preparation of task objectives.
- Preparation of detailed protocols addressing all aspects of the sampling/analytical program, i.e., obtaining the samples, sample analysis, data interpretation and report preparation.
- Preparation of detailed manuals/procedures addressing the use and operation of all sampling/analytical instrumentation, including calibration.
- Details of an analytical QA/QC program that includes requirements such as the analysis of field blanks, laboratory blanks, duplicate samples, spiked samples and reference samples. Duplicates and blanks will be collected at the time of sampling.

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Frieda River Limited

Frieda River Copper-Gold Project

Environmental Management and Monitoring Plan

Acid and Metalliferous Drainage, Waste Rock and Tailings Management Sub-plan

Construction and operations

Environmental Management and Monitoring Plan
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1. Acid and Metalliferous Drainage, Waste Rock and Tailings Management Sub-plan

1.1 Background

Construction and operational activities associated with the Frieda River Copper-Gold Project (FRCGP) have the potential to result in the generation of acid and metalliferous drainage (AMD) from bulk earthworks, mined benches in the open-pit, stockpiled waste rock, crushed ore stockpiles, and construction of access roads. Naturally occurring AMD also occurs in the vicinity of the ore body. The tailings generated from processing of ore also has the potential for AMD. The oxidisation of reactive sulphide minerals in potentially acid forming (PAF) waste rock and tailings may lead to AMD and subsequent downstream impacts.

The primary factors that determine the requirements for management of waste rock and tailings are:

- The potential to produce acid, its exposure to atmospheric conditions and the consequent generation of drainage that is both acidic and contains elevated concentrations of dissolved metals.
- The control of surface water runoff and the containment of sediment generated by erosion of sulphidic material.

The composition and variability of the waste material from the Horse-Ivaal-Trukai, Ekwai and Koki (HITEK) deposits was evaluated in terms of its geochemistry, with a focus on acid-forming potential. The following characterisation has been adopted for waste rock management planning purposes:

- Green (non-acid forming (NAF)) = <0.5 %S or totally oxidised.
- Amber (PAF) = 0.5 to 1.0 %S.
- Red (low sulphur) (PAF) = 1.0 to 3.0 %S.
- Red (high sulphur) (PAF) = >3.0 %S

Open-pit wall runoff is anticipated to be of poor quality due to the presence of PAF material, and will be transferred via a number of sumps to a water treatment plant.

Testwork indicates that final tailings will likely contain between 0.5 and 1.0% sulphur and will be PAF, with only a small inherent neutralising capacity. The tailings slurry will initially be moderately alkaline as a consequence of lime added during the flotation process. Tailings is expected to have a long lag time (one year or more after exposure to atmospheric conditions) prior to acid generation.

Exposure, disturbance and stockpiling of sulphidic soils and spoil have the potential to contribute significantly to AMD from bulk earthwork sites to the environment and result in downstream impacts.

AMD can have significant impacts on downstream beneficial uses due to reduced water quality, including impacts on:

- Water extraction for drinking and domestic purposes.
- Aquatic ecosystem health.

- Use of aquatic flora and fauna resources.

This AMD, Waste Rock and Tailings Management Sub-plan details measures to manage potential impacts from AMD that may result from construction and operation activities.

Management of soil erosion, sedimentation, and acid sulphate soils (ASS) and potentially acid sulphate soils (PASS) is addressed in the Erosion, Sediment and Soils Management Sub-plan. Management of waste (including wastewater) is addressed in the Waste Management Sub-plan. The Water Management Sub-plan provides specific details on the background and management of surface water and groundwater in the FRCGP area, which are also relevant to the management of AMD.

1.2 Objectives

The objectives of the AMD, Waste Rock and Tailings Management Sub-plan are to:

- Manage soils and waste rock following acid-forming characterisation.
- Limit the oxidisation of sulphide materials that would lead to generation of AMD.
- Manage waste rock stockpiles and associated runoff in order to prevent contamination of downstream water quality impacts.
- Limit contamination of downstream environments (including groundwater) from increased acidity and/or dissolved metal contaminants by controlling surface water runoff and treating water, if required.
- Identify any potential impacts to water quality during construction and operations through monitoring.
- Ensure that all activities comply with legislative requirements, industry standards and company guidelines.

1.3 Responsibility

Implementation of the AMD, Waste Rock and Tailings Management Sub-plan will be the responsibility of the Environmental Superintendent and the Safety, Health and Environment (SHE) Manager. The SHE manager is also responsible for ensuring that activities associated with the FRCGP are undertaken in full compliance with relevant statutory environmental regulations and FRL's environment policy and FRCGP Environmental Management and Monitoring Plan (EMMP).

While the environment team is responsible monitoring, compliance, and follow up on corrective actions, other teams are also responsible for implementing measures to manage design, construction and operations activities related to AMD, waste rock and tailings. For example, the design team is responsible for ensuring that the design of facilities is adequate to perform as required to limit impacts downstream (i.e., design of the ISF); the construction team is responsible for management of stockpiles; the mining team is responsible for waste rock characterisation, stockpile placement and deposition within the ISF reservoir, and the process manager is responsible for ensuring the tailings are deposited within the ISF reservoir. These responsibilities are listed in the management measures tables in Section 6.5.

Individual accountabilities will be defined through conditions of contracts of employment.

1.4 Definitions

Acid and metalliferous drainage (AMD). Water that is acidic, and/or contains elevated concentrations of metals, typically formed by the oxidation of sulphide minerals.

Non-acid forming (NAF). Material that does not form acid on exposure to atmospheric oxygen and water.

Potentially acid forming (PAF). Material that has the potential to form acid on exposure to atmospheric oxygen and water.

Runoff. The draining away of water (or substances carried in it) from the surface of an area of land, a building or structure, etc.

Tailings. A by-product of processing ore.

Watercourse. A river, creek or stream in which water flows permanently or intermittently in a visibly defined channel with:

- Continuous bed and banks.
- An adequacy of flow that sustains basic ecological processes and maintains biodiversity.

Waste rock. Mineralised rock associated with an orebody that is not economic for resource recovery due to low resource grades.

1.5 Procedures

The following procedures detail FRL's AMD, waste rock and tailings control measures that will be implemented for the FRCGP's construction and operations phase.

1.5.1 Planning and preparation

Planning and preparation management measures to address AMD are detailed in Table 1-1.

Table 1-1 Planning and preparation AMD, waste rock and tailings management measures

No.	Management measures	Performance measures	Target	Responsibility
MP004	Train and induct all personnel and contractors in potential AMD, waste rock, and tailings impacts on water quality and the management measures detailed in this management plan.	Maintenance of induction register.	Completion of induction by all employees and contractors where relevant to their role.	Mine Manager, SHE Manager
MP134	Conduct training for relevant personnel on waste rock classification.	Training records.	Completion of training by all relevant personnel.	Operations Manager

1.5.2 AMD, waste rock and tailings management

Management measures to manage AMD in waste rock, tailings and open-pit water during construction and operations are detailed in Table 1-2.

Table 1-2 AMD management measures

No.	Management measures	Performance measures	Target	Responsibility
MM021	Divert clean water upstream of the open-pit, where practicable, around the open-pit to avoid generating additional contact water (i.e., water making contact with the open-pit walls and therefore assumed to be contaminated).	Infrastructure designed to limit clean water entering the open-pit.	Diversion drains installed upstream of open-pit.	Mine Manager

Table 1-2 AMD management measures (cont'd)

No.	Management measures	Performance measures	Target	Responsibility
MM023	Design and operate the ISF to limit the potential for AMD including: • Store PAF materials subaqueously. • Manage potentially contaminated water from the open-pits. From Year 1 and during operations, treat open-pit contact water (using a high-density sludge lime treatment system) with treated water discharged to Ubai Creek which flows into the ISF. • Deposit the water treatment solids (sludge) within tailings in the ISF.	All materials classified as PAF stored within ISF. All potentially contaminated pit sump water to be treated.	Downstream water quality meets environment permit criteria at compliance point.	Detailed Design Manager, Mine Manager and SHE Manager
MM042	Treat open-pit water runoff using an engineered water treatment plant to mitigate poor water quality downstream. Discharge treated open-pit water to Ubai Creek where it will flow into the ISF for further dilution prior to entering the downstream environment. Discharge treatment residues to the bottom of the ISF.	Records of discharge water.	No direct discharge of untreated poor quality water to Ubai Creek.	SHE Manager
MM046	Store tailings subaqueously via a pipeline with barge-dumped PAF waste rock in the ISF to limit the potential for formation of AMD.	Records of disposal.	Zero non-compliances.	Mine Manager, Process Manager
MM055	Place only NAF material in the limestone quarry waste dump and in the Ok Binai waste dump.	Records of identified PAF and NAF volumes disposed and their disposal locations.	No AMD due to incorrect placement of PAF material in the limestone quarry or Ok Binai waste dumps.	Mine Manager
MM056	Minimise time of exposure for PAF waste rock prior to subaqueous deposition within the ISF impoundment.	Records of waste rock stockpiles storage times.	No waste rock stockpiles exposed for more than 12 weeks.	Mine Manager
MP006	Visually monitor runoff from construction sites. Uncontained stormwater contamination from AMD, hydrocarbons or sediment must be recorded. Where practicable and where required, appropriate steps will be taken to remediate the area.	Records of runoff inspections for large rainfall events.	Avoidance of uncontained stormwater being contaminated with AMD, hydrocarbons or sediment.	SHE Manager

Table 1-2 AMD management measures (cont'd)

No.	Management measures	Performance measures	Target	Responsibility
MP007	Document and investigate complaints about water quality and work with local communities to resolve any issues via the FRCGP grievance mechanism.	Maintenance of grievance register.	No unresolved complaints from communities regarding water quality.	Community Relations Manager, SHE managers

1.5.3 AMD contingency management

Management measures to address AMD if detected during monitoring are detailed in Table 1-3.

Table 1-3 AMD contingency management measures

No.	Management measures	Performance measures	Target	Responsibility
MP009	Collect and treat runoff affected AMD areas to meet downstream water quality objectives, which may involve: • Additional surface water management works to contain and isolate the impacted areas as far as possible in order to reduce the volume of water impacted and requiring additional treatment. • Treating AMD affected runoff with lime.	Record of AMD-affected areas and management in incident register.	No unresolved incidents.	SHE Manager
MP010	Review the design of spoil dumps, waste rock and tailings management, and change construction/ management practices if necessary.	Record of AMD-affected areas and management in incident register.	No unresolved incidents.	Mine Manager

1.6 Performance, monitoring and reporting

The AMD, Waste Rock and Tailings Management Sub-plan, and any other associated procedures will be reviewed annually to ensure that they remain valid.

Applicable plans and procedures will be reviewed after any non-conformance with a measure in this plan to ensure that they were effective and to identify where improvements can be made.

General monitoring relevant to AMD and water quality will include documenting of incidents in incident reports and maintenance of induction and training records. Incident reports will be completed and appropriate measures will be taken to ensure that similar incidents or accidents will not occur in the future.

Ongoing monitoring of construction and operational activities will be undertaken to assess the success of management measures and identify areas where changes to management measures will limit risks to downstream water quality. Where monitoring identifies deficiencies in the control methods described above, the procedures in this plan will be reviewed.

Compliance by personnel with the procedures in this sub-plan will be verified through both routine and unannounced inspections and monitoring by the SHE Manager (or their delegate). Inspection results will be reported to the Safety and ERT Superintendent.

Monitoring activities will be recorded and annual reports prepared by in-house staff or suitably qualified and experienced third parties. Environmental performance reports will be submitted to the Conservation Environment Protection Authority and other regulatory authorities as part of routine environmental reporting as per the conditions of the environmental permit and other Project approvals.

AMD monitoring will incorporate:

- Compliance with established geochemical classification criteria.
- Monitoring for the presence of PAF and NAF material during open-pit preparation and mining.
- Monitoring to ensure material is being handled and stored appropriately.
- Water quality (including pH, alkalinity, sulphate, electrical conductivity and metals).
- Soil quality including soil structure, aeration and chemical properties.
- Analysis of landscape stability and revegetation success.
- Visual inspections for evidence of AMD.

Monitoring of surface and groundwater is detailed in the Water Management Sub-plan. This will include baseline monitoring programs to establish the ambient water quality of the receiving environment. Results of water quality sampling will indicate whether AMD generation is currently occurring and if further/more regular testing and/or operational controls are required. Downstream water quality monitoring will be undertaken throughout the life of the FRCGP to confirm that downstream water quality remains acceptable. If the monitoring shows that downstream water quality is below permitted levels, then either additional mitigation measures or changes to the water treatment regime may need to be adopted.

The key locations for monitoring AMD for the FRCGP will include:

- A compliance point at AP7 in the upper Frieda River. At this compliance point, water quality shall comply with PNG Ambient Water Quality Standards (Schedule 1) and PNG Drinking Water Guidelines as a regulatory requirement. This compliance point shall be the downstream boundary of the mixing zone and the waters between the discharge locations and the compliance point will be a mixing zone where PNG water quality standards and guidelines shall not be required to be met.
- Flow from the ISF prior to its discharge into the Frieda River (either through the hydroelectric power facility intake or spillway). IFC effluent discharge standards shall be met at this location with the exception of TSS, which is naturally highly variable, and iron which are naturally elevated.

Where concentrations of metals and metalloids are found to exceed maximum background concentrations, the ANZECC/ARMCANZ (2000) guidelines for 95% aquatic ecosystem protection will be adopted as trigger values for further action. In other words, if the trigger values are exceeded it will prompt further site-specific investigations and/or additional management measures. Concentrations will still, however, be compared to the PNG ambient water quality standards.

Where maximum background concentrations of (dissolved and total) parameters measured in the Frieda River (at AP7) exceed the PNG ambient water quality standards, the 90th percentile background concentrations will be adopted as the site-specific criteria.

Total dissolved copper is predicted to exceed background concentrations as well as the ANZECC/ARMCANZ (2000) trigger value at AP7 in the upper Frieda River. It is therefore proposed that:

- A site-specific total dissolved copper concentration of 0.02 mg/L apply as a trigger value for further action at AP7.
- A labile copper concentration of 0.003 mg/L (based on the reduction factors above) will apply as a trigger value for further action at AP7. This value is based on a total dissolved copper concentration of 0.02 mg/L (see above) and considering:
    - The highest experimentally measured proportion of labile copper compared with total dissolved concentration of approximately 30% in the Frieda River.
    - Further reduction of labile copper through adsorption onto suspended particulate matter of 46% at AP7 (reflecting the lowest experimentally measured reduction of dissolved copper via adsorption at AP7 in the Frieda River).

With reference to aluminium, the total dissolved contaminant concentrations are predicted to exceed background concentrations as well as ANZECC/ARMCANZ (2000) trigger values at AP7 in the upper Frieda River. It is therefore proposed that:

- A site-specific total dissolved aluminium concentration of 0.3 mg/L apply as a trigger value for further action at AP7. This concentration is the maximum concentration predicted during operation of the FRCGP and is below USEPA-calculated site-specific acute and chronic criteria of 2.9 and 1.2 mg/L during average flows (pH = 7.5, DOC = 1.7, hardness = 67 mg/L),

respectively (also during low flows (pH = 7.5, DOC = 1.9, hardness = 93 mg/L) of 2.7 mg/L and 0.92 mg/L, respectively).

Further action may include:

- Further site-specific aluminium or copper speciation investigations.
- Biological monitoring in the Frieda and Sepik rivers to determine if there are any impacts to aquatic biota occurring during operations.
- Laboratory toxicity testing of selected macroinvertebrates collected from the Frieda River.
- If warranted, investigation of further water treatment options.

Specific AMD monitoring is outlined in Table 1-4.

Table 1-4 AMD monitoring

Monitoring measure	Performance indicator	Target	Frequency
Monitor downstream water quality.	Water quality in watercourses downstream of FRCGP activities.	Monitoring results comply with environment permit conditions.	Weekly to quarterly depending on locations (ambient water quality sites) and as required prior to release from the ISF
	Number of complaints about FRCGP related water quality.	Complaints recorded and investigated in compliance with grievance procedure.	As required
Using established geochemical classification criteria, monitor for the presence of PAF and NAF material during pit preparation and mining so the material can be handled and stored appropriately.	Geochemical classification criteria for NAF and PAF. AMD impacts. Handling and management of waste material appropriately.	Avoidance of AMD by identifying problematic PAF material and handling appropriately.	As required during pit preparation and mining

FRIEDA RIVER

Frieda River Limited

Frieda River Copper-Gold Project

Environmental Management and Monitoring Plan

Air Quality, Noise and Vibration Management Sub-plan

Construction

Environmental Management and Monitoring Program
Air Quality, Noise and Vibration Management Sub-Plan
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Tables

2. Air Quality, Noise and Vibration Management Sub-plan

2.1 Background

Sensitive receptors (i.e., places where people live and/or congregate) may be affected by air, noise and vibration emissions from earthworks and vehicles during construction of the Frieda River Copper-Gold Project (FRCGP).

Activities that will result in airborne dust and the release of combustion emissions into the atmosphere include:

- Clearance of vegetation.
- Drilling and blasting rock.
- Loading rock to trucks.
- General vehicle movements over unsealed roads.
- Wind erosion from exposed surfaces (e.g., soil, stockpiles and dumps).
- Combustion of diesel fuel for equipment, generators and vehicles.
- Welding of the concentrate pipeline.
- Decomposition, disposal and incineration of waste.
- High temperature industrial incinerators.

The main noise and vibration generating sources will include:

- Machinery (e.g., drills, loaders, trucks, excavators, graders, compactors, pile drivers and other ancillary equipment).
- Vehicles and vessels (including reversing alarms).
- Blasting.
- Diesel power generators during construction at the mine's major infrastructure locations.
- Activities at Vanimo Ocean Port including the construction of the concentrate export facility.
- Hauling and dumping of rock and operation of crushing facilities.

This sub-plan provides procedures that should be followed during construction to limit the potential impacts to human health and the environment caused by dust, combustion emissions, noise and vibration.

2.2 Objectives

The objectives of the Air Quality, Noise and Vibration Management Sub-plan are to:

- Limit dust emissions and dust nuisance to sensitive receptors.
- Limit combustion emissions.
- Limit noise and vibration nuisance to sensitive receptors.
- Limit noise and vibration annoyance from blasting.

2.3 Responsibility

Implementation of the Air Quality, Noise and Vibration Management Sub-plan will be the responsibility of the Environment Superintendent and Safety, Health and Environment (SHE) Manager, who is also responsible for ensuring that activities associated with the FRCGP are undertaken in compliance with relevant statutory environmental regulations and the Frieda River Limited (FRL) sustainability policy and FRCGP Construction Environmental Management and Monitoring Plan (EMMP).

2.4 Definitions

Combustion. The process of burning something – rapid oxidation accompanied by heat and usually light. Chemical combination attended by heat and light.

Dispersion. The spreading and dilution of substances emitted in a medium (e.g., air or water) through turbulence and mixing effects.

Emission. That which is emitted; a discharge; an emanation. The production and discharge of something, especially gas or radiation.

Greenhouse Gas. Gases found in the atmosphere that contribute to the greenhouse effect by absorbing infrared radiation (e.g., carbon dioxide).

Particulate. A substance consisting of separate particles.

Sensitive receptor. Villages where people live and/or congregate in the vicinity of FRCGP infrastructure.

2.5 Procedures

Performance will be measured through audits and inspections conducted by the FRL Environment Department. Performance indicators for air quality, noise and vibration management are outlined below.

2.5.1 Planning and preparation

Planning and preparation management measures to address air quality, noise and vibration emissions are detailed in Table 2-1.

Table 2-1 Planning and preparation management measures

No.	Management measures	Performance measure	Target	Responsibility
MM112	Sensitive receptors within 800 m of the infrastructure corridor will be made aware of the times and duration of construction activities associated with the concentrate pipeline.	Stakeholder engagement records.	Engagement with all affected villages.	Community Relations Superintendent
MM115	Schedule construction works to avoid working in proximity of villages on religious and cultural holidays, where practicable.	Dates of religious and cultural holidays included in construction schedule. Stakeholder engagement records.	No unresolved complaints from community and residents regarding air or noise emissions during religious and cultural holidays.	Construction Project Manager
MM118	The export facility at Vanimo Ocean Port and the main access road and concentrate pipeline associated with the infrastructure corridor will consider noise impacts in the design layout.	Final design demonstrates consideration of noise impacts.	Project design limits noise impacts to nearby residents.	SHE Manager
MM119	Train personnel and contractors, through site inductions, on potential noise and vibration impacts and appropriate management procedures (e.g., vehicle and truck drivers, earthwork machinery operators, dust suppression), including techniques to reduce noise emission.	Maintenance of induction register.	Completion of induction by all employees and contractors where relevant to their role.	SHE Manager
SEM057	Provide access to an effective and transparent Grievance Management Procedure for communities, employees and contractors.	Grievance management procedure.	Communications links defined in grievance management procedure.	Community Relations Manager

2.5.2 Management of air quality

2.5.2.1 Dust emissions

Management measures to address dust emissions are detailed in Table 2-2.

Table 2-2 Air emissions management measures

No.	Management measures	Performance measures	Target	Responsibility
MM126	During construction, nuisance dust will be managed using water sprays.	Records showing the use of dust suppression. Maintenance of incident register.	Dust suppression implemented during extended dry and windy weather periods. No unresolved complaints from community and residents regarding air quality.	SHE Manager
MM127	General measures will be applied to the construction works, including: • Limiting burning of vegetation or other waste materials on site. • Limiting dust generating activities in windy conditions where practicable. • Limiting the use of material stockpiles and minimising open stockpiles in areas prone to elevated wind erosion or close to sensitive receptors.	Records of on-site burning events. Records of regular visual inspections.	No unscheduled burning events. Erosion control measures implemented and control structures maintained.	SHE Manager

Table 2-2 Air emissions management measures (cont'd)

No.	Management measures	Performance measures	Target	Responsibility
MM128	Dust and exhaust emissions from trucks and other vehicles will be controlled by: • Maintaining vehicles and machinery in accordance with the manufacturer's specifications. • Establishing vehicle speed limits. • Ensuring vehicles keep to marked trafficable areas. • Covering trucks carrying dusty or erodible materials when travelling on public roads. • Covering the ROM stockpile at the mine, and the product stockpile at the Vanimo Ocean Port.	Maintenance records. Routine inspections of transport routes. Records of visual inspections of trucks as they exit the mine area.	Servicing and maintenance carried out in accordance with manufacturer's specifications. Drivers follow project related driving and road rules. No uncovered loads of erodible materials to be transported along main access road.	Environment Supervisor
MM129	Dust emissions from clearing and grading activities will be reduced by: • Limiting cleared areas as far as practicable and retaining existing vegetation where possible. • Stripping areas progressively and only where it is necessary for works to occur. • Retaining root stock in the ground where practicable to reduce erosion and to facilitate rapid rehabilitation, e.g., trimming and retaining trees rather than remove them, where practicable. • Employing stabilisation methods such as matting, grassing or mulch.	Records of regular visual inspections.	Clearance works conducted in accordance with management measures. No clearance of vegetation beyond that approved in site plan and clearance permits. Compliance with documented Rehabilitation and Revegetation Program.	SHE Manager

Table 2-2 Air emissions management measures (cont'd)

No.	Management measures	Performance measures	Target	Responsibility
MM130	Additional measures for sensitive receptors located within 800 m from road and construction activities include: • Locate fixed and mobile equipment with consideration to potential impacts on local residents. • Postpone, limit or relocate dust-generating activities in close proximity to villages in dry and windy (e.g., >5 m/s) conditions, where practicable. • Ensure blasting is not conducted in windy (e.g., >5m/s) conditions when works are within the wind path of nearby villages.	Records of regular visual inspections.	Clearance works conducted in accordance with management measures.	SHE Manager and Community Relations Manager
MM131	Proceed with clean up and restoration as soon as is practicable after works are completed to minimise the duration of exposure of disturbed areas.	Records of regular visual inspections.	Compliance with documented Rehabilitation and Revegetation Program.	Environment Superintendent
MM132	Consider discharge of emissions via appropriately designed stacks to limit downwash, wakes and eddy effects in the design of the waste incinerators and diesel generators.	Final design demonstrates consideration of air emissions.	Air emissions considered in final designs for incinerators and generators.	SHE Manager

2.5.2.2 Combustion and greenhouse gas emissions

The measures detailed in Table 2-3 will be undertaken to manage combustion and greenhouse gas emissions.

Table 2-3 Combustion and greenhouse gas emissions management measures

No.	Management measures	Performance measures	Target	Responsibility
MM133	Limit the use of diesel fuel through the optimisation of on-site driving practices such as: • Establishing speed limits on site. • Reducing gradients around site where possible.	Records of fuel consumption. Records of road and vehicle maintenance.	Fuel consumption consistent with fleet size and manufacturers specifications. All roads and vehicles maintained regularly and vehicles maintained in accordance with manufacturer's specifications.	Construction Project Manager
MM134	Develop and implement a greenhouse gas management system that accurately quantifies emissions on a regular basis to allow major sources of emissions and the effectiveness of adopted measures to be continually identified, measured and indexed.	Documented and approved system. Record greenhouse gas emissions (by calculation), using nationally and internationally recognised and approved calculation methods on an annual basis.	100% current reporting on greenhouse gas emissions and fuel consumption.	Environment Superintendent

2.5.3 Management of noise and vibration

The measures detailed in Table 2-4 will be undertaken to manage noise and vibration.

Table 2-4 Noise and vibration management measures

No.	Management measures	Performance measures	Target	Responsibility
MM113	When a grievance has been received, investigate and conduct noise and/or vibration monitoring, if required.	Maintenance of incident register.	No unresolved complaints from community and residents regarding noise nuisance.	Community Relations Manager
MM114	Communicate the findings of a grievance investigation to construction site personnel.	Maintenance of incident register.	All relevant findings communicated to construction personnel.	Community Relations Manager
MM116	Equipment and vehicles will be maintained regularly in accordance with manufacturers' specifications.	Maintenance records.	Servicing and maintenance carried out in accordance with manufacturer's specifications.	Environment Superintendent
MM117	Construct enclosures, bunds and noise barriers for operation of equipment and fixed infrastructure that may result in an exceedance of the adopted Project noise guidelines, where practicable.	Records of installation and visual inspections.	Installation of enclosures prior to use of equipment and fixed infrastructure.	SHE Manager
MM120	Vehicle speed, the use of compression brakes and horn signals will be limited on roads close to villages.	Maintenance of incident register.	No unresolved complaints from community and residents regarding noise nuisance.	SHE Manager

Table 2-4 Noise and vibration management measures (cont'd)

No.	Management measures	Performance measures	Target	Responsibility
MM121	Limit construction activities associated with the main access route, pipeline and export facility at the Vanimo Ocean Port to daytime hours, or schedule significant noise generating activities during the daytime where possible. Should night-time works or noise generating activities be required in exceedance of the project noise limits, alternative arrangements would be made with relevant sensitive receptors. Schedule aircraft movements during the daytime period to minimise sleep disturbance and annoyance when practicable.	Maintenance of incident register.	No unresolved complaints from community and residents regarding noise nuisance.	SHE Manager
MM122	In quarry areas near villages, place large rocks in dump trucks rather than dropping them in.	Records of visual inspections of quarry operations. Maintenance of incident register.	No unresolved complaints from community and residents regarding noise nuisance.	Load and Haul Superintendent
MP012	Locate fixed and mobile equipment (e.g., generators) sensitively with respect to sensitive receptors.	Records of regular visual inspections of work sites.	At least 500 m separation distance between equipment and sensitive receptors.	SHE Manager

2.6 Performance, monitoring and reporting

This FRL Air Quality, Noise and Vibration Sub-plan, and any other associated procedures will be reviewed annually to ensure that they remain valid.

Applicable plans and procedures will be reviewed after any air quality, noise or vibration incident or complaint to review their effectiveness and determine whether improvements are required.

General monitoring and reporting relevant to air quality, noise and vibration will include:

- Maintenance of induction and training records.
- Documenting of incidents and community complaints in incident reports.
- Monthly monitoring of weather conditions (wind speed, wind direction, temperature, humidity and rainfall) at the existing meteorological monitoring stations.
- Recording the use of dust suppression techniques in log books to gauge the effectiveness of suppression techniques against monitoring data.
- Recording of energy production, energy consumption and greenhouse gas emissions (by calculation).
- Maintenance of calibration records for monitoring equipment.
- Recording of servicing and maintenance of construction equipment in accordance with manufacturer's specifications.
- Visual monitoring of dust emissions from concentrate pipeline construction when close to villages.

Baseline monitoring of particulate emissions (PM_{10} and total suspended particles) will be conducted using low volume samplers or beta-attenuation monitors in villages close to the proposed main access road prior to construction commencing to determine background air quality.

Baseline noise monitoring ($L_{Aeq,\ 1hr}$) at selected sensitive receptors along the infrastructure corridor and Vanimo Ocean Port will be conducted to establish background noise levels prior to construction commencing. In the event that measured background noise levels exceed the WHO Guidelines for community noise shown in Table 2-5, then these measured noise levels will be used to develop site-specific criteria for monitoring purposes.

Complaints concerning air quality, noise or vibration will be recorded as incidents in the incident register. This register will record the complaint and actions taken to address the complaint and show that all reasonable complaints are addressed. Portable samplers will be used to monitor impacts downwind from activities upon receipt of the complaint.

Compliance by all personnel with the procedures in this plan will be verified through both routine and unannounced inspections and monitoring by the SHE Manager (or their delegate).

Results from monitoring activities will be recorded and annual reports prepared by in-house staff or suitably qualified and experienced third parties. Environmental performance reports will be submitted to the Conservation and Environment Protection Authority and other regulatory authorities, as part of routine environmental reporting as per the conditions of the environmental permit and other project approvals.

Table 2-5 outlines the monitoring required to demonstrate performance in air quality, noise and vibration management.

Table 2-5 Air quality, noise and vibration monitoring

Monitoring measure	Performance indicator	Target	Frequency
Air quality			
In response to a complaint; conduct dust monitoring at or between the receptor and the source.	Total suspended particulate (TSP) and PM_{10} using portable monitors (i.e., low volume sampler or beta-attenuation monitor).	TSP 150 µg/m^3 PM_{10} 50 µg/m^3 24-hour averaging period.	In response to complaints
Noise			
Conduct noise monitoring at relevant sensitive receptors during construction of the concentrate pipeline in response to complaints and/or to verify construction noise levels.	$L_{Aeq, 1hr.}$	55 dBA $L_{Aeq, 1hr.}$	In response to complaints or as required
Vibration			
Conduct vibration monitoring where vibration generating construction activities are carried out within 55 m of sensitive receptors.	Peak vibration level for continuous vibration (vertical) during the daytime.	0.6 mm/s	As required

FRIEDA RIVER

Frieda River Limited

Frieda River Copper-Gold Project

Environmental Management and Monitoring Plan

Biodiversity Management Sub-plan

Construction

Environmental Management and Monitoring Plan
Biodiversity Management Sub-plan
Construction

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3. Biodiversity Management Sub-plan

3.1 Background

This sub-plan has been developed to manage the potential impacts on the terrestrial, freshwater and nearshore marine biodiversity and natural habitats that may occur, during the construction phase of the Frieda River Copper Golder Project (FRCGP).

Construction activities and their associated effects that this sub-plan addresses include:

- Physical disturbance involving:
  - Clearing of vegetation and bulk earthworks for the construction of the FRCGP infrastructure and mine development.
  - Blasting, excavation and sidecasting to create suitable surfaces for facilities and infrastructure.
- The potential for accidental spills, leaks and incorrect disposal of waste.
- Increased fauna mortality from traffic.
- Accidental ignition of uncontrolled wild fire.

Potential impacts that may arise as a result of FRCGP activities that this sub-plan addresses include:

- Habitat loss from vegetation clearance and earthworks and subsequent physical effects (e.g., smothering).
- Habitat degradation resulting from edge effects, barrier effects, deposition of eroded sediments, or from contamination caused by accidental spills of hazardous materials.
- Reduced abundance and/or diversity of terrestrial, freshwater and nearshore marine flora and fauna species, including conservation significant and endemic species as a consequence of:
  - Changes to available habitat (including food sources, shelter and nesting or roosting sites) due to habitat loss and degradation (described above).
  - Injury, death or displacement of flora and fauna from vegetation clearing and earthworks, collision with vehicles, predation by invasive species, infection by introduced diseases or increased hunting in previously inaccessible areas or increased hunting pressure.
  - Increased disturbance (through project-related noise and lighting) disrupting the behaviour of fauna and potentially reducing reproductive success.

To manage potential impacts, where vegetation clearance is unavoidable, the extent of clearing will be limited, and clearance undertaken in a manner that reduces the impacts on environmental, social and land use values, and provides opportunities for future revegetation.

Further measures that will limit impacts on terrestrial, freshwater and nearshore marine biodiversity are outlined in the:

- Acid and Metalliferous Drainage, Waste Rock and Tailings Management Sub-plan.
- Air Quality, Noise and Vibration Management Sub-plan.

- Emergency Response and Fire Management Sub-plan.
- Erosion and Sediment Control Management Sub-plan.
- Hazardous Materials, Fuel Handling and Spill Response Management Sub-plan.
- Rehabilitation Management Sub-plan.
- Traffic and Transport Management Sub-plan.
- Waste Management Sub-plan.
- Water Management Sub-plan.
- Weed, Pest and Quarantine Management Sub-plan.

The quarantine measures are located within the Weed, Pest and Quarantine Management Sub-plan to ensure that personnel and freight movements are controlled in and out of the FRCGP area.

3.2 Objectives

The objectives of biodiversity management are to:

- Reduce the impacts of the FRCGP on terrestrial, freshwater, and nearshore marine habitats and specific ecological aspects arising from construction activities.
- Reduce habitat fragmentation and degradation.
- Reduce disturbance to terrestrial, freshwater and nearshore marine fauna from FRCGP activities.
- Conduct monitoring of the terrestrial, freshwater and nearshore marine environment to allow identification of any unexpected impacts of FRCGP construction.

3.3 Responsibility

Implementation of the Biodiversity Management Sub-plan will be the responsibility of the Safety, Health, Environment (SHE) Manager. The SHE Manager is responsible for ensuring that activities associated with the project are undertaken in compliance with relevant statutory regulations, and the FRL environment policy and FRCGP EMMP. All staff, including contractors, are responsible for compliance with this sub-plan.

3.4 Definitions

Barrier effect. Occurs where a strip of non-forest habitat (including linear infrastructure) acts as a barrier to fauna movement and potentially splits a species population into two or more fragmented populations.

Critically endangered. A critically endangered species is one that has been categorised by the International Union for Conservation of Nature (IUCN) as facing a very high risk of extinction in the wild (http://www.iucnredlist.org/).

Endangered. An endangered species is a species that has been categorised as likely to become extinct by the IUCN (http://www.iucnredlist.org/).

Edge effect. Alteration of forest ecology adjacent to cleared areas due to the creation of an open space. Alteration can include microclimate changes such as raised light levels, higher temperature and lower humidity, resulting in altered (and potentially less favourable) conditions for forest biota.

Nearshore marine environment. Relating to, consisting of or being in nearshore marine water, i.e., nearshore, and estuarine environments.

Vegetation clearance permit. Internal permit for the clearing of new areas before construction commences. This process includes the submission of a plan to identify the extent of the area to be cleared of vegetation and approval from the Environment Superintendent.

3.5 Procedures

3.5.1 Planning and preparation

Planning and preparation management measures to address biodiversity management are detailed in Table 3-1.

Table 3-1 Planning and preparation

No.	Management measures	Performance measure	Target	Responsibility
Inductions, training and awareness				
MM078	Implement appropriate inductions and education to ensure staff comply with hunting and collecting regulations.	Maintenance of induction register.	Completion of induction by all employees and contractors where relevant to their role.	SHE Manager
MM079	Include training in the recognition of endangered fauna in inductions of all staff and contractors. Encourage a precautionary approach "If in doubt - report it".	Maintenance of induction register.	Completion of induction by all employees and contractors where relevant to their role.	SHE Manager
MP014	Ensure that personnel are familiar with this sub-plan and the importance of controlling impacts on terrestrial, freshwater and nearshore environments during construction.	Maintenance of induction register.	Completion of induction by all employees and contractors where relevant to their role.	SHE Manager
MP015	Induct employees and contractors regarding vegetation management including the process of obtaining a vegetation clearing permit.	Maintenance of induction register.	Completion of induction by all employees and contractors where relevant to their role.	SHE Manager
MM104	Establish cave management protocols for worker and contractor inductions, to prohibit unnecessary disturbance of bat colonies by FRCGP workers.	Evidence of established procedures.	Documented and approved procedures prior to the beginning of construction.	SHE Manager
Further management planning				
MM057	Locate quarries, and temporary infrastructure in cleared areas, secondary and/or degraded forest as far as practicable.	Incorporate environmental considerations when siting infrastructure as part of detailed engineering.	Maximise the use of disturbed areas for quarries and temporary facilities as part of planning.	SHE Manager

Table 3-1 Planning and preparation (cont'd)

No.	Management measures	Performance measure	Target	Responsibility
Further management planning (cont'd)				
MM058	Retain and manage vegetation between Project components, where practicable.	Maintenance of no-go areas with appropriate signage and training.	Zero reported incidences of construction activity in no-go areas.	SHE Manager
MM074	Develop and implement fire management procedures for the construction phase of the FRCGP aimed at reducing the likelihood of fires starting in the FRCGP disturbance area to very low. The procedures will include observations for weather trends and forecasts and the requirement for a permit for burning of cleared vegetation and other fires, particularly in the hill environment in drought years.	Evidence of established procedures.	Documented and approved procedures prior to the beginning of construction.	SHE Manager
MM090	Avoid, where practicable, placement of infrastructure in the Nena limestone karst area, and minimise disturbance to other karst areas.	Incorporate constraint into detailed engineering design.	No infrastructure in Nena karst.	SHE Manager
MM106	Establish a conservation program for fauna at risk of being overhunted to manage direct impacts and indirect impacts of in-migration.	Documented, approved and adequately financed program with input from appropriate stakeholders.	Documented program.	SHE Manager
MM107	Develop a fauna relocation program for species of conservation concern to be implemented during clearing of relevant habitat.	Evidence of established procedures and implementation of program during construction.	Documented and approved program with input from appropriate stakeholders prior to beginning of construction.	SHE Manager

Table 3-1 Planning and preparation (cont'd)

No.	Management measures	Performance measure	Target	Responsibility
Design of infrastructure (cont'd)				
MM097	Minimise disturbance to forest on or close to the summit if facilities must be placed on hilltops.	Incorporate constraint into detailed engineering design.	Some forest retained on or close to hilltops where practicable.	SHE Manager
MM085	Install markers visible to birds on the transmission line to reduce the likelihood of bird and bat strikes at high risk locations including near waterbodies.	Incorporate constraint into detailed engineering design.	Relevant measures included in detailed engineering design.	Environment Superintendent
MP016	Ensure that sensitive features that are to be avoided are identified on maps and work plans.	All sensitive features are mapped prior to construction. Audit of FRCGP GIS contains layers for sensitive features.	Inclusion of all recorded sensitive features on maps. FRCGP GIS regularly updated.	SHE Manager
MM044	Where practicable, locate valley-bottom access alignments so as to provide a buffer strip of natural vegetation between the access ways and watercourses.	Incorporate constraint into detailed engineering design.	Engineering design and construction includes natural vegetation buffers between access ways and watercourses.	SHE Manager
MM091	As far as practicable place transmission line pylons in already cleared or degraded areas.	Inspection of transmission line pylons.	Minimise disturbance to undisturbed areas.	SHE Manager

3.5.2 Pre-construction

Pre-construction management measures to address biodiversity management are detailed in Table 3-2.

Table 3-2 Pre-construction measures

No.	Management measures	Performance measure	Target	Responsibility
MM063	Complete targeted pre-construction surveys of proposed transmission line tower and access track locations within intact primary forest to identify ecological values to be considered as part of the detailed design of the transmission line.	Documentation of survey results.	Siting of transmission line towers and access tracks avoids intact primary forest.	Construction Project Manager
MM092	For roads required within riparian vegetation, utilise areas of disturbed riparian vegetation as far as practicable. Keep road alignment approaches to watercourses as close to right angles as practicable to limit disturbances to the banks of watercourses.	Documentation of survey results. Inspection of engineering records.	Route of all relevant access ways limits the extent of riparian vegetation cleared. Road alignments limit disturbance to watercourse banks.	Construction Project Manager
MM102	Ensure that any limestone karst areas situated above RL 500 m and located within 2 km of project components is surveyed for the presence of roosting populations of Bulmer's fruit bat *(Aproteles bulmerae)* prior to the development.	Documentation of survey results.	Survey results inform management measures to avoid any Bulmer's flying fox and their roosting sites.	SHE Manager

Table 3-2 Pre-construction measures (cont'd)

No.	Management measures	Performance measure	Target	Responsibility
MM103	If Bulmer's flying fox (*Aproteles bulmerae)* is located, develop a management plan that includes 1) avoidance of direct disturbance and encroachment by project activities, 2) avoiding construction that would increase access to the roosting site, 3) monitor the population, 4) implement a local cultural awareness program with the objective of a local moratorium on hunting of cave roosting flying foxes.	Completion of management plan including consultation with relevant stakeholders, if required.	Zero reported incidence of direct disturbance to and encroachment on Bulmer's flying fox roosting sites.	SHE Manager
MM104	Conduct a pre-clearance survey of infrastructure, including quarries, to determine presence of caves with bat colonies and where colonies are located within 100 m of infrastructure, establish procedures to reduce disturbance, where practicable. • Limiting or controlling where practical, blasting within 150 m of known colonies of cave bats. • Avoiding quarry sites within 150 m of caves with protected bat species, as far as practicable. Potential quarry sites should not be located within 150 m of caves with protected bat species as far as practicable.	Completion of survey, if required. Establishment of procedures to reduce disturbance.	Zero reported incidence of disturbance to bat colonies.	Environment Superintendent

3.5.3 Construction

Construction measures to address biodiversity management are detailed in Table 3-3.

Table 3-3 Construction measures

No.	Management measures	Performance measure	Target	Responsibility
MM027	Mark the extent of vegetation to be cleared on technical drawings and mark in the field. Do not clear beyond design limits.	Clearance does not exceed areas approved in vegetation clearing permits (any clearance beyond permitted areas must be reported as an incident). All clearing supported by a clearing permit.	100% of clearing mapped and pegged on the ground prior to clearing.	Environment Superintendent
MM038	In areas that will be rehabilitated, use land clearing techniques that preserve the rootstock of removed vegetation in the ground, where practicable.	Evidence of land clearing measures used to preserve rootstock of removed vegetation.	Land clearing techniques developed to preserve rootstock.	Environment Superintendent
MM060	Retain bird-of-paradise display tree and megapode mounds as far as practicable.	Inclusion of details of known display trees of bird-of-paradise and/or megapode mounds in vegetation clearance permit application. Clearance does not exceed areas approved in vegetation clearing permits (clearance beyond permitted areas must be reported as an incident)	Zero non-conformances related to the vegetation clearance of display trees of bird-of-paradise and megapode mounds.	Environment Superintendent

Table 3-3 Construction measures (cont'd)

No.	Management measures	Performance measure	Target	Responsibility
MM061	Retain large trees (including fig trees) likely to have hollows and other roosting sites for fauna at sites for temporary facilities such as vehicle parks, lay down areas, storage sites, bulk fuel storage, dumps and temporary camp where practicable and safe to do so.	Clearance does not exceed areas approved in vegetation clearing permits (clearance beyond permitted areas must be reported as an incident)	Zero non-conformances relating to the clearance of trees marked to be avoided.	Environment Superintendent
MM065	Minimise the width of clearing required for linear infrastructure as far as practicable.	Clearance does not exceed areas approved in vegetation clearing permits (clearance beyond permitted areas must be reported as an incident) as demonstrated by regular inspection and monitoring by Environment Department.	Zero non-compliances recorded of clearing beyond FRCGP footprint.	Construction Project Manager
MM066	Retain trees along the edges of roads and pipeline routes so that the canopy gap is reduced where practicable and safe to do so.	Clearance does not exceed areas approved in vegetation clearing permits (clearance beyond permitted areas must be reported as an incident). Clearing supported by a clearing permit.	Zero non-conformances relating to the clearance of trees marked to be avoided.	Construction Project Manager
MM067	Install fauna 'underpasses' and/or 'overpasses' at strategic locations along the infrastructure corridor to reduce vehicular fauna strike.	Protocols developed.	To allow as much fauna as possible to pass below and/or above roadways.	SHE Manager

Table 3-3 Construction measures (cont'd)

No.	Management measures	Performance measure	Target	Responsibility
MM075	Maintain the mine access road (south of Hotmin), link road and FRHEP access road as private roads.	Project roads are controlled by checkpoints and swing gates.	No unauthorised access.	SHE Manager
MM077	Prohibit hunting, collecting, or harassing of wildlife, keeping wildlife as pets and/or the possession and/or transport of wildlife products by project employees and contractors at project sites.	Regular inspections and audits of premises and work sites.	Zero non-compliances recorded.	SHE Manager
MM080	Enforce speed limits on project roads, tracks, pipeline rights-of way and transmission line corridors.	Fauna injury and mortality.	Monitoring data shows no increase in rate of fauna injury and mortality during FRCGP construction.	SHE Manager
MM081	Prohibit the procurement or consumption of bush meat in project sites, including fly camps and exploration camps.	Regular inspection and monitoring by Environment Department.	Zero non-conformances of bush meat procurement.	Environment Superintendent
MM082	Prohibit non-security related project employees and contractors from possessing firearms and/or bows and arrows while engaged in project activities.	Regular inspection and monitoring by Environment Department.	Zero non-conformances of possession of firearms and bows.	Environment Superintendent
MM083	Prohibit keeping or temporary housing of pets or wild fauna at project facilities other than trained animals under the control of a handler.	Regular inspections and audits of premises and work sites.	Zero non-compliances recorded.	SHE Manager
MM086	Maintain unsealed roads, tracks, pipeline rights-of-way and transmission line corridors in a damp and compacted condition (when required and safe) to control dust.	Inspection of roads, tracks and pipeline right-of ways.	Zero non-compliances recorded	SHE Manager

Table 3-3 Construction measures (cont'd)

No.	Management measures	Performance measure	Target	Responsibility
MM087	Direct lights at facilities and camps to minimise shine into surrounding forest where practicable.	Evidence of constraint being considered in detailed engineering design.	Constraint considered in detailed engineering design.	Environment Superintendent
MM093	Preserve riparian vegetation to the greatest extent practical and create a buffer of natural vegetation between watercourses and construction areas, where practicable.	Clearance does not exceed areas approved in vegetation clearing permits (clearance beyond permitted areas must be reported as an incident) as demonstrated by regular inspection and monitoring by Environment Department.	Zero non-compliances recorded of clearing beyond project footprint.	Construction Project Manager
MM094	Stabilise cleared banks to facilitate regeneration of riparian vegetation.	Records of visual inspections.	No failures of banks.	Construction Project Manager
MM097	Minimise disturbance to forest on or close to the summit if facilities must be placed on hilltops.	Records of visual inspections and inventory list of species planted.	Hill tops to be revegetated with only native species.	Environment Superintendent
MM101	Implement good industry-practice management of in-stream activities to limit the downstream extent of turbid water created by fords, trenching or bridge building as far as practicable.	Review management documentation. Inspect work sites.	Implementation of good industry-practice management.	SHE Manager
MM108	Project workers or contractors to report sightings of the following species to the project environment team: Long-beaked echidna (*Zaglossus* spp.), Telefomin cuscus (*Phalanger matanim*), black-spotted cuscus (*Spilocuscus rufoniger*) and any tree kangaroo.	Sightings documented and reported.	All sightings reported to project environment team. Construction activities managed to avoid disturbing areas identified.	Construction Project Manager

Table 3-3 Construction measures (cont'd)

No.	Management measures	Performance measure	Target	Responsibility
MM088	Limit disturbance in montane forest as far as practicable and do not place any temporary infrastructure in this habitat.	Incorporate constraint into detailed engineering design.	No disturbance in areas of montane forest.	SHE Manager
MP018	Restrict construction activities to the project footprint.	Clearance does not exceed areas approved in vegetation clearing permits (clearance beyond permitted areas must be reported as an incident). Clearing supported by a clearing permit.	Zero non-compliances recorded of clearing beyond FRCGP footprint.	Environment Superintendent
MP019	Supervise vegetation clearing to ensure disturbance is in accordance with the vegetation clearing permit, so as to prevent unnecessary clearing.	Regular inspection and monitoring of vegetation clearance by Environment Department.	100% of clearing supervised in areas of significant vegetation or habitat.	Environment Superintendent

3.6 Performance, monitoring and reporting

This FRL Biodiversity Management Sub-plan, and any other associated procedures will be reviewed annually to ensure that they remain valid.

Applicable plans and procedures will be reviewed after any non-conformance with a measure in this sub-plan to ensure that they were effective and to identify where improvements can be made.

General monitoring relevant to biodiversity will include documenting of incidents in incident reports and maintenance of induction and training records. Incident reports will be completed, and appropriate measures will be taken to ensure that similar incidents or accidents will not occur in the future. Specific biodiversity monitoring is outlined in Table 3-4.

Ongoing monitoring of construction activities will be undertaken to assess the success of management measures and identify areas where changes to management measures will limit risks to biodiversity. Where monitoring identifies deficiencies in the control methods described above, the procedures in this sub-plan will be reviewed.

Compliance by personnel with the procedures in this sub-plan will be verified through both routine and unannounced inspections and monitoring by the SHE Manager (or their delegate). Inspection results will be reported to the Safety and Emergency Response Team (ERT) Superintendent.

Monitoring activities will be recorded, and annual reports prepared by in-house staff or suitably qualified and experienced third parties. Environmental performance reports will be submitted to the Conservation Environment Protection Authority and other regulatory authorities as part of routine environmental reporting as per the conditions of the environmental permit and other FRCGP approvals.

Table 3-4 Biodiversity monitoring

Monitoring measure	Performance indicator	Target	Frequency
Ground disturbance and vegetation clearance	Area of disturbance	Does not exceed areas approved in vegetation clearing permits (clearance beyond permitted areas must be reported as an incident)	Weekly during vegetation clearance.
	Cleared vegetation recovered, reused, recycled or stockpiled appropriately	Zero non-compliances recorded.	As required.
Monitoring of forest condition and biodiversity at FRCGP road and facility edges.	Diversity and cover of plant species.	Reduction does not exceed 50% in diversity and 75% in cover.	Annual

Table 3-4 Biodiversity monitoring (cont'd)

Monitoring measure	Performance indicator	Target	Frequency
Analysis of imagery to monitor habitat cover and condition.	Broad-scale vegetation community changes.	No large-scale vegetation community changes are recorded.	Biennial
Monitoring of abundance and diversity of aquatic biota including the presence/abundance of introduced species in watercourses downstream of the FRCGP, as well as at reference sites.	Diversity and abundance of macroinvertebrate and fish taxa.	No departure from predicted changes in aquatic biota.	Annual
Metal concentrations in the tissues of aquatic biota.	Metal bioaccumulation in comparison to the baseline.	No statistically significant change from baseline.	Annual
Catches per unit effort of key fish species important from a resource use perspective.	Departure of biomass of key fish in comparison to baseline.	No significant change from baseline.	Annual
Downstream riverine and floodplain ecosystem condition.	Broad-scale vegetation or community changes.	No significant change from baseline.	Annual
Monitoring of amphibious fauna in streams and adjoining forests.	Integrated measure of ecological health of streams and riparian vegetation. Persistence of many of the species new to science.	No reduction of ecological health at landscape scale. No loss of species new to science.	Annual
Aerial surveys of waterbirds and flying fox colonies in the Terrestrial Biodiversity Study Area Lowland Zone.	Abundance of migratory and/or congregatory species.	No evidence of large colonies being abandoned demonstrably as a result of the FRCGP.	Annual
Fauna injury and mortality.	Records kept of animal deaths, injuries or entrapments as a result of FRCGP activities.	No increase in rate of fauna injury and mortality during FRCGP construction.	Ongoing
	Routine marine fauna observation near Vanimo Ocean Port.	No increase in rate of fauna injury and mortality during FRCGP construction.	Ongoing

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Frieda River Copper-Gold Project

Environmental Management and Monitoring Plan

Cultural Heritage Management Sub-plan

Construction

Environmental Management and Monitoring Plan
Cultural Heritage Management Sub-plan
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4. Cultural Heritage Management Sub-plan

4.1 Background

Construction activities have the potential to uncover and damage artefacts and sites of archaeological, cultural or historical significance, primarily as a result of vegetation clearance, earthworks and ground disturbance.

This sub-plan details procedures to be followed for the Frieda River Copper Gold Project (FRCGP) to ensure that sites and artefacts of cultural, historical and archaeological significance are identified, protected and managed in accordance with statutory requirements. It also provides procedures that should be followed before work can commence in an undisturbed area.

4.2 Objectives

The objectives for managing cultural, heritage and archaeological artefacts and sites are to:

- Identify sites and artefacts of historical, cultural and archaeological significance (registered and non-registered) that may be disturbed by FRCGP construction activities.
- Avoid or limit disturbance to registered and unregistered sites of historical, cultural and archaeological significance.
- Manage all found historical, cultural and archaeological artefacts and sites in accordance with relevant legislation.

4.3 Responsibility

The FRL Community Relations Manager is responsible for the implementation of this sub-plan, and for ensuring others within the company comply with procedures found within this document.

4.4 Definitions

Archaeological site. A site where traces of past human use occur, including settlement or burial sites, that have research potential for reconstructing the prehistory of a site or region using scientific or systematic methods.

Artefact. An item made or given shape by a person, such as a tool or a work of art; especially an object of archaeological interest.

Cultural site. A site that is considered significant by the local community. These sites are generally further classified as sacred, mythical or historical. In some cases, settlement or burial sites are considered to be cultural sites.

Disturbance. Any direct or indirect physical destruction, movement, relocation, burying or flooding of archaeological or cultural heritage sites.

Exhumation. To dig or recover an archaeological or cultural find that has been buried.

Salvage. To recover or save archaeological and cultural heritage artefacts or sites.

Land clearance permit. Internal permit for the clearing of new areas before construction commences. This process includes the submission of a plan to identify the extent of the area to be cleared and approval from the Environment Superintendent.

4.5 Procedures

FRL will implement avoidance, mitigation and management measures to address the potential impacts on archaeology, cultural and historical artefacts and sites.

4.5.1 Planning and preparation

The planning and preparation measures to address cultural heritage are detailed in Table 4-1.

Table 4-1 Planning and preparation

No.	Management measure	Performance measure	Target	Responsibility
SEM030	Include cultural heritage awareness briefings in workforce inductions, including briefing on individual obligations to protect cultural heritage in accordance with PNG law.	Maintenance of induction register.	Induction completed by all employees and contractors where relevant to their role.	Community Relations Manager
SEM033	Conduct engagement with local communities regarding: • The content of the Cultural Heritage Management Sub-plan. • The development of culturally appropriate methods for the practical management of cultural heritage values that are to be protected from impacts. • The development of appropriate management measures in relation to their oral tradition sites. Culturally appropriate responses to the management of sites and places that will be unavoidably impacted by project activities may include avoidance, exhumation/relocation of the value and traditional ceremonies (that should precede the commencement of project activities in that location).	Documented engagement activities with relevant communities.	Engagement with all relevant communities.	Community Relations Manager
MP022	Develop and implement a 'Chance Finds Protocol' with clear processes for reporting, investigation and management of cultural heritage chance finds discovered during project-related activities.	Records of chance finds.	100% compliance with the Chance Finds Protocol.	Community Relations Manager
MP023	Ensure that a Cultural Heritage Site Card is completed for all newly discovered sites and artefacts that have been confirmed to be of cultural, historical or archaeological significance.	Documented Cultural Heritage Site Card.	100% completion for newly discovered sites.	Community Relations Manager

Table 4-1 Planning and preparation (cont'd)

No.	Management measure	Performance measure	Target	Responsibility
MP187	Maintain a cultural heritage site database and update the database as new information becomes available. The database will inform planning and design, and will assist in the implementation of recommended management measures (including the precise locations of all sites, particularly those to be avoided).	Documented and current database.	All cultural heritage sites documented in database.	Community Relations Manager
MP188	Conduct pre-construction cultural heritage clearance surveys along the final alignment of linear infrastructure corridors, and within the disturbance footprints of previously unsurveyed areas, to identify any new cultural heritage sites requiring management or impact mitigation.	Completion of survey, if required.	Documentation of survey results.	Community Relations Manager
MP189	Ensure that archaeology and cultural site information is considered by infrastructure design teams when making siting decisions to avoid disturbance to the extent practicable.	Cultural heritage included in site selection criteria.	Align cultural heritage values with the infrastructure design.	Construction Project Manager Community Relations Manager
MP193	Specify salvage activities (whether it be surface artefact collections or subsurface archaeological excavations) where required, including but not limited to: • Having a suitably qualified professional archaeologist develop an appropriate salvage method and lead the salvage investigations. • Development of an appropriate salvage methodology to be implemented prior to ground disturbing project activities taking place. • Establishing specific procedures for the exhumation of any human remains that may be unearthed as chance finds or during cultural heritage salvage investigations.	Documented and approved salvage activities for all sites to be disturbed.	Documented salvage activities.	Community Relations Manager
MP024	Where the recording of oral traditions is recommended (see site specific measures), engage a suitably qualified professional to complete the fieldwork prior to ground disturbing project activities taking place.	Documented interview with relevant landowners.	100% completion for recommended sites.	Community Relations Manager

4.5.2 Cultural heritage management

General management measures to ensure the appropriate management of cultural heritage sites are detailed in Table 4-2.

Table 4-2 Cultural heritage management

No.	Management measure	Performance measure	Target	Responsibility
SEM031	Disseminate information derived from chance finds acquired during the project to the custodians of cultural heritage and/or the public and National Museum and Gallery, where relevant.	Documented communications with relevant stakeholders.	All information from chance finds communicated within 72 hours of close out of finding.	Community Affairs Manager
SEM032	Support research programs which document cultural aspects of communities including traditional subsistence practices (e.g., hunting and gardening), language, capturing 'stories' and other cultural aspects.	Documented, approved and adequately financed programs with input from appropriate stakeholders.	Documented programs.	Community Affairs Manager
MP190	Implement standard operating procedures and permits for ground disturbance that require approval by Community Relations officers to ensure boundaries of cultural heritage sites identified are avoided or authorised disturbance is kept to a minimum, prior to disturbance.	Documented approval of land clearance permits by Community Relations officers. Inclusion of cultural heritage site boundaries in land clearance permits.	Zero non-conformances of clearing.	Construction Project Manager SHE Manager
MP191	Limit disturbance to cultural sites by confining traffic and machinery to designated tracks, as far as practicable.	Inclusion of cultural heritage details in land clearance permits.	No clearance or disturbance outside of permitted and demarcated areas.	Community Relations Manager SHE Manager
MP192	Prohibit the disturbance of cultural heritage sites by project workers or contractors while working, travelling in project vehicles, and residing in project accommodation.	Prohibition of disturbance of cultural heritage sites included in employee and contractor agreements.	No unpermitted disturbance of cultural heritage sites	Community Relations Manager SHE Manager

4.5.3 Site specific measures (pre-construction)

The measures detailed in Table 4-3 will be undertaken to ensure the appropriate management of specific cultural heritage sites identified during EIS baseline studies and shown in Figure 4-1[1].

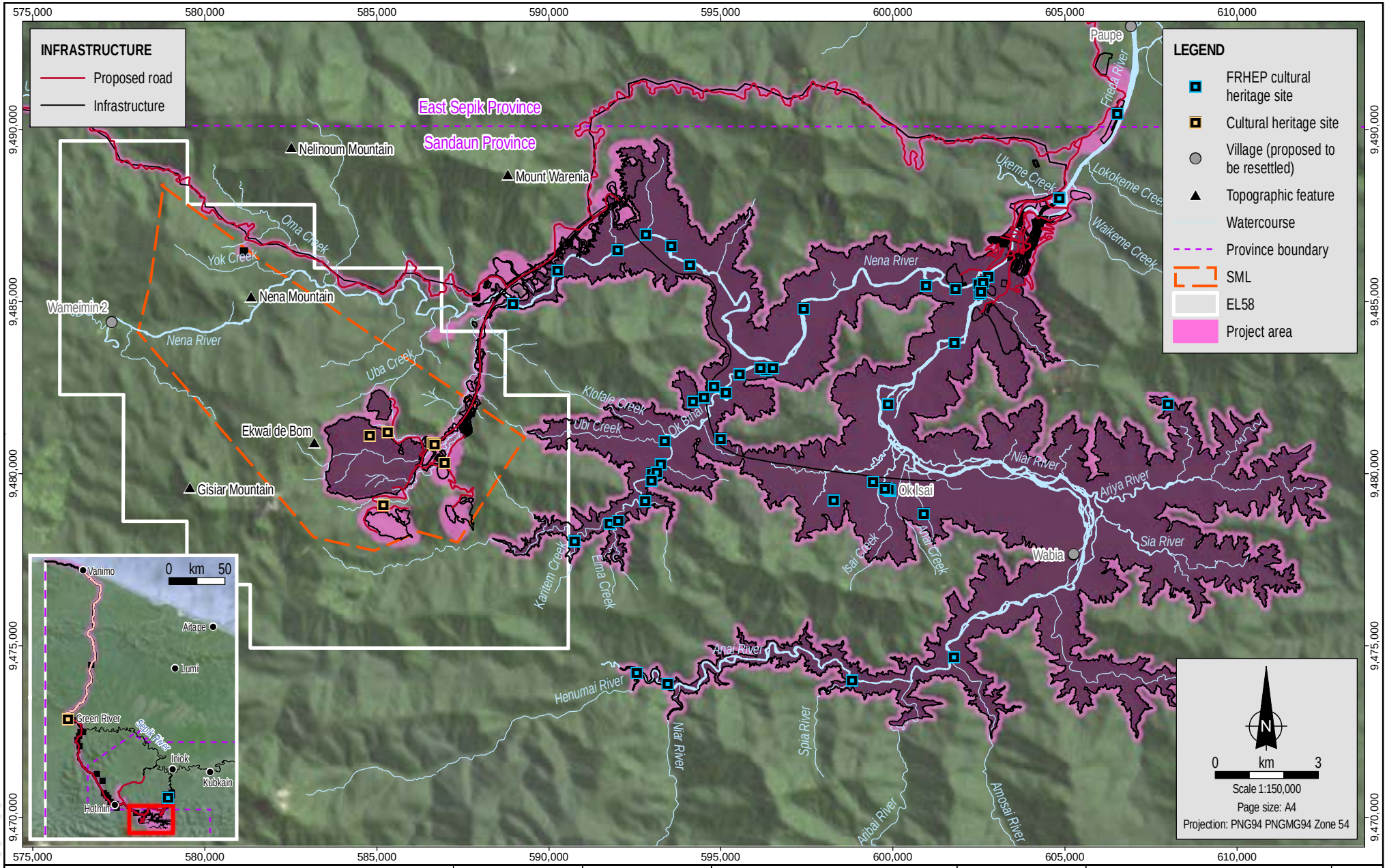
Table 4-3 Site specific measures

No.	Management measure	Performance measure	Target	Responsibility
MP025	Offer to relevant clans or village communities to assist with culturally appropriate ceremonies prior to construction of the main access road, Ok Binai waste dump and mine access road and construction and use of the diorite quarry for the following sites: • H037. • H038. • H042/H162. • H045 • H143. • H158.	Documented engagement with relevant clans or communities. Approved and adequately financed programs to assist with ceremonies.	Assistance to be offered and provided prior to construction beginning.	Community Relations Manager
MP026	Conduct pre-construction surveys by a qualified archaeologist to identify whether or not there is a potential for subsurface cultural deposits prior to construction and operation of the open-pit at sites H042/H162 and H045.	Documented results of survey. Evidence of archaeologist qualifications.	Survey to be completed prior to proposed disturbance.	Community Affairs Manager
MP027	Conduct pre-construction surveys to confirm if site H038 is a duplicate of site H158.	Documented results of survey.	Survey to be completed prior to proposed disturbance.	Community Affairs Manager
MP028	Conduct salvage collection of visible surface artefacts by a qualified archaeologist prior to construction and operation of the open-pit at sites H042/H162 and H045.	Record of salvage. Evidence of archaeologist qualifications.	Salvage to be completed prior to construction beginning.	Community Affairs Manager

[1] Identification numbers for cultural heritage sites have been removed from Figure 4-1 in this version of the EMMP due to cultural sensitivity.

Table 4-3 Site specific measures (cont'd)

No.	Management measure	Performance measure	Target	Responsibility
MP029	If subsurface archaeological deposits are identified, conduct an appropriate salvage excavation by a qualified archaeologist at sites H042/H162 and H045, prior to construction and operation of the open-pit.	Record of salvage. Evidence of archaeologist qualifications.	Salvage to be completed prior to construction beginning.	Community Affairs Manager
MP030	Once prior approval from affected communities has been received, conduct recording of oral traditions by an anthropologist prior to construction of the main access road, Ok Binai waste dump and mine access road and Construction and use of the diorite quarry for the following sites: • H037. • H038. • H042/H162. • H045 • H143. • H158.	Documented interview with relevant landowners.	Recording of oral tradition prior to construction beginning.	Community Affairs Manager
MP033	Conduct recording of all rock art identified at the site H042/H162 by a qualified archaeologist prior to construction and operation of the open-pit.	Records of all rock art found. Evidence of archaeologist qualifications.	All rock art is identified and recorded.	Community Affairs Manager



Source:
Cultural heritage sites and study areas from ALA.
Infrastructure, roads and tenements from FRL.
Villages, topographic features, watercourses and water bodies from FRL and Coffey.
Provinces from NMB.
Landsat satellite imagery from FRL (capture date unknown). Hillshade DEM from SRTM.

coffey
A TETRA TECH COMPANY

Date: 05.09.2018
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File Name: 11575_22_F04-04_GIS

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Sepik Development Project

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Cultural heritage sites identified as having potential to be impacted by project activities

Figure No: **4-1**

MXD Reference: 11575B_22_GIS001_v0_4

4.6 Performance, monitoring and reporting

The FRL FRCGP Cultural Heritage Management Sub-plan, and any other associated procedures will be reviewed annually to ensure that they remain valid.

Applicable plans and procedures will be reviewed after any non-conformance with a measure in this sub-plan to ensure that they were effective and to identify where improvements can be made.

General monitoring relevant to cultural heritage will include documenting of incidents in incident reports and maintenance of induction and training records. Incident reports will be completed and appropriate measures will be taken to ensure that similar incidents or accidents will not occur in the future. Specific monitoring of disturbance to cultural heritage sites is outlined in Table 4-4.

Compliance by personnel with the procedures in this sub-plan will be verified through both routine and unannounced inspections and monitoring by FRL Community Affairs Department personnel.

Monitoring activities will be recorded and annual reports prepared by in-house staff or suitably qualified and experienced third parties. Environmental performance reports will be submitted to the Conservation and Environment Protection Authority and other regulatory authorities, as part of routine environmental reporting as per the conditions of the environmental permit and other project approvals.

Table 4-4 Cultural heritage monitoring

Monitoring measure	Performance indicator	Target	Frequency
Inspections of known archaeological and cultural heritage sites that are avoided to assess the preservation and integrity of structures and the effectiveness of current management techniques.	Site record in cultural heritage database.	Preservation of known and avoided cultural heritage sites and no significant degradation of structural integrity where relevant.	Quarterly during the first year of construction, with annual inspections thereafter.
Inspections of all newly discovered historical, cultural and archaeological artefacts and sites in accordance with the Chance Finds Protocol.	Artefact or site record in cultural heritage database.	All new artefacts and sites documented in cultural heritage database and managed in accordance with the Chance Finds Protocol.	Once after completion of Chance Finds Protocol process to verify process and then inspect as per known sites inspection frequency.

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Frieda River Copper-Gold Project

Environmental Management and Monitoring Plan

Emergency Response and Fire Management Sub-plan

Construction

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5 Emergency Response and Fire Management Sub-plan

5.1 Background

During Frieda River Copper-Gold Project (FRCGP) construction activities there is the potential for a range of emergency situations to occur either as a result of construction activities, such as incidental events causing explosions or uncontrolled fire or due to natural hazards such as landslides, severe flooding, earthquakes and tsunamis.

5.1.1 Emergency response management

Examples of the types of emergencies that could occur during the FRCGP are covered within this sub-plan. It is not the intention of this document to provide the detail of these emergency situations, procedures and response plans. A detailed project emergency response management procedure will be developed prior to commencing construction to address these areas. As a part of this, a risk assessment will be undertaken for each of the potential emergency situations and the scenarios under which they could eventuate will be described. Specific management measures will then be developed for each of these situations.

Examples of accidental events and natural hazards that could occur on-site during construction include:

- Aircraft or vehicle accident.
- Vessel collision.
- Hazardous material spill or leak.
- Uncontrolled explosion.
- Structure failure.
- Natural disasters, such as earthquake, landslides, severe flooding, tsunamis (inundation of Vanimo).
- Fire.
- Epidemic, pandemic or communicable disease outbreak.
- Local unrest, demonstrations and riots.

Prevention and management measures have only been included in this sub-plan if they are not covered elsewhere. For example, prevention of civil unrest, epidemic, pandemic or communicable disease outbreak is covered in this sub-plan but prevention of vehicle and vessel collisions is covered in the Traffic and Transport Sub-plan. Likewise, prevention of uncontrolled explosion or hazardous material spills are covered in the Hazardous Materials and Fuel Handling, and Spill Response Management Sub-plan.

5.1.2 Fire management

The FRCGP area typically has wet conditions and tropical vegetation around the mine and integrated storage facility (ISF) areas and concentrate pipeline. Climate events such as El Niño – Southern Oscillation have occasionally led to drought conditions in PNG, which leaves the landscape unusually

dry. During these variations in weather, the dry conditions and increased fuel load associated with vegetation drying out provides an increased risk of fire.

The environmental impacts associated with uncontrolled fire may include fire spreading into surrounding vegetation, and release of large quantities of air emissions and contaminated runoff from firewater, with subsequent impacts on water quality, biota and potentially human health. The magnitude of this will be heavily dependent the extent of the fire driven by the climatic conditions at the time.

5.2 Objectives

The objectives of the Emergency Response and Fire Management Sub-plan are to:

- Provide the framework for the preparation, management and recovery from emergency situations.
- Provide the framework for the development and implementation of the detailed emergency response and fire management procedures.
- Limit the occurrence of civil unrest among the workforce and as a result of in-migration.
- Limit the spread of disease in the event of an outbreak among the workforce and/or communities.
- Limit uncontrolled fire and explosions.

5.3 Responsibility

Implementation of the Emergency Response and Fire Management Sub-plan will be the responsibility of the Safety, Health and Environment (SHE) Manager. The SHE Manager is responsible for ensuring that activities associated with the FRCGP are undertaken in compliance with FRL's detailed emergency response management procedure, relevant statutory regulations and other safety policies, and the FRL environment policy and FRCGP Construction Environmental Management and Monitoring Plan (EMMP). All staff, including contractors, are responsible for compliance with this sub-plan.

5.4 Definitions

Emergency. A present or imminent event that requires prompt coordination of actions or special regulation of persons or property to protect the health, safety, or welfare of people, or to limit damage to property and the environment.

Hazardous material. A hazardous material is any substance, mixture or article that satisfies the criteria of one or more *Globally Harmonised System of Classification and Labelling of Chemicals* (GHS) hazard classes (United Nations, 2011).

In relation to chemicals, a hazard is a set of inherent properties of the substance, mixture, article or process that may cause adverse effects to organisms or the environment.

Hot works. Any activity likely to produce a source of ignition. It includes but is not limited to:

- All forms of welding: Any process designed to fuse, weld, build up or line materials, which generates heat in the process.

- Cutting: Any activity designed to remove or separate materials using an energy source which generates a flame or a spark.
- Grinding: Any activity utilising mechanical, electrical or pneumatic energy to rotate a grinding wheel or disc which generates heat in the process.
- Soldering: Using an open flame.
- Belt cutting: Using a friction saw.

Natural hazard. The threat of a naturally occurring event that will have negative consequences on people and/or the environment.

Response plan. A concise, logical document that details the steps that should be followed by all personnel in the event of an emergency situation occurring.

5.5 Procedures

5.5.1 Planning and preparation

Planning and preparation management measures to address emergency response and fire management are detailed in Table 5-1.

Table 5-1 Emergency response and fire planning and preparation measures

No.	Management measures	Performance measure	Target	Responsibility
MP035	Train FRL workers and contractors to provide initial response to an emergency or fire incident.	Proportion of personnel trained in emergency and fire response.	Completion of training by all employees and contractors where relevant to their role.	Safety and Emergency Response Team (ERT) Superintendent
MP036	Conduct regular emergency preparedness and response drills.	Records of emergency preparedness and response drills.	Emergency preparedness and response drills conducted in accordance with emergency response plan.	ERT Superintendent
MP038	Specify plant and facility design criteria for fire prevention, detection, control and personnel safety requirements.	Records of design selection criteria.	Design selection criteria incorporated into facility design.	Detailed Design Manager
MP186	Prepare an emergency response and evacuation plan that details: • Potential emergency situations and possible scenarios under which they may eventuate. • Risk assessment for each situation including scenario-specific management measures. • Triggers for the escalation of emergency response procedures. • Provision of essential services to affected communities regarding the supply of food, water, accommodation and essential services such as medical support and water for ablutions specifying the means, frequency and duration of the supply.	Documented and approved plan.	Emergency response and evacuation plan prepared prior to the beginning of construction.	ERT Superintendent

Table 5-1 Emergency response and fire planning and preparation measures (cont'd)

No.	Management measures	Performance measure	Target	Responsibility
MP040	Prepare a general emergency response procedure that clearly identifies: • Lines of responsibility within FRCGP management should the emergency occur. • Response and evacuation procedures. • Alert and communication system and procedures (authorities, population, shipping and media). • Close-out actions following an emergency situation, including treatment/disposal of material, rehabilitation, incident reporting and review and preventative actions to be instituted.	Documented and approved procedures.	Emergency response and fire management procedure finalised prior to the beginning of construction.	Safety and ERT Superintendent

5.5.2 Emergency response

Management measures to address emergency response are detailed in Table 5-2.

Table 5-2 Emergency response management measures

No.	Management measures	Performance measure	Target	Responsibility
MP042	In the event of a potential emergency situation, personnel should: • Identify the emergency. • Follow all alert and communications procedures as detailed in the emergency response management procedure for that particular emergency. • Respond as detailed in the emergency response and fire management procedure for that emergency. • Identify the potential impacts of the emergency (e.g., loss or injury to human life, material or environmental harm and economic impacts). • During the subsequent debrief, assess the response of personnel to the emergency and provide further training on the relevant emergency procedure and response plan if required.	Maintenance of incident register. Documented emergency response debriefs.	No unresolved incidents. Emergency response procedures followed.	Safety and ERT Superintendent

5.5.3 Epidemic, pandemic and communicable disease outbreak management

The measures detailed in Table 5-3 will be undertaken to manage epidemic, pandemic and communicable disease outbreak.

Table 5-3 Epidemic, pandemic and communicable disease outbreak management measures

No.	Management measures	Performance measure	Target	Responsibility
SEM046	Implement workforce health screening during the recruitment process; on-going workforce health education and awareness programs; and comprehensive employee health service provision in compliance with legislative requirements and company workplace health and safety policies.	Records of health screenings. Training records. Record of health service provisions.	All employees receive pre-employment health screening, periodical follow up health screenings and health services. Delivery of health education and awareness programs to workforce.	Chief Medical Officer
SEM048	Educate workers on disease prevention and health promotion, and encourage workers to share their learnings with the community.	Training records.	Delivery of health education and awareness programs to workforce.	Chief Medical Officer
SEM051	Implement infectious disease management programs for workers, incorporating worker education, to reduce potential for disease occurrence.	Program and training records.	Delivery of disease management programs.	Chief Medical Officer
MP045	Develop and implement a vector management procedure to limit the contraction of vector-borne illnesses on-site, if deemed necessary.	Documented and approved procedure.	Vector management procedure finalised prior to the beginning of construction.	SHE Manager
MP046	Implement strategies to manage the impact of diseases through assessment, surveillance, action plans and monitoring.	Documented and approved strategies to manage the impact of diseases.	Disease management strategies finalised prior to the beginning of construction.	Chief Medical Officer

Table 5-3 Epidemic, pandemic and communicable disease outbreak management measures (cont'd)

No.	Management measures	Performance measure	Target	Responsibility
SEM047	Construct and operate workforce accommodation and messing facilities in accordance with recognised standards for hygiene and safety.	Records of visual inspections of camp and worksite amenities.	Amenities maintained in clean, working order that meet international standards.	Construction Project Manager
SEM054	In partnership with government and non-government health service providers implement health and education programs, and infrastructure development and delivery of health treatment and prevention services in communities surrounding Project facilities.	Records of engagement and support for third-party community-based health programs.	Health and nutrition indicators monitored in surrounding communities.	Social Development Superintendent
MP047	Develop a workplace program aimed at preventing new human immunodeficiency virus (HIV) infections and provide care and support for infected and affected employees.	Documented and approved workplace HIV prevention program.	Workplace HIV prevention program to be finalised prior to beginning of construction.	Chief Medical Officer
MP048	Implement outreach activities among the FRCGP workforce and local communities to raise awareness and educate people about prevention of vector-borne and communicable diseases and encourage improved hygiene practices.	Records of engagement with workforce and communities.	Outreach activities implemented with FRCGP workforce and local communities.	Chief Medical Officer
MP057	Establish a regular pattern of village medical patrols, the priorities of which may include immunisations, tuberculosis screening, maternal and HIV/AIDS education and nutrition.	Records of patrols and medical records.	Village medical patrols conducted biannually.	Social Development Superintendent

5.5.4 Civil unrest limitation measures

The measures detailed in Table 5-4 will be undertaken to manage and minimise civil unrest.

Table 5-4 Civil unrest limitation measures

No.	Management measures	Performance measure	Target	Responsibility
MM154	Develop and implement a project security plan.	Documented and approved security plan.	Security plan to be finalised prior to the beginning of construction.	Safety and ERT Superintendent
MM153	Implement In-Migration Plan and Human Resources and Localisation Plan to minimise opportunistic migration into local areas.	Documented and approved in-migration, human resources and localisation plans.	Reduction of in-migration.	Community Relations Manager
SEM016	Notify communities about proposed employment and commercial participation (business development, supply, procurement) policies and systems, including the designated preferential zones, and ensure that stakeholders have clear and regularly updated information on how to access employment and procurement opportunities.	Documented and approved commercial participation plan.	Commercial participation plan finalised prior to the beginning of construction.	Procurement Superintendent
SEM036	Collaborate with the PNG Government and support government led processes to resolve land disputes if they arise.	Records of engagement.	Engagement with Sandaun and East Sepik provincial governments.	Community Relations Manager
SEM042	Develop and implement (commencing with workforce induction training) a workforce code of conduct to guide workplace behaviour and respectful interaction with host communities. As a minimum, this code of conduct will cover: ethics; health; environment; safety; alcohol and drug use; workforce diversity; harassment; and cultural and social sensitivities of workers and communities.	Developed and approved code of conduct.	Completion of training by all personnel.	Training Superintendent

Table 5-4 Civil unrest limitation measures (cont'd)

No.	Management measures	Performance measure	Target	Responsibility
SEM050	Conduct background checks on security personnel and train them in the Voluntary Principles on Security and Human Rights.	Maintenance of training records.	Completion of training by all security personnel.	Training Superintendent
SEM057	Provide access to an effective and transparent Grievance Management Procedure for communities, employees and contractors.	Documented and approved Grievance Management Procedure.	Grievance Management Procedure finalised and established prior to the beginning of construction.	Community Relations Manager
MP043	Support community leadership development programs that will aim to increase communities' understanding of the distribution of compensation and royalties associated with the FRCGP.	Evidence of engagement to communicate community leadership development program.	Community leadership development program communicated to all affected communities.	Social Development Superintendent

5.5.5 Fire management

The measures detailed in Table 5-5 will be undertaken to limit the likelihood of uncontrolled fire and explosion

Table 5-5 Fire management and limitation measures

No.	Management measures	Performance measure	Target	Responsibility
MM050	Store, handle and transport hazardous substances in accordance with Australian Standards AS1940:2017 and AS3780:2008, and the PNG Environmental Code of Practice for Vehicle/Machinery Workshops and Petroleum Storage/Resale/Usage Sites.	Records of visual inspections.	Storage and handling of hazardous materials and hydrocarbon products to meet specifications in relevant Australian and PNG standards.	SHE Manager

Table 5-5 Fire management and limitation measures (cont'd)

No.	Management measures	Performance measure	Target	Responsibility
MM074	Develop and implement fire management procedures for the construction phase of the FRCGP aimed at reducing the likelihood of fires starting in the FRCGP disturbance area to very low. The procedures will include observations for weather trends and forecasts and the requirement for a permit for burning of cleared vegetation and other fires, particularly in the hill environment in drought years.	Evidence of established procedures.	Documented and approved procedures prior to the beginning of construction.	SHE Manager
MP051	Store explosives and blasting accessories in a secured magazine compound, located at least 500 m away from other infrastructure.	Magazine site selection Design of magazine to meet storage requirements	No storage of explosives and blasting accessories outside of allocated magazine.	Construction Project Manager
MP052	Comply with appropriate statutory standards and requirements for the construction of explosive magazines.	Records of magazine design.	Explosive magazine to meet specifications in AS 2187:2006 Explosives – Storage and use specifications.	Construction Project Manager
MP053	Store and handle all flammable and combustible substances, including waste, under conditions that limit the risk of fire and toxic emissions.	Records of visual inspections of storage facilities.	Storage and handling of flammable and combustible substances in accordance with AS 1940:2017 The storage and handling of flammable and combustible liquids.	Construction Project Manager
MP054	Ensure that 'hot works' do not take place in the vicinity of flammable or combustible materials.	Records of visual inspections of hot works. Hot works permit records.	No hot works conducted in the vicinity of flammable or combustible materials.	Safety and ERT Superintendent

Table 5-5 Fire management and limitation measures (cont'd)

No.	Management measures	Performance measure	Target	Responsibility
MP055	Identify and have available firefighting equipment suitable for the level of risk at hand and conduct regular maintenance and testing to ensure that this equipment remains in good working order.	Records of visual inspections and maintenance.	Firefighting equipment tested and maintained in good working order.	Safety and ERT Superintendent
MP056	Train all personnel in fire risk management during the induction process, the risks that could be present at the site and their personal responsibility in terms of fire prevention.	Maintenance of induction records.	Completion of induction by all employees and contractors where relevant to their role.	Safety and ERT Superintendent

5.6 Performance, monitoring and reporting

Applicable plans and procedures will be reviewed routinely, after any emergency or annually to ensure that they were effective and to identify where improvements can be made. The results of reviews will be available to all personnel to which the emergency procedure is relevant.

General monitoring relevant to emergency response and fire management will include documenting incidents in incident reports and maintenance of induction and training records. Incident reports will be completed and appropriate measures will be taken, aimed at preventing similar incidents or accidents from occurring in the future.

Weekly inspection of construction activities will be undertaken to assess the success of management measures and identify areas where changes to management measures will further limit the risk of uncontrolled fire and explosion. Where monitoring identifies deficiencies in the control methods described above, the procedures in this plan will be reviewed.

Monitoring of weather conditions will be conducted to help predict, prepare for and manage the occurrence of weather-related natural hazards. Monitoring is detailed in Table 5-6.

Compliance by all personnel with the procedures in this plan will be verified through both routine and unannounced inspections and monitoring by the SHE Manager and Loss Prevention and ERT Manager (or their delegates). Inspection results will be reported to the Safety and ERT Superintendent.

Results from monitoring activities will be recorded and annual reports prepared by in-house staff or suitably qualified and experienced third parties. Environmental performance reports will be submitted to the Conservation Environment Protection Authority and other regulatory authorities as part of routine environmental reporting as per the conditions of the environmental permit and other project approvals.

Table 5-6 Emergency response and fire management monitoring

Objective	Performance indicator	Target	Frequency
Conduct weather monitoring to detect increased rainfall, dry conditions and wind directions.	Records of weather monitoring data.	Weather data recorded and reported to relevant departments.	Daily

FRIEDA RIVER

Frieda River Limited

Frieda River Copper-Gold Project

Environmental Management and Monitoring Plan

Erosion, Sediment and Soils Management Sub-plan

Construction

Environmental Management and Monitoring Plan

Erosion, Sediment and Soils Management Sub-plan Construction

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6. Erosion, Sediment and Soils Management Sub-plan

6.1 Background

Construction activities associated with the Frieda River Copper-Gold Project (FRCGP) will include the clearance of vegetation and earthworks. Activities that will involve the excavation and movement of soils and rock on site will include removal and storage of topsoil and waste rock, quarrying, development of the Horse-Ivaal-Trukai, Ekwai and Koki (HITEK) open-pits, construction of roads, pipelines and FRCGP infrastructure including the process plant, laydown areas and accommodation camps. Exposure, disturbance and stockpiling of soils and spoil all have the potential to contribute significantly to sediment-laden runoff from work sites to the receiving environment, resulting in downstream sedimentation and water quality impacts. These Project activities also have the potential to disturb acid sulphate soils (ASS), particularly in the lowland areas, which can result in low pH and mobilisation of metals upon exposure to atmospheric conditions.

Sedimentation and changes to water quality in watercourses can have significant impacts on downstream beneficial uses[1] (resulting from reduced water quality, such as, increased total suspended solids (TSS), bed sediment loading and metals concentrations, including:

- Water extraction for drinking and domestic purposes.
- Aquatic ecosystem health.
- Use of aquatic flora and fauna resources.

This Erosion, Sediment and Soils Management Sub-plan details measures to manage potential soil erosion, sedimentation and mobilisation of particulate-associated metals that may result from FRCGP construction activities.

Management of revegetation and rehabilitation is addressed in the Rehabilitation Management Sub-plan.

6.2 Objectives

The objectives of soil erosion and sediment control are to:

- Limit soil erosion from areas disturbed by FRCGP activities.
- Limit the transport of sediment in runoff from FRCGP areas.
- Manage all soil and spoil stockpiles in order to prevent erosion and downstream sedimentation.
- Limit the mobilisation of particulate-associated metals in runoff from project areas.
- Protect downstream beneficial uses of surface water and water resources.

[1] A beneficial value is defined in the PNG *Environment Act 2000* as a quality or characteristic of the environment or any element or segment of the environment, which –
(a) is conducive to ecological health, public benefit, welfare, safety, health or aesthetic enjoyment and which requires protection from environmental harm; or
(b) is declared in an Environment Policy or permit to be a beneficial value.

6.3 Responsibility

Implementation of the Erosion and Sediment Control Sub-plan will be the responsibility of the Safety, Health and Environment (SHE) Manager, who is also responsible for ensuring that activities associated with the project are undertaken in compliance with relevant statutory environmental regulations and FRL's environment policy and FRCGP Construction Environmental Management and Monitoring Plan (EMMP).

While the environment team is responsible for monitoring, compliance, and follow up on corrective actions, other teams are also responsible for implementing measures to manage erosion, sediment and soils. For example, the construction team is responsible for construction-related activities, such as installation of erosion control measures and management of stockpiles, the mining team is responsible for waste rock characterisation, stockpile placement and deposition within the ISF impoundment, and the process manager is responsible for ensuring the tailings are deposited within the ISF impoundment. These responsibilities are listed in the management measure tables in Section 6.5.

6.4 Definitions

Acid sulphate soils (ASS). Soils and sediments containing iron sulphides, the most common being pyrite. When exposed to air due to drainage or disturbance, these soils can generate sulphuric acid, often with elevated concentrations of iron, aluminium and heavy metals.

Potentially acid sulphate soils (ASS). Soils and sediments that have the potential to generate acid and elevated concentrations metals if exposed to atmospheric conditions.

Erosion and sediment control structures. Structures of various types and construction (e.g., cut-off drains, berms, sediment ponds, rock rip-rap on drains, reno mattresses, geotextile netting) used to intersect and/or impede the flow of surface water to reduce scouring of soils and to cause the settling of suspended material.

Rehabilitation. The process of reinstating and revegetating land to restore it to a stable landform.

Ripping. Deep ripping to break up and aerate compacted soils, typically using ripper tynes on a bulldozer or grader.

Sedimentation. The deposition or accumulation of sediment.

Topsoil. The surface layer of the soil profile, which usually contains more organic matter, is more fertile, darker in colour, better structured and supports greater biological activity than underlying layers. The surface layer may vary in depth depending on soil forming factors, including parent material, location and slope.

Vegetation clearance. Any activity that involves the removal of plants, trees, grass and forested areas (e.g., clear felling, brush cutting and clearing) to provide access to construction sites and facilities.

6.5 Procedures

The following procedures detail FRL's erosion and sediment control measures that will be implemented for the FRCGP's construction phase.

6.5.1 Planning and preparation

Planning and preparation management measures to address erosion and sediment control are detailed in Table 6-1.

Table 6-1 Planning and preparation erosion and sediment control measures

No.	Management measures	Performance measure	Target	Responsibility
MM001	Constructed landforms will be designed to cope with high surface water flows.	Constructed landform design criteria.	Constructed landforms meet design criteria.	Construction Project Manager, SHE Manager
MM002	Appropriate diversion structures will be designed to channel surface water away from constructed landforms.	Constructed landform design criteria.	Constructed landforms meet design criteria.	Construction Project Manager, SHE Manager
MM006	Limit the FRCGP footprint during the design phase.	Final design demonstrates consideration of project footprint.	Disturbance area limited where practical.	Detailed Design Manager
MM011	Implement a risk based soil survey for individual disturbance areas prior to disturbance to identify potentially problematic surface and subsurface soils (i.e., ASS, PASS, dispersive soils). Where problematic soils are encountered, develop appropriate management controls.	Records of soil surveys and mapping. Results of soils surveys to be included in site clearance permit.	100% completion of soil surveys prior to disturbance in areas of high risk.	SHE Manager
MM035	Develop and implement site-specific erosion and sediment control plans for disturbance works. See MP057 and MM004.	Evidence of site-specific erosion and sediment control plans. Records of visual inspection.	No disturbance works conducted without site-specific erosion and sediment control plan.	Construction Project Manager
MP001	Undertake training to ensure that personnel are aware of the importance of controlling erosion from areas disturbed during construction.	Maintenance of induction register.	Induction completed by all employees and contractors where relevant to their role.	SHE Manager

Table 6-1 Planning and preparation erosion and sediment control measures (cont'd)

No.	Management measures	Performance measure	Target	Responsibility
MP002	Ensure that potential 'high risk' (i.e., ASS, PASS, dispersive soils) areas for soil erosion are identified on maps and work plans. These areas are likely to include: • Steep slopes or valleys. • Land adjacent to watercourses. • Areas where landslips are frequent.	Maintenance of maps and work plans. Maps and work plans to be included in site clearance permits.	'High risk' soil erosion areas identified and mapped.	SHE Manager
MP008	Implement measures to divert surface water around crushed ore and waste stockpiles, such as diversion drainage (i.e., berms and swales with erosion protection).	Records of visual inspection.	Infrastructure constructed to limit runoff from crushed ore stockpile.	Mine Manager
MP185	Identify the location of sediment control structures on maps and work plans.	Maintenance of maps and work plans.	Sediment control structures identified and included on maps and work plans.	Construction Manager, SHE Manager

6.5.2 Soil and stockpile management

Measures for the management of soil and stockpiles to prevent erosion and sedimentation are detailed in Table 6-2.

Table 6-2 Soil and stockpile management

No.	Management measures	Performance measure	Target	Responsibility
MM010	Implement control measures to minimise concentrated water flow and to protect the soil surface of disturbed areas, where practicable, which may include: • Applying vegetative debris (e.g., logs) or coarse material (e.g., rock armouring). • Diverting surface water around disturbed areas. • Progressively revegetating disturbed areas. • Applying erosion control matting.	Records of visual inspections.	All major soil and sediment controls function efficiently.	Construction Project Manager, SHE Manager
MM015	Manage encountered ASS by: • Mixing the ASS material with a neutralising agent such as fine-ground lime that inhibits oxidation and increases pH. • Burying excavated ASS material at least 1 m below the permanent water table at a disposal site without prior treatment. • Stockpiling ASS material in a bunded area with a very low permeability base (e.g. acid-resistant liner or clay layer).	Records of soil surveys and mapping. Results of soils surveys to be included in site clearance permit.	Soil surveys and mapping to be completed prior to disturbance.	SHE Manager
MM043	Conduct a risk assessment prior to commencing works in areas of steep terrain where sidecasting is to be undertaken to determine potential impacts downslope and identify appropriate controls. See MP002.	Record of risk assessment.	100% completion of risk assessment and identification of controls to prior to disturbance.	Construction Project Manager, SHE Manager

Table 6-2 Soil and stockpile management (cont'd)

No.	Management measures	Performance measure	Target	Responsibility
MP058	Avoid compaction of topsoil stockpiles, where collected and stored, and restrict vehicle, plant and equipment movement over topsoil stockpiles.	Records of visual inspection.	No unnecessary compaction.	Construction Project Manager, SHE Manager
MP060	Topsoil stockpiles, where collected and stored, will not be situated in areas identified as high risk to erode (e.g., on the side of a hill) as identified on maps and work plans.	Records of visual inspections. Location of stockpiles detailed and approved in site clearance permit.	No stockpiles located in areas identified as high risk of erosion.	Construction Project Manager, SHE Manager
MP061	Install erosion and sediment control structures around the base of stockpiles to limit the amount of topsoil able to be eroded from stockpiles.	Records of visual inspections.	No stockpiles without sediment control structures established and maintained.	Construction Project Manager, SHE Manager
MP062	Stockpile and use cut and mulched vegetation as matting on exposed earth surfaces.	Records of visual inspections. Disposal of cleared vegetation approved in vegetation clearance permit.	Cleared vegetation to be cut and mulched in accordance with vegetation clearance permit.	Construction Project Manager, SHE Manager
MP032	Avoid locating soil stockpiles in low-lying areas that will impede the natural drainage patterns. If unavoidable, use earthworks to redirect the natural surface water flow.	Records of visual inspections. Location of stockpiles detailed and approved in site clearance permit.	No stockpiles located in low-lying areas without prior approval.	Construction Project Manager, SHE Manager

6.5.3 Sediment management

Management measures to prevent sedimentation are detailed in Table 6-3.

Table 6-3 Sediment management measures

No.	Management measures	Performance measure	Target	Responsibility
MM005	Rehabilitate cleared areas to reduce erosion and runoff as soon as possible after clearance. Store and re-use suitable topsoil wherever practicable.	Records of progressive rehabilitation.	Compliance with documented Rehabilitation and Revegetation Program.	Environment Superintendent
MM007	Restrict vehicles to only those areas that need to be accessed or trafficked.	Clearance does not exceed areas approved in vegetation clearing permits (any clearance beyond permitted areas must be reported as an incident). All clearing supported by a clearing permit.	Zero non-compliances recorded of clearing beyond Project footprint.	Environment Superintendent
MM034	During the construction phase, where practicable, construct sediment ponds downstream of major sediment sources.	Sediment pond design criteria. Records of visual inspection.	Construction of sediment ponds in accordance with design criteria.	SHE Manager
MM036	Mark boundaries along cleared areas to limit machinery movement outside the clearance area and ensure that only trees/vegetation within the defined zone are removed.	Clearance does not exceed areas approved in vegetation clearing permits (any clearance beyond permitted areas must be reported as an incident) as demonstrated by regular inspection and monitoring by FRL Environment Department.	Zero non-compliances recorded of clearing beyond FRCGP footprint.	Construction Project Manager

Table 6-3 Sediment management measures (cont'd)

No.	Management measures	Performance measure	Target	Responsibility
MM037	Restrict watercourse crossings to designated crossing points where riparian vegetation clearing widths will be limited. Maintain riparian vegetation buffer zones elsewhere.	Regular inspection and monitoring of buffers, where necessary.	Zero non-compliances of vegetation clearing within buffers.	Construction Project Manager
MM038	In areas that will be rehabilitated, use land clearing techniques that preserve the rootstock of removed vegetation in the ground, where practicable.	Evidence of land clearing measures used to preserve rootstock of removed vegetation.	Land clearing techniques developed to preserve rootstock.	Construction Project Manager
MM039	Divert runoff, to the extent practicable, around disturbed areas including roads.	Records of visual inspections. Non-compliant discharges to be recorded as an environmental incident.	No unresolved incidents.	SHE Manager
MM040	Use rip-rap, gabions and check dams to reduce velocity flow of water in constructed drainage channels where practicable.	Records of visual inspections. Non-compliant discharges to be recorded as an environmental incident.	No unresolved incidents.	SHE Manager

Table 6-3 Sediment management measures (cont'd)

No.	Management measures	Performance measure	Target	Responsibility
MM041	Apply the following principles during construction of benches and batters: • Construct benches that are graded to shed water so as to avoid erosion or batter slumping. • Retain vegetation at the top of cut batters and at the toe of fill batters where practicable in order to minimise erosion. Plant vegetation including shrubs/grasses/legumes on benches. • Install dikes and swales at the top of batters (where practicable) and divert runoff to a slope drain and into stabilised areas. • Stabilise batters using brush layers or geotextile/fibrous matting. • Install slope drainage such as cut-off trenches or horizontal drains at the top edge of the batter or slope. Construct adequate drainage at the toe of the bench/slope to ensure controls are not compromised with undercutting erosion.	Construction design plans. Records of visual inspections.	Benches and batters meet the construction principles.	Construction Project Manager
MM053	Design and construct project facilities involving the storage, handling, or use of hazardous materials to intercept potentially contaminated water for treatment if required prior to discharge.	Records of visual inspections. Non-compliant discharges to be recorded as an environmental incident.	No unresolved incidents.	Construction Project Manager, SHE Manager
MP063	Limit the area of soil disturbed and exposed to erosion.	Area of disturbed and exposed soil. Length of time that disturbed soils are exposed.	Impact of fugitive sediment release is within EIS predictions.	Construction Project Manager, Environment Superintendent

Table 6-3 Sediment management measures (cont'd)

No.	Management measures	Performance measure	Target	Responsibility
MM098	Place suitable erosion control devices between tracks and upland torrential streams, where practicable.	Records of visual inspection.	Suitable erosion control devices in place.	Construction Project Manager, Environment Superintendent
MM099	Reduce sediment loading by reducing sidecasting above watercourses where practicable.	Regular visual inspections.	Sidecasting above water courses only present where no other suitable alternative exists.	Construction Project Manager, Environment Superintendent

6.6 Performance, monitoring and reporting

The FRCGP Erosion and Sediment Control Sub-plan, and any other associated procedures will be reviewed annually to ensure that they remain valid.

Applicable plans and procedures will be reviewed after any erosion or sediment related incident to review their effectiveness and determine whether improvements are required.

FRL Environment Department personnel will monitor the effectiveness of erosion and sedimentation control methods. Where monitoring identifies deficiencies in the control methods, the procedures in this plan will be reviewed. Compliance by personnel with the procedures in this plan will be verified through routine and unannounced inspections and monitoring by FRL Environment Department personnel. Monitoring of surface water is detailed in the Water Management Sub-plan.

FRL will ensure erosion control structures are maintained in good working order and that monitoring of sediment accumulation is undertaken. There will also be regular liaison with Community Affairs personnel to determine whether villagers are reporting increased rates of sediment accumulation outside the predictions of the EIS and whether this is potentially due to construction activity.

Successful rehabilitation will be confirmed through the presence of the following (as detailed in the Rehabilitation Management Sub-plan):

- No significant soil erosion resulting in large rills, gullies or significant downstream sedimentation outside the predictions of the EIS.
- Stabilised soils and native species regeneration.
- Limit environmental or noxious weed infestations.

Ongoing monitoring and management of surface water flows and landform erosion during the duration of the FRCGP will be implemented to identify areas that require further efforts prior to closure.

Monitoring of soils, erosion and sediment control is outlined in Table 6-4.

Monitoring activities will be recorded and annual reports prepared by in-house staff or suitably qualified and experienced third parties. Environmental performance reports will be submitted to the Conservation Environment Protection Authority and other regulatory authorities as part of routine environmental reporting as per the conditions of the environmental permit and other FRCGP approvals.

Table 6-4 Erosion and sediment control monitoring

Monitoring measure	Performance indicator	Target	Frequency
Pre-construction soil surveys	Soils data and mapping of high-risk areas (i.e., ASS, PASS and dispersive soils) with respect to work plans	FRCGP soils mapped in Project footprint areas prior to construction.	Prior to construction
Soil erosion from areas disturbed by FRCGP activities. Transport of sediment in runoff from project areas. Monitor construction and effectiveness of control devices.	Erosion and sediment controls installed and maintained correctly.	100% compliance with approved site clearance plans and this management plan.	Weekly during disturbance activities
	Failures of control devices.	Failures reported as an environmental incident. No unresolved incidents.	In response to incidents
Management of soil and spoil stockpiles in order to prevent erosion and downstream sedimentation.	Stockpiles located in accordance with this management plan and site clearance plans.	100% compliance with approved site clearance permits and this management plan.	Weekly during disturbance activities
	Segregation of topsoils from subsoils.	100% compliance with approved site clearance permits and this management plan.	Weekly during disturbance activities
	Topsoil and subsoil stockpile height.	Not exceeding 2 m.	Weekly during disturbance activities
	Batter gradients.	Not exceeding 15 degrees (unless otherwise agreed with FRL Mining and Environment departments).	At construction
Beneficial uses of downstream surface water and water resources	Sediment concentrations/turbidity in watercourses downstream of FRCGP activities.	Monitoring results comply with FRCGP environment permit conditions.	Monthly
	Number of complaints about FRCGP related sedimentation.	Any complaints recorded and investigated in compliance with FRCGP procedures.	In response to complaints

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Frieda River Copper-Gold Project

Environmental Management and Monitoring Plan

Hazardous Materials, Fuel Handling and Spill Response Management Sub-plan – Construction

Environmental Management and Monitoring Plan
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7 Hazardous Materials, Fuel Handling and Spill Response Management Sub-plan

7.1 Background

During construction of the Frieda River Copper Gold Project (FRCGP), there is the potential for workers and community members to be injured by or exposed to hazardous materials. In addition, there is the potential for hazardous material to enter the environment through spills or incorrect handling. The Hazardous Materials, Fuel Handling and Spill Response Management Sub-plan has been developed to provide procedures for the management of hazardous materials including: handling; storing; transporting; preventing and responding to spills; and disposing of chemicals and other hazardous materials during construction activities.

The classification, packaging, labelling and safe transport of dangerous goods to PNG will be the responsibility of manufacturers, suppliers and transport contractors. These contractors will be required to comply with FRL's standards, which will be defined in their contracts. Where FRL has these responsibilities, it will comply with the relevant statutory requirements (typically the Australian Dangerous Goods Code 2008 (NTC, 2018)) and FRL will seek the advice of the appropriate authority, where necessary.

Storage and handling of hazardous materials will be in accordance with Australian Standards AS 1940:2017, 3780:2008, PNG Environmental Code of Practice for Vehicle/Machinery Workshops and Petroleum Storage/Resale/Usage Sites and any other relevant standards as required.

To manage a hazardous spill, FRL acknowledges that all incidents necessitate a multi-disciplinary approach with staff members participating in a coordinated effort, as well having an emergency response team onsite. The emergency response management plan will include information for dealing with accidental hazardous material releases and should be consulted in conjunction with this Hazardous Materials, Fuel Handling and Spill Response Management Sub-plan. In addition, the Waste Management Sub-plan contains a detailed outline of on and off-site waste generation, handling and disposal and should be used in conjunction with this sub-plan.

7.2 Objectives

The objectives of the Hazardous Materials, Fuel Handling and Spill Response Management Sub-plan are to:

- Ensure hazardous materials required for construction activities are identified, stored, transported, handled and disposed of safely and in an environmentally responsible manner.
- Prevent accidental hazardous material release that may cause injury and/or exposure to people and the environment.
- Provide procedures for the control of leaks, containment of spillages and recovery in the event of an accidental hazardous material release.

7.3 Responsibility

Responsibility for each aspect of hazardous material spills, storage, handling and transport will be clearly established before the commencement of construction activities. Implementation of the Hazardous Material, Fuel Handling and Spill Response Management Sub-plan will be the responsibility of the Safety, Health, Environment (SHE Manager), who is responsible for ensuring that activities associated with the project are undertaken in full compliance with FRL's hazardous material and fuel handling management procedure and other safety policies. All staff, including contractors, are responsible for compliance with this sub-plan.

7.4 Definitions

Bunded. Enclosed by a bund of sufficient capacity to contain all the stored liquid.

Emergency. A present or imminent event that requires prompt co-ordination of actions or special regulation of persons or property to protect the health, safety, or welfare of people, or to limit damage to property and the environment.

Emergency Response Team. Employees of FRL who have been trained to respond to hazardous materials spills and other emergencies.

Hazardous material. Hazardous materials is any substance, mixture or article that satisfies the criteria of one or more *Globally Harmonised System of Classification and Labelling of Chemicals* (GHS) hazard classes.

In relation to chemicals, a hazard is a set of inherent properties of the substance, mixture, article or process that may cause adverse effects to organisms or the environment.

Major spill. A spill, which if not acted upon properly, will contaminate the natural environment and may have potential significant human health and safety risks.

Safety data sheet. A detailed information print out provided by the supplier outlining the hazards associated with a chemical.

Minor spill. A spill which can be easily and safely handled by those person(s) initiating the spill and which has minimal health and safety risks.

Personal protective equipment (PPE). Anything worn or used by a person to reduce a risk to the person's health or safety.

7.5 Procedures

The procedures outlined in this section will be established for the construction phase and details hazardous materials handling measures (i.e., storage, transport and disposal) and management measures to reduce the risks of an accidental hazardous material release. Staff responsibilities, and the facilities and equipment that will be in place to prevent emergencies associated with mismanagement of hazardous materials are also detailed. In the event of a hazardous material spill

or leak, FRL will ensure that appropriate procedures are in place for the control of spills and notifying potentially affected parties.

7.5.1 Planning and Preparation

The planning and preparation measures to address hazardous materials and fuel handling are detailed in Table 7-1.

Table 7-1 Planning and preparation hazardous materials and fuel handling

No.	Management measures	Performance Measures	Target	Responsibility
MM050	Store, handle and transport hazardous substances in accordance with Australian Standards AS1940:2017 and AS3780:2008, and the PNG Environmental Code of Practice for Vehicle/Machinery Workshops and Petroleum Storage/Resale/Usage Sites.	Records of visual inspections.	Storage and handling of hazardous materials and hydrocarbon products to meet specifications in relevant Australian and PNG standards.	SHE Manager
MM052	Provide appropriate spill response equipment for Project facilities, vehicles and vessels.	Records of visual inspections of spill response kits.	Spill response kits are available and maintained in all designated areas.	SHE Manager
MM116	Equipment and vehicles will be maintained regularly in accordance with manufacturers' specifications.	Records of maintenance and servicing.	All vehicles and machinery serviced and maintained regularly in accordance with manufacturer's specifications.	Mobile Maintenance Manager
MP066	Train and induct all personnel in procedures for the safe handling, transport, storage, transfer and disposal of hazardous materials as well as emergency response measures for spills and leaks.	Number of personnel inducted. Personnel training records.	Completion by all employees and contractors where relevant to their role.	Environment Superintendent
MP067	Ensure hazardous materials transfer and storage facilities are designed in accordance with AS1940:2017 and PNG Environmental Code of Practice for Vehicle/Machinery Workshops and Petroleum Storage/Resale/Usage Sites.	Records of visual inspection of transfer and storage facilities.	Transfer and storage facilities meet Australian and PNG standards.	SHE Manager
MP068	Safety data sheets (SDS) and regulatory authority guidelines for the safe handling, transport and storage of all hazardous materials should be located in an accessible place and regularly maintained.	Records of SDS'.	All SDS' are accessible and up to date	SHE Manager

Table 7-1 Planning and preparation hazardous materials and fuel handling (cont'd)

No.	Management measures	Performance Measures	Target	Responsibility
MP069	An emergency response team will be trained and provided with appropriate resources to contain and control major spills of hazardous materials.	Personnel training records. Emergency response resource register.	All emergency response team training records and resources are up to date.	SHE Manager
MP070	Vehicle and vessel refuelling to be conducted only at designated sites.	Records of visual inspections of refuelling areas.	No refuelling at unauthorised locations.	SHE Manager
MP071	All construction personnel will be provided with and trained in the use of appropriate personal protective equipment (PPE).	Records confirming that all personnel have appropriate PPE to perform the work.	All personnel provided with appropriate PPE and training.	SHE Manager
MP072	Maintain spill response kits and equipment to ensure that appropriate supply quantities are on hand at all times.	Maintenance records of spill response kits (including portable spill containment and clean-up equipment). Records of regular inspections.	All spill response kits inspected and replenished every six months or after an incident.	SHE Manager
MP073	Maintain an inventory of spill control materials and equipment.	Records of inventory register.	Inventory register must be available and current.	SHE Manager
MP074	Maintain a register that includes information cards (which will be displayed as required in Tok Pisin as well as English) and SDS' prepared by manufacturers or suppliers for all hazardous materials on site. Containers of hazardous substances will be labelled in both English and Tok Pisin.	Maintenance of SDS' and information card register.	Register is current and up to date. SDS' are current and up to date.	SHE Manager
MP075	Undertake a risk assessment of all hazardous materials to be stored and used on site. Rank the hazardous materials by level of severity and identify any specific management measures.	Records of risk assessment.	Assessment to be conducted prior to beginning of construction.	SHE Manager
MP011	Develop and implement a dangerous goods marine transport procedure in accordance with International Maritime Dangerous Goods Code.	Procedure developed. Personnel and necessary third parties received procedure induction.	Marine transport of dangerous goods conducted in accordance with International Maritime Dangerous Goods Code.	SHE Manager

Table 7-1 Planning and preparation hazardous materials and fuel handling (cont'd)

No.	Management measures	Performance Measures	Target	Responsibility
MP021	Develop a hazardous materials management plan that: • Identifies the hazardous materials that will used during construction. • Documents the risk assessment for all hazardous materials. • Describes the specific management measures for all hazardous materials.	Hazardous materials management plan developed.	Manage hazardous materials in accordance with plan.	SHE Manager

7.5.2 Hazardous Materials Storage and Use

The measures detailed in Table 7-2 will be undertaken to ensure the appropriate storage and use of hazardous materials.

Table 7-2 Hazardous materials storage and use

No.	Management measures	Performance Measures	Target	Responsibility
MP076	Store corrosive and toxic materials separately in a designated HAZCHEM storage area and label in accordance with AS3780:2008 and PNG Environmental Code of Practice for Vehicle/Machinery Workshops and Petroleum Storage/Resale/Usage Sites.	Records of visual inspections.	Storage of corrosive and toxic materials must meet specifications in relevant specifications in relevant Australian and PNG standards.	SHE Manager
MP077	Use chemical storage containers only for the storage of the chemical labelled.	Records of visual inspections.	No incorrect storage of chemicals.	SHE Manager

Table 7-2 Hazardous materials storage and use (cont'd)

No.	Management measures	Performance Measures	Target	Responsibility
MP078	Hazardous materials will not be stored or handled within 50 m of a waterbody or a drainage line leading to a waterbody.	Records of visual inspections.	Hazardous materials must be kept in designated areas at all times and at least 50 m from waterbodies.	SHE Manager
MP079	Display appropriate warning signs when storing, handling or using hazardous materials.	Records of visual inspections.	Hazardous materials signposting must meet specifications in AS1940:2017 and PNG Environmental Code of Practice for Vehicle/Machinery Workshops and Petroleum Storage/Resale/Usage Sites.	SHE Manager
MP080	Maintain a hazardous materials inventory that tracks types and volumes of hazardous materials used.	Maintenance of inventory.	Inventory current and up to date.	SHE Manager

7.5.3 Hazardous Materials Disposal

Measures to be undertaken to ensure the appropriate disposal of hazardous materials are detailed in Table 7-3.

Table 7-3 Hazardous Materials Disposal

No.	Management measures	Performance Measures	Target	Responsibility
MP081	Collect and dispose of all waste hazardous materials and their containers to FRL approved disposal facilities in accordance with the Waste Management Sub-plan.	Register of waste recording type, weight and destination (including reuse) of all wastes produced on site.	No unauthorised disposal of hazardous materials.	SHE Manager
MP165	Manage water used to clean down vehicles, plant and equipment to ensure against uncontained release to watercourses.	Records of visual inspections.	No uncontrolled release of wash water to watercourses.	SHE Manager

7.5.4 Hazardous Materials Transport

The measures detailed in Table 7-4 will be undertaken to ensure the appropriate transport of hazardous materials.

Table 7-4 Hazardous Materials Transport

No.	Management measures	Performance Measures	Target	Responsibility
MP082	Ensure an appropriately licensed contractor is used to transport and dispose of hazardous materials.	Records of licensed waste providers. Waste transport certificates.	Waste transport contractors hold relevant licences.	SHE Manager
MP083	Transport dangerous goods in accordance with the Australian Dangerous Goods Code.	Records of visual inspections of transportation.	Transportation of dangerous goods must meet specifications in relevant Australian standards.	SHE Manager
MP084	Document the transport and disposal of all hazardous material and wastes appropriately.	Waste transport certificates. Register of waste, recording type, weight and destination (including reuse) of all wastes produced on site.	Waste transport certificates completed for every consignment of waste that leaves the facility.	SHE Manager

7.5.5 Fuel and Oil Storage

The measures detailed in Table 7-5 will be undertaken to ensure the appropriate storage of fuel and oil.

Table 7-5 Fuel and Oil Storage

No.	Management measures	Performance Measures	Target	Responsibility
MP085	Maintain a fuel and oil storage log, including the following information: • Types and volumes of fuel and oils in use. • Locations and type of storage facilities. • Containment methods (both primary and secondary) and volumes.	Records of fuel and oil storage and maintenance of storage facilities.	Fuel and oil storage log is maintained and up to date.	SHE Manager
MP086	Fuel and oil pumps and storage areas will be located within impermeable containment bunds at a minimum of 50 m from any waterbody or watercourse.	Records of visual inspections of depots.	All fuel and oil materials kept in designated areas at all times, at least 50 m from any waterbody.	SHE Manager

7.5.6 Spill Response

The measures detailed in Table 7-6 will be undertaken to ensure the appropriate response and management of spills.

Table 7-6 Spill Response

No.	Management measures	Performance Measures	Target	Responsibility
MP087	If a minor spill occurs (including contaminated water), immediately contain and clean up the spill in accordance with the relevant SDS or specific spill response plan.	Maintenance of incident register.	All spills containment/clean up to be actioned within 2 hours of detection. No unresolved incidents. Spill response to meet SDS specifications.	SHE Manager
MP088	If a major spill occurs: • Immediately halt the associated activity and contain the spill in accordance with the relevant SDS or specific spill response plan. • Conduct clean-up and remediation in accordance with SDS or specific spill response plan, any relevant guidelines and the instructions of responsible authorities.	Maintenance of incident register.	All spills containment/clean up to be actioned within 2 hours of detection. No unresolved incidents. Spill response to meet SDS specifications.	SHE Manager

Table 7-6 Spill Response (cont'd)

No.	Management measures	Performance Measures	Target	Responsibility
MP089	Appropriate PPE should be used by all persons completing spill clean-up.	Use of PPE recorded in incident report.	Appropriate PPE used during spill clean-up.	SHE Manager
MP090	Remediation will be undertaken to limit impacts to the environment from any spill, where required.	Records of remediation procedures in corrective actions report.	Identification of need and completion of remediation of spills.	SHE Manager
MP091	Emergency preparedness (spill response) drills will be conducted regularly.	Records of emergency spill response drills.	Emergency spill response drills conducted in accordance with emergency response plan.	SHE Manager

7.6 Performance, monitoring and reporting

The FRL Hazardous Materials, Fuel Handling and Spill Response Management Sub-plan, and any other associated procedures will be reviewed annually to ensure that they remain valid.

Applicable plans and procedures will be reviewed after any non-conformance with a measure in this plan to ensure that they were effective and to identify where improvements can be made.

General monitoring relevant to hazardous materials, fuel handling and spill response will include, documenting of incidents in incident reports, and maintenance of induction and training records. Spills will be reported to the SHE Manager as follows:

- In the event of a minor spill, those individuals at the site will report the spill to the SHE Manager.
- In the event of a major spill, the Emergency Response Team shall be contacted. The Emergency Response Team will report the spill to the SHE Manager who will, in turn, report to the General Manager.
- Spills causing off-site environmental impacts will be reported to the Conservation Environment Protection Authority (CEPA), the Mineral Resources Authority (MRA) and local communities, as appropriate.

The SHE Manager is accountable for submission of the preliminary incident report, which will be prepared using the appropriate FRL form in accordance with the Incident Reporting Procedure. All reported incidents will be investigated and reports distributed in accordance with the FRL “Incident Management” standard.

Regular inspections of all on-site workshops, hazardous materials storages and fuel and oil depots will occur to ensure that such sites are being managed and maintained in accordance with the appropriate PNG Environmental Code of Practice for Vehicle and Machinery Workshops, Petroleum Storage, Resale and Usage Sites (1997) and Australian Standards AS1940:2017 and AS3780:2008.

Monitoring of the receiving environment will be conducted in accordance with the Water Management Sub-plan. Additional monitoring may be required in the event of a leak or spill, the requirements of which will be determined in response to the incident and documented in the incident report.

Compliance by personnel with the procedures in this plan will be verified through both routine and unannounced inspections and monitoring by the SHE Manager (or their delegate). Inspection results will be reported to the Safety and the Emergency Response Team (ERT) Superintendent. Specific hazardous materials, fuel handling and spill response monitoring is outlined in Table 7-7.

Monitoring activities will be recorded, and annual reports prepared by in-house staff or suitably qualified and experienced third parties. Environmental performance reports will be

submitted to the CEPA and other regulatory authorities as part of routine environmental reporting as per the conditions of the environment permit and other FRCGP approvals.

Table 7-7 Hazardous materials, fuel handling and spill response monitoring

Objective	Performance indicator	Target	Frequency
Conduct regular integrity testing and maintenance of hazardous materials storage tanks, pipe, transfer hosing and couplings.	Records of testing and maintenance.	No spills or leaks left undetected. No unresolved hazardous material transfer incidents.	Monthly or as required
Inspection and replenishment of spill response kits and equipment.	Records of visual inspections. Record in inventory register.	Spill response kits and equipment stocked and maintained.	Weekly
Monitoring of pipe and hose pressure during fuel transfers to enable early detection of spills or leaks.	Records of pressure monitoring.	No spills or leaks left undetected. No unresolved fuel transfer spill or leak incidents.	Ongoing
Monitor downstream receiving environments.	Surface and groundwater quality downstream of landfill facility, septic tank and fuel storage and refuelling facilities.	Water quality results meet required standards and environment permit conditions.	Monthly

FRIEDA RIVER

Frieda River Limited

Frieda River Copper-Gold Project

Environmental Management and Monitoring Plan

Rehabilitation Management Sub-plan

Construction

Environmental Management and Monitoring Plan
Rehabilitation Management Sub-plan
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8. Rehabilitation Management Sub-plan

8.1 Background

Construction activities associated with the Frieda River Copper-Gold Project (FRCGP) will impact on the natural environment as a result of physical disturbance such as vegetation clearance, bulk earthworks, and establishing project infrastructure. These activities can alter local hydrology and negatively impact on biodiversity by contributing to habitat fragmentation and degradation.

If not rehabilitated, cleared and disturbed ground can contribute to ongoing erosion, sedimentation of watercourses and impacts on surrounding vegetation and amenity.

Rehabilitation is the process by which impacts on the environment are repaired and generally consists of the following two stages:

- Landform design and reconstruction of a stable land surface.
- Revegetation of the reconstructed landforms to meet the final land use.

To maximise the chance of rehabilitation success, progressive rehabilitation needs to continue over the life of mine; consideration (and implementation where feasible) of rehabilitation should not be left until the end of the Project. Periodic monitoring and maintenance will be undertaken as completion criteria are progressively achieved and sustained.

This Rehabilitation Management Sub-plan details procedures to be followed to rehabilitate and revegetate land following ground disturbance associated with construction activities.

8.2 Objectives

Rehabilitation generally comprises two stages: landform design and the reconstruction of a stable land surface; and the revegetation or development of an alternative land use on the reconstructed landform. The main objectives of rehabilitation are to:

- Physically stabilise the land so that it is safe, and erosion is controlled.
- Leave final landforms with a surface upon which vegetation can be successfully established.
- Revegetate landforms to meet the agreed final land use.
- Ensure that drainage is of acceptable quality.
- Protect adjacent undisturbed ecosystems.

8.3 Responsibility

Implementation of the Rehabilitation Management Sub-plan will be the responsibility of the Safety, Health, Environment (SHE) Manager. The SHE Manager is responsible for ensuring that activities associated with the FRCGP are undertaken in compliance with relevant statutory regulations and the FRL environment policy and FRCGP Construction Environmental Management and Monitoring Plan (EMMP). All staff, including contractors, are responsible for compliance with this document.

8.4 Definitions

Progressive rehabilitation. The process of rehabilitating those portions of the disturbed sites that are no longer necessary for the immediate operating requirements of the mine to reach the agreed post-mining land use. Progressive rehabilitation would be expected to occur during construction of the concentrate pipeline.

Rehabilitation. The restoration of a disturbed landscape, especially the vegetation, to an agreed state.

Land clearance permit: Internal permit for the clearing of new areas before construction commences. This process includes the submission of a plan to identify the extent of the area to be cleared of vegetation and approval from the Environment Department.

8.5 Procedures

8.5.1 Planning and preparation

Planning and preparation management measures to address rehabilitation management are detailed in Table 8-1.

Table 8-1 Planning and preparation

No.	Management measures	Performance measure	Target	Responsibility
Inductions, training and awareness				
MP020	Ensure that personnel (including contractors) are aware of the importance of progressively rehabilitating areas disturbed during construction.	Maintenance of induction register.	Completion of induction by all employees and contractors where relevant to their role.	SHE Manager
MP097	Implement appropriate inductions, education and pre-work meetings to ensure staff comply with limiting disturbance to vegetation, quarantine requirements, and fauna management. Include limits of vegetation clearing on maps as part of communications.	Maintenance of induction register. Records of pre-work meetings.	Completion of induction and pre-work meetings by all employees and contractors where relevant to their role.	SHE Manager
MP015	Induct employees and contractors regarding vegetation management including the process of obtaining a vegetation clearing permit.	Maintenance of induction register.	Completion of induction by all employees and contractors where relevant to their role.	SHE Manager

Table 8-1 Planning and preparation (cont'd)

No.	Management measures	Performance measure	Target	Responsibility
Further management planning				
MP098	Develop and regularly update a detailed Rehabilitation and Revegetation Program that includes clear delineation of areas that will be rehabilitated following disturbance and the methods that will be used.	Evidence of established program.	Documented and approved program with input from appropriate stakeholders.	SHE Manager

8.5.2 Rehabilitation

Rehabilitation measures are detailed in Table 8-2.

Table 8-2 Rehabilitation measures

No.	Management measures	Performance measure	Target	Responsibility
MP063	Limit the area of soil disturbed and exposed to erosion.	Area of disturbed and exposed soil. Length of time that disturbed soils are exposed.	Impact of fugitive sediment release is within EIS predictions.	Environment Superintendent
MM038	In areas that will be rehabilitated, use land clearing techniques that preserve the rootstock of removed vegetation in the ground, where practicable.	Records of vegetation clearance permits.	Compliance with vegetation clearance permits.	Environment Superintendent
MM005	Rehabilitate cleared areas to reduce erosion and runoff as soon as possible after clearance. Store and re-use suitable topsoil wherever practicable.	Records of progressive rehabilitation.	Compliance with documented Rehabilitation and Revegetation Program.	Environment Superintendent

Table 8-2 Rehabilitation measures (cont'd)

No.	Management measures	Performance measure	Target	Responsibility
MP100	Rehabilitate disturbed lands progressively, where practicable.	Areas of disturbed land progressively rehabilitated.	Self-sustaining vegetation is growing on previously disturbed areas around the open-pit and other areas, as evidenced by vegetation monitoring. Vegetative cover is increasing, and on a trajectory to achieve in excess of 70% of foliage cover.	Environment Superintendent
MM059	Spread excavated soil, mulch and discarded vegetation debris (including natural seed stock) on reclaimed or rehabilitated disturbed land surfaces to facilitate natural revegetation, where practicable.	Regular inspection and monitoring by Environment Department demonstrates natural revegetation facilitated by spread of vegetation debris.	Self-sustaining vegetation generated by spread of vegetation debris.	Environment Superintendent

Table 8-2 Rehabilitation measures (cont'd)

No.	Management measures	Performance measure	Target	Responsibility
MP101	Landscape rehabilitation (where appropriate for the agreed post-mining land use) will include: • Reprofiling the ground surface to original or stable contours and surface drainage lines. • Scarifying compacted soils along the contours, particularly in heavily trafficked areas. • Applying brush matting, mulching or compost to all prepared surfaces to assist with moisture retention and erosion control.	Regular inspection and monitoring by Environment Department.	Compliance with documented Rehabilitation and Revegetation Program.	Environment Superintendent
MM016	Landscape restoration (i.e., revegetation) will be undertaken on cut faces of hills where access roads are constructed.	Inspection and monitoring by Environment Department.	Self-sustaining vegetation is growing on previously disturbed areas.	Environment Superintendent
MP102	Establish a nursery for selected species to be used in revegetation including local native pioneer species and nitrogen-fixing plants.	Documented evidence of functioning nursery.	Functioning nursery established.	Environment Superintendent
MM094	Stabilise cleared banks to facilitate a suitable habitat for regeneration.	Appropriately stabilised banks as demonstrated by inspection by Environment Department.	Cleared banks stabilised. Self-sustaining vegetation is growing on previously disturbed areas.	Environment Superintendent

Table 8-2 Rehabilitation measures (cont'd)

No.	Management measures	Performance measure	Target	Responsibility
MM111	Include threatened plant species, the food plants of listed butterfly species and fruiting plants that attract frugivores in revegetation plans as far as possible.	Inclusion of these species within on-site nursery.	Use of these species in revegetation.	Environment Superintendent
MM109	Attempt to cultivate species of plants that are new to science and use them in revegetation where practicable.	Inclusion of these species within on-site nursery.	Use of these species in revegetation.	Environment Superintendent
MM095	Use local species, wherever practicable, where watercourse crossings are to be revegetated.	Evidence of local provenance within on-site revegetation.	Use of these species in revegetation.	Environment Superintendent
MM110	Establish a project to identify the food plants of the new butterfly species so as to cultivate these plants and use them in revegetation.	Successful program established.	Use of these species in revegetation.	Environment Superintendent
MP103	Trial of a range of rehabilitation procedures and processes throughout the life of the mine including direct seeding and facilitated natural regeneration.	Trials completed and monitored.	Successful trials established.	Environment Superintendent
MP104	Based on rehabilitation trials, develop rehabilitation and revegetation program to further refine and improve the success of closure rehabilitation.	Trials completed and monitored.	Guidelines developed and reviewed.	Environment Superintendent

8.6 Performance, monitoring and reporting

This FRL Rehabilitation Management Sub-plan, and any other associated procedures will be reviewed annually to ensure that they remain valid.

Applicable plans and procedures will be reviewed after any non-conformance with a measure in this plan to ensure that they were effective and to identify where improvements can be made.

General monitoring relevant to rehabilitation will include documenting of incidents in incident reports and maintenance of induction and training records. Incident reports will be completed, and appropriate measures will be taken to ensure that similar incidents or accidents will not occur in the future. Specific rehabilitation monitoring is outlined in Table 8-3.

Ongoing monitoring of construction activities will be undertaken to assess the success of management measures and identify areas where changes to management measures will limit risks to rehabilitation. Where monitoring identifies deficiencies in the control methods described above, the procedures in this sub-plan will be reviewed.

Compliance by personnel with the procedures in this sub-plan will be verified through both routine and unannounced inspections and monitoring by the SHE Manager (or their delegate). Inspection results will be reported to the Safety and ERT Superintendent.

Monitoring activities will be recorded, and annual reports prepared by in-house staff or suitably qualified and experienced third parties. Environmental performance reports will be submitted to the Conservation Environment Protection Authority and other regulatory authorities as part of routine environmental reporting as per the conditions of the environment permit and other FRCGP approvals.

Table 8-3 Rehabilitation monitoring

Monitoring measure	Performance indicator	Target	Frequency
Progressive rehabilitation works.	Documented monitoring will include visual inspection and photography.	Area under rehabilitation undertaken progressively as construction completed and within the required timeframes.	Fortnightly inspection of rehabilitation works ongoing for two months, after completion of revegetation Follow-up inspections six monthly after planting to assess the range of species established, and whether there is a need for remedial actions

Table 8-3 Rehabilitation monitoring (cont'd)

Monitoring measure	Performance indicator	Target	Frequency
Soils during and following rehabilitation activities, including comparison with pre-construction conditions.	Physical and chemical characteristics of soil.	All physical and chemical characteristics of rehabilitated areas meet rehabilitation criteria as specified in the detailed Rehabilitation and Revegetation Program.	During and following rehabilitation activities
Revegetation success	Plant abundance and cover assessed in relation to stated targets after topsoil respreading or after seeding until rehabilitation criteria are met. Areas deficient in revegetation quality or quantity will be noted and analysed to determine the reason for poor performance. Where necessary, the causes will be rectified, the site re-treated and appropriate adjustments made to rehabilitation planning.	All revegetation meets rehabilitation criteria as specified in the detailed Rehabilitation and Revegetation Program.	Initially twelve months after topsoil respreading or after seeding, and at appropriate intervals until rehabilitation criteria are met.
Erosion of constructed landforms and in disturbance areas	Landform stability as documented by geotechnical observations and monitoring, with the assessment including a comparison of pre- and post-mining erosion rates.	Zero occurrences of erosion of constructed landforms post-rehabilitation (with the exception of large-scale natural landslips).	Immediately following rehabilitation activities and then on an annual basis.

FRIEDA RIVER

Frieda River Limited

Frieda River Copper-Gold Project

Environmental Management and Monitoring Plan

Traffic and Transport Management Sub-plan

Construction

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9. Traffic and Transport Management Sub-plan

9.1 Background

Construction of the Frieda River Copper-Gold Project (FRCGP) will require the transport of personnel, equipment and materials to, from and around site, using aircraft, barges and heavy and light vehicles. The FRCGP will use the existing Frieda River airstrip until the airstrip at Green River is upgraded. Daily flights will operate from the Frieda River airstrip to transport personnel to site during the construction phase. Freight will be imported via existing ports at Wewak, Lae and Madang and barged upstream along the Sepik River to the Frieda or May River ports until upgrade of both the Vanimo Ocean Port and the Vanimo to Green River Road has been completed and the Upper Sepik River Port is constructed. Freight will then be trucked from Vanimo to Green River and barged from the Upper Sepik River Port downstream along the Sepik River. Once the main access road from Green River to the mine is complete all freight will be trucked to site.

The transport of personnel, equipment and materials via aircraft, vessels and vehicles gives rise to the potential for an incident to occur, such as a collision or crash. Vessel or vehicle incidents may occur due to factors such as operator error, equipment malfunction or extreme weather. Maintenance and operation of aircraft is not included in this sub-plan as it will be the responsibility of the appointed aircraft contractor. FRL shall ensure that the contractor appointed is contractually required to meet all safety and regulatory requirements.

Potential consequences from an aircraft, vessel or vehicle incident include:

- Loss of life or severe injury.
- Lost time injuries.
- Damage to infrastructure and property (FRCGP and non-FRCGP owned).
- Social tension, particularly if local villagers are involved.
- Environmental contamination via the release of hazardous materials and potential fire, depending on the vehicles and cargo involved in the incident.

Procedures for transportation of chemicals and other hazardous substances are described in the Hazardous Materials and Fuel Handling Management Sub-plan.

9.2 Objectives

The objective of the traffic and transport management sub-plan is to limit the potential for traffic accidents, including vessel collisions, aircraft and vehicle incidents.

9.3 Responsibility

Implementation of the Traffic and Transport Management Sub-plan will be responsibility of the Safety, Health and Environment (SHE) Manager. The SHE Manager is responsible for ensuring the implementation of this sub-plan and all the activities associated with the project in full compliance with relevant statutory environmental regulations and the FRL environment policy and the FRCGP Construction Environmental Management and Monitoring Plan (EMMP).

9.4 Definitions

Barge. A large flat-bottomed vessel, usually moved by towing, used for transporting freight on water.

Emergency. A present or imminent event that requires prompt co-ordination of actions or special regulation of persons or property to protect the health, safety, or welfare of people, or to limit damage to property and the environment.

Stevedore. A firm or individual engaged in the loading or unloading of a vessel.

Vehicle. Any receptacle, or means of transport, in which something is carried or conveyed, or travels.

Vessel. A craft for travelling on water, one larger than an ordinary rowing boat; a ship or boat.

9.5 Procedures

The following procedures provide measures to limit the likelihood of traffic accidents and are separated into the following categories: general planning and preparation; marine vessel collisions or sinking; vehicle incident and aircraft incident.

9.5.1 Planning and preparation

The measures detailed in Table 9-1 will be undertaken to reduce the likelihood of traffic and transport accidents.

Table 9-1 Planning and preparation management measures

No.	Management measures	Performance Measures	Target	Responsibility
MM150	Define engineering and terrain constraints as part of road design criteria to enhance road surface protection, taking design control measures such as camber, visibility, bunds and alignment into consideration.	Roads designed in accordance with criteria.	Roads meet safety requirements of relevant codes and standards.	Construction Manager
SEM044	Develop and implement measures which include vessel crew education, community risk awareness, operational vessel management protocols, and appropriate physical safety measures (such as visual and audible warnings) where required for construction.	Operational protocols established. Records of visual inspections and training.	All vessels to meet relevant maritime safety standards and operational protocols.	Supply and Logistics Manager
MP105	Appoint procurement, supply and logistics coordinators responsible for the transportation of materials to the FRCGP.	Appointment of procurement, supply and logistics coordinators.	Relevant positions to be appointed prior to the beginning of construction.	General Manager
MP106	The following procedures will be prepared: • Loading and unloading procedures. • Control of emissions and spills procedures. • Clean-up and contingency procedures. • Vehicle cleaning procedures. • Operator training and audit procedures.	Preparation of transport related procedures.	All procedures to be finalised and approved at least six months prior to the beginning of construction.	Logistics Coordinator

Table 9-1 Planning and preparation management measures (cont'd)

No.	Management measures	Performance Measures	Target	Responsibility
MP107	Written agreements between FRL and the originator of the goods, PNG Ports Corporation, stevedores and transporters will address the following: • Packaging as per the relevant authority (United Nations (for international sector) and PNG). • Labelling in both English and Tok Pisin languages. • Transport to and from PNG. • Safety of transportation vehicle and security during transportation. • Training of handlers during transportation and unloading. • Emergency response for the duration of the transportation.	Records of written agreements that address packing, labelling and safe transportation.	Compliance with relevant national and international import/export regulations.	Logistics Coordinator
MP108	Train personnel and contractors, through site inductions, on FRCGP related traffic and road rules.	Percentage of personnel inducted on transport and traffic management procedures. Maintenance of induction register.	Completion of induction by all employees and contractors relevant to their role.	SHE Manager
MP109	Train relevant personnel and contractors, through site inductions, on FRCGP related barge traffic and river transport rules.	Maintenance of induction register.	Completion of induction by all employees and contractors relevant to their role.	SHE Manager
MP110	Provide fatigue management training to all drivers and vessel operators.	Maintenance of induction register.	Completion of induction by all employees and contractors relevant to their role.	SHE Manager
MP111	Provide inductions for passengers travelling in vehicles, detailing specific response procedures to emergency situations and potential incidents.	Percentage of personnel inducted in vehicle incident response. Personnel induction records.	All personnel inducted in vehicle incident response.	SHE Manager
MP112	Train and licence vehicle operators appropriately for the machinery they are operating.	Percentage of personnel inducted and licensed. Personnel induction records.	All operators hold relevant licensing for machinery operation.	SHE Manager

9.5.2 Marine vessel collisions or sinking

The measures detailed in Table 9-2 will be undertaken to reduce the likelihood of marine vessel collisions or sinking.

Table 9-2 Marine vessel collisions or sinking

No.	Management measures	Performance measures	Target	Responsibility
MM147	Suspend vessel transport operation into and out of Sepik River when extreme weather conditions make operations unsafe. During such conditions, vessels will be moored in the nearest safe location until conditions are deemed safe enough to recommence operation.	Incident register.	No unresolved incidents.	Supply and Logistics Manager
MP113a	Induct vehicle operators to ensure they are aware of site traffic procedures.	Percentage of personnel inducted and licensed. Personnel induction records.	All operators hold relevant licensing for machinery operation.	SHE Manager
MP113b	Develop and implement a community road and water safety management plan including driver education, community risk awareness, operational road and water traffic management protocols, and appropriate physical safety measures (including vehicle-pedestrian separation) where required.	Records of stakeholder engagement. Development of management plan.	Plan to be finalised and approved prior to construction works beginning. Engagement with all affected villages.	Community Relations Manager
MP114	Conduct regular servicing and inspection of vessels to ensure that they are operating in good working order.	Records of servicing and inspection.	All servicing to meet manufacturer's specifications.	Supply and Logistics Manager
MP116	Ensure that operators maintain a safe distance between vessels at all times.	Records of visual observations. Incident register.	No unresolved incidents.	Supply and Logistics Manager
MP118	Maintain low speeds of cargo vessels entering and departing Frieda, May and Upper Sepik river ports to reduce the risk of vessel wash swamping small fishing canoes.	Records of visual observations. Number of complaints regarding vessel wash.	No unresolved complaints or incidents.	Supply and Logistics Manager
MP119	Store adequate safety equipment on vessels and vehicles.	Records of visual inspections.	All safety equipment is maintained and meets relevant maritime safety standards.	SHE Manager

Table 9-2 Marine vessel collisions or sinking (cont'd)

No.	Management measures	Performance measures	Target	Responsibility
MP121	Ensure vessel operators do not transport non-project passengers between villages.	Maintenance of incident register.	No unresolved incidents.	SHE Manager
MP122	Ensure vessels are moored at designated areas. In an emergency vessels may be stopped/moored outside of designated areas but should avoid stopping at villages.	Maintenance of barge movement logs. Maintenance of incident register.	No unresolved incidents.	Supply and Logistics Manager

9.5.3 Vehicle incident

The measures detailed in Table 9-3 will be undertaken to reduce the likelihood of a vehicle incident.

Table 9-3 Vehicle incident

No.	Management measures	Performance measures	Target	Responsibility
MM151	Conduct vehicle route risk assessments factoring in the type of vehicle used on the roads and watercourse crossings and install speed limits and signage to advise road users of safe operating speeds and conditions.	Maintenance of risk register.	Risk assessments completed for all vehicle routes.	Supply and Logistics Manager
MM152	Provide fatigue management training to drivers and vessel operators.	Maintenance of training register.	No unresolved incidents.	Supply and Logistics Manager
SEM043	Develop and implement measures including driver education, community risk awareness, operational road traffic management protocols and appropriate physical safety measures (including vehicle-pedestrian separation) where required.	Maintenance of driver training and risk awareness register.	No unresolved incidents.	Supply and Logistics Manager
MP123	Control dust and exhaust emissions from trucks and other vehicles in accordance with the Air Quality, Noise and Vibration Management Sub-plan.	Records of inspections.	No unresolved incidents.	Mobile Maintenance Manager

Table 9-3 Vehicle incident (cont'd)

No.	Management measures	Performance measures	Target	Responsibility
MP124	Regularly service and inspect vehicles to ensure that they remain in good working order.	Records confirming that appropriate servicing and maintenance has been carried out in accordance with manufacturer's specifications.	All vehicles maintained accordingly and up to date.	Mobile Maintenance Manager
MP125	Service and inspection of vehicles to be conducted by a qualified mechanic.	Records confirming regular mechanic service.	All vehicles maintained accordingly and up to date.	Mobile Maintenance Manager
MP126	Maintain roads to a suitable and safe standard.	Records of road maintenance.	All roads are maintained regularly and accordingly.	Supply and Logistics Manager
MP127	Enforce speed limits and install signage to advise road users of safe operating speeds and conditions, particularly around villages.	Records of visual inspections. Number of incidents of reported speeding and unsafe operation. Number of complaints regarding speeding and unsafe vehicle operation.	No unresolved incidents or complaints.	Supply and Logistics Manager
MP128	Equip special purpose vehicles such as fuel trucks with equipment necessary to respond to an accident that may result in a spill.	Records of visual inspections.	All special purpose vehicles are equipped with appropriate spill response kits.	Mobile Maintenance Manager
MP129	Fit all construction machinery with appropriate warning equipment such as reversing alarms and night lighting.	Records confirming that appropriate warning equipment has been installed on construction machinery. Records of visual inspections.	All equipment to be fitted prior to arrival on site.	Mobile Maintenance Manager
MP130	Fit light vehicles with flashing lights and hazard flags to warn larger vehicles of their presence.	Records confirming that appropriate warning equipment has been installed on light vehicles. Records of visual inspections.	All equipment to be fitted prior to arrival on site.	Mobile Maintenance Manager

Table 9-3 Vehicle incident (cont'd)

No.	Management measures	Performance measures	Target	Responsibility
MP180	Ensure drivers do not stop for, pick up and/or transport non-FRCGP personnel in FRCGP vehicles.	Maintenance of incident register.	No unresolved incidents.	Supply and Logistics Manager
MP181	Restrict all site vehicles to constructed roads and authorised access tracks; travel outside of these areas will only be allowed with prior clearance and the appropriate driver training.	Maintenance of vehicle travel log.	No unauthorised use of non-project access roads and tracks.	Supply and Logistics Manager

9.5.4 Aircraft incident

The measures detailed in Table 9-4 will be undertaken to reduce the likelihood or consequence of an aircraft incident.

Table 9-4 Aircraft incident

No.	Management measures	Performance Measures	Target	Responsibility
MP131	Ensure that all FRCGP personnel use reputable airlines for air travel.	Maintenance of air travel log.	All air travel by FRCGP personnel used reputable airlines.	SHE Manager
MP135	Ensure that airstrips used by FRCGP have appropriate emergency response equipment and trained personnel to deal with an aircraft incident.	Records of visual inspections. Training records.	Completion of training by all employees and contractors where relevant to role.	Safety and Emergency Response Team (ERT) Superintendent

9.6 Performance, Monitoring and Reporting

The Traffic and Transport Management Sub-plan will be reviewed annually or as needed to ensure it remains valid. Procedures in the sub-plan will also be reviewed after any traffic incident to ensure the response is effective and to identify where improvements can be made.

General monitoring relevant to traffic incidents will include documenting incidents in incident reports and maintenance of induction and training records. Incident reports will be completed and appropriate measures will be taken to ensure that similar incidents or accidents will not occur in the future. Specific monitoring requirements relating to traffic and transport are outlined in Table 9-5.

Compliance by all personnel will be verified through both routine and unannounced inspections and monitoring by occupational, health and safety personnel.

Monitoring activities will be recorded and annual reports prepared by in-house staff or suitably qualified and experienced third parties. Environmental performance reports will be submitted to the Conservation Environment Protection Authority and other regulatory authorities as part of routine environmental reporting as per the conditions of the environmental permit and other FRCGP approvals.

Table 9-5 Traffic and transport monitoring

Monitoring measure	Performance indicator	Target	Frequency
Training and licensing.	Records of training and licensing.	All operators are trained and hold necessary licences to operate vehicles or vessels.	Ongoing
Vehicle and vessel movements.	Vehicle and vessel travel logs.	No unauthorised travel in FRL vehicles or vessels.	Ongoing
Monitoring of traffic accidents, including vessel collisions, aircraft and vehicle incidents.	Number of traffic related incidents and/or complaints.	No unresolved incidents and complaints.	Ongoing
Conduct hydrometeorology monitoring to detect unsafe weather conditions.	Records of hydrometeorology data.	Hydrometeorology data recorded and reported to relevant departments.	Daily

Frieda River Limited

Frieda River Copper-Gold Project

Environmental Management and Monitoring Plan

Waste Management Sub-plan

Construction

Environmental Management and Monitoring Plan
Waste Management Sub-plan
Construction

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Tables

10. Waste Management Sub-plan

10.1 Background

This sub-plan provides measures for the management of domestic and industrial wastes generated during construction of the Frieda River Copper-Gold Project (FRCGP). Management of this waste is required to keep construction area sites safe and tidy, and to limit contamination of land and water.

This sub-plan has been developed to limit waste generation and to ensure appropriate methods for handling and disposal of domestic and industrial wastes generated during construction activities are implemented. The aim of this sub-plan is to guide FRL in effectively managing waste (including domestic and industrial wastewater) from generation to collection, transport, storage, treatment, recycling and disposal in accordance with FRL's policies and procedures.

An environmental waste management facility will be constructed in the mine area and will comprise:

- Laydown areas.
- A lined solid waste landfill.
- Unrestricted waste covered area for storage of full and empty waste bins, waste bin cleaning area, storage area for unshredded and shredded vegetation for use in composting, shredder/chipper equipment and bailer for compacting plastic waste for disposal in landfill.
- Restricted waste covered area for storage of full and empty waste bins, drum and can crusher, incinerator and storage area for incinerator waste.
- High-temperature incinerator
- Scrap metal area for both ferrous and non-ferrous scrap metal.
- Composting area with bunkers for collection of compost material.
- Self-bunded diesel storage tank.
- Storage area for shipping containers for recycled materials.
- Environmental facility mobile fleet and waste containers.

A sewage treatment plant will be located at the site accommodation village. The network will consist of gravity sewers with pumped rising mains where required. The sewage treatment plant specifications will cater for 300 L/person/day based on peak personnel requirements. Effluent treated at the sewage treatment plant will be pumped to a process water pond or irrigated on vegetated areas. Solids will be composted in the composting area of the environmental waste management facility.

Handling, storage and disposal of hazardous material waste and any spills of hazardous materials are addressed in the Hazardous Materials, Fuel Handling and Spill Response Management Sub-Plan. Management measures for tailings and waste rock are detailed in the Acid and Metalliferous Drainage, Waste Rock and Tailings Management Sub-plan.

10.2 Objectives

The objectives of the Waste Management Sub-plan are to:

- Limit waste generation.

- Maximise the reuse of waste products in a safe and effective manner.
- Maximise recycling of waste where reuse is not practicable.
- Limit the adverse effects of waste disposal on the environment.
- Ensure waste management activities comply with legislative requirements, waste industry standards and company guidelines.
- Prevent the attraction or foraging of feral and/or native animals.
- Avoid safety risks to communities.

10.3 Responsibility

Accountability for waste movement and disposal will be the responsibility of the Environment Superintendent and FRL Safety, Health, Environment (SHE) Manager. Individual accountabilities will be defined through conditions of contracts of employment.

10.4 Definitions

Domestic waste. Waste resulting from household rubbish (i.e., food scraps, clothing, cloths and packaging), paper and wood.

Industrial waste. Non-domestic waste produced by construction activities that may require regulated storage, collection, treatment and/or disposal.

Watercourse. A river, creek or stream in which water flows permanently or intermittently in a visibly defined channel with:

- Continuous bed and banks.
- An adequacy of flow that sustains basic ecological processes and maintains biodiversity.

10.5 Procedures

The following procedures detail FRL's waste handling and disposal measures that will be implemented for the FRCGP's construction phase. Waste disposal will occur at both on-site and off-site facilities, depending on the type of waste stream.

10.5.1 Planning and preparation

Planning and preparation management measures to address waste emissions are detailed in Table 10-1.

Table 10-1 Planning and preparation waste management measures

No.	Management measures	Performance measures	Target	Responsibility
MP136	Train personnel in the waste management hierarchy (in order of preference): • avoid, • reduce, • reuse, • recycle, and appropriate disposal of domestic and industrial waste.	Proportion of personnel inducted on domestic and industrial waste management procedures. Personnel induction records.	All personnel inducted on domestic and industrial waste management procedures.	SHE Manager
MP137	Provide appropriate domestic and industrial waste disposal and collection facilities at construction offices, accommodation camps and construction activity sites. These will include rubbish bins and toilet facilities. Facilities to be based on the following waste management hierarchy and principles: • Limit waste generation. • Segregate main waste types (dedicated containers assist separation of waste). • Reuse materials or equipment. • Recycle materials or equipment. • Appropriate disposal in accordance with regulatory requirements.	Register of waste recording type, weight and destination of wastes produced on site.	All waste collection areas are well designed and clearly labelled for waste collection and segregation.	SHE Manager

Table 10-1 Planning and preparation waste management measures (cont'd)

No.	Management measures	Performance measures	Target	Responsibility
MP144	Waste storage and landfill facilities will be located at least 50 m from watercourses.	Site selection criteria for facility locations.	Waste storage and landfill facilities to meet PNG environmental code of practice for sanitary landfill sites specifications.	Construction Project Manager

10.5.2 Waste management

Management measures to address waste emissions during construction are detailed in Table 10-2.

Table 10-2 Waste emissions management measures

No.	Management measures	Performance measures	Target	Responsibility
MP138	Keep sites clean and tidy as follows: • No litter present. • Spills, including minor spills, are to be cleaned up immediately. • Wastes segregated and stored according to classification.	Records of visual inspections demonstrating that the facilities are kept clean and tidy.	No unresolved incidents of untidy practices.	SHE Manager
MP139	Document types, volumes and destinations of wastes generated during construction activities using a waste tracking system.	Register of waste recording type, weight and destination of wastes produced on site.	Develop and successfully implement register.	SHE Manager

10.5.2.1 Segregation of main waste types

The measures detailed in Table 10-3 will be undertaken when segregating main waste types.

Table 10-3 Waste segregation management measures

No.	Management measures	Performance measures	Target	Responsibility
MP140	Segregate and store metal waste into ferrous and non-ferrous metal areas for transportation to Vanimo. Metal waste to be collected at Vanimo by a scrap metal recycling contractor.	Register of waste recording type, weight and destination of wastes produced on site. Waste transport certificates.	Waste transport certificates completed for every consignment of waste that leaves the facility.	SHE Manager
MP141	Construction aggregate, waste concrete, sand and other waste from site works that are not chemically or biologically reactive and will not decompose, will be stored until they can be reused in construction projects, where practical.	Register of waste recording type, weight and destination (including reuse) of wastes produced on site.	Waste storage areas are well designed and clearly labelled for waste segregation.	SHE Manager
MM024	Design and construction of the FRCGP landfill in accordance with the Environmental Code of Practice for Sanitary Landfill Sites, PNG (2001).	Requirements of the Environmental Code of Practice for Sanitary Landfill Sites are incorporated into detailed engineering design. Records of visual inspection of construction.	Engineering design and construction meets requirements of the Environmental Code of Practice for Sanitary Landfill Sites.	SHE Manager

10.5.2.2 Disposal of waste

The measures detailed in Table 10-4 will be undertaken to manage the disposal of waste.

Table 10-4 Waste disposal management measures

No.	Management measures	Performance measures	Target	Responsibility
MP142	Domestic and industrial waste from the site that cannot be reused or recycled will be disposed of in the CEPA-approved environmental waste management facility.	Register of waste recording type, weight and destination of wastes produced on site.	No disposal of waste outside of the waste management facility.	SHE Manager
MP143	Landfill facilities will be lined to limit the potential for seepage to groundwater.	Records of liner installation and specifications.	Landfill lining to meet PNG environmental code of practice for sanitary landfill sites specifications.	Construction Project Manager

Table 10-4 Waste disposal management measures (cont'd)

No.	Management measures	Performance measures	Target	Responsibility
MP146	No solid or liquid waste will be disposed of in a manner where it can directly enter surface water through runoff.	Register of waste recording type, weight and destination of wastes produced on site. Bunding present where solid or liquid waste could directly enter surface water through runoff. Monitoring of surface and groundwater.	No uncontrolled discharge to watercourses.	SHE Manager
MM100	Prohibit disposal of domestic and industrial waste outside of designated waste storage and disposal areas.	Regular visual inspections.	Zero incidents of domestic and industrial waste disposal into forest stream and sinkholes.	Environment Superintendent
MP147	Food and green waste will be segregated and composted in the FRCGP environmental waste management facility and used on vegetated areas.	Register of waste recording type, weight and destination of wastes produced on site.	All food and green waste segregated and composted.	SHE Manager
MP148	Sharps and biological waste will be incinerated at the FRCGP environmental waste management facility.	Register of waste recording type, weight and destination of wastes produced on site. Incinerator records showing day of use and source of waste incinerated.	No unregulated disposal of sharps, biological and medical waste.	SHE Manager
MP149	Hydrocarbon impacted soil will be disposed of in the FRCGP environmental waste management facility (i.e. incinerated or disposed in landfill).	Register of waste recording type, weight and destination of wastes produced on site.	No incorrect disposal of wastes.	SHE Manager

Table 10-4 Waste disposal management measures (cont'd)

No.	Management measures	Performance measures	Target	Responsibility
MP150	Used hydrocarbon clean up material, oily rags and grease will be incinerated at the FRCGP environmental waste management facility.	Register of waste recording type, weight and destination of solid wastes produced on site. Incinerator records showing day of use and source of waste incinerated.	No incorrect disposal of hydrocarbon wastes.	SHE Manager
MP151	Workshop wastes, plastic type materials, scrap metal and miscellaneous wastes will be segregated and, where possible, recycled at the environmental waste management facility.	Register of waste recording type, weight and destination of solid wastes produced on site.	Waste is recycled wherever possible.	SHE Manager
MP152	Chemicals and chemical containers will be disposed offsite to a Government approved waste disposal facility.	Register of waste recording type, weight and destination of solid wastes produced on site. Waste transport certificates.	Waste transport certificates completed for every consignment of waste that leaves the environmental waste management facility.	SHE Manager
MP153	Tyres will be transferred to the tyre disposal area where they will be shredded. Steel bead from the tyre sidewalls will be removed and transported to the steel storage area.	Register of waste recording type, weight and destination of solid wastes produced on site.	No incorrect disposal of wastes.	SHE Manager
MP154	Ensure all construction and domestic waste (solid and wastewater) is removed from work sites or temporary access tracks.	Records of visual inspections Register of waste recording type, weight and destination of all wastes produced on site.	No construction waste left at work sites.	SHE Manager
MP184	Operate sewage treatment plants in accordance with the manufacturer's specifications and discharge treated effluent in accordance environmental permit requirements.	Review operating procedures and effluent discharge analysis results.	100% compliance with environmental permit.	SHE Manager

10.5.2.3 Industrial wastewater from workshop and fuel areas

The measures detailed in Table 10-5 will be undertaken to manage industrial wastewater from workshop and fuel storage areas.

Table 10-5 Industrial wastewater management measures

No.	Management measures	Performance measures	Target	Responsibility
MM096	Conduct washing, servicing and refuelling of equipment, vehicles or machinery at designated, appropriately designed facilities, away from watercourses.	Records of visual inspections.	Zero non-conformances of washing equipment in watercourses. All washing, servicing or refuelling of equipment performed in appropriately designed facilities.	Construction Project Manager
MP155	Manage all wastewater from plant runoff, oil and fuel storage area runoff by: • No litter present. • Contain and treat wastewater to remove sediment and hydrocarbons before discharge. • Install and maintain oil-waste separator traps in appropriate areas. • Divert clean rainwater away from fuel storage areas and segregate runoff from plant maintenance and fuel storage areas for treatment prior to release.	Records of visual inspections.	No uncontrolled discharge of wastewater or contaminated rainwater runoff. No unresolved incidents.	SHE Manager
MP156	Oil-water separator traps will be installed and maintained for the separation of oil-film from wastewater from the workshop and fuel storage areas.	Records of visual inspections.	All workshop water captured and directed through trap prior to discharge.	SHE Manager

Table 10-5 Industrial wastewater management measures (cont'd)

No.	Management measures	Performance measures	Target	Responsibility
MP157	Rainfall runoff from workshops and fuel storage areas will be segregated by diversion of clean runoff in order to avoid cross-contamination with hydrocarbon waste. Oil contaminated runoff will be diverted to the oil-water separator trap.	Records of visual inspections.	Facilities to meet PNG Environmental Code of Practice for Vehicle/ Machinery Workshops and Petroleum Storage/ Resale/ Usage sites specifications. All oil contaminated water captured and directed through trap prior to discharge.	SHE Manager
MP086	Fuel and oil pumps and storage areas will be located within impermeable containment bunds a minimum of 50 m from any waterbody or watercourse	Site selection criteria for facility locations.	Facilities to meet PNG Environmental Code of Practice for Vehicle/ Machinery Workshops and Petroleum Storage/ Resale/ Usage sites specifications.	SHE Manager

10.6 Performance, monitoring and reporting

This FRL Waste Management Sub-plan, and any other associated procedures will be reviewed annually to ensure that they remain valid.

Applicable plans and procedures will be reviewed after any non-conformance with a measure in this plan to ensure that they were effective and to identify where improvements can be made.

General monitoring relevant to waste management will include documenting of incidents in incident reports and maintenance of induction and training records. Incident reports will be completed, and appropriate measures will be taken to ensure that similar incidents or accidents will not occur in the future.

Regular inspections and monitoring of on-site landfills, workshops, and fuel and oil depots will occur to ensure that such sites are being maintained in accordance with the appropriate PNG Environmental Code of Practice for Sanitary Landfill Site (2001) and the Code of Practice for Vehicle and Machinery Workshops, Petroleum Storage, Resale and Usage Sites (1997). Specific waste management monitoring is outlined in Table 10-6.

The treatment and release of domestic and industrial wastewater will similarly be monitored by FRL and will include sampling surface and groundwater near the landfill facility, sewage treatment discharge point and fuel storage and equipment refuelling areas for the following aspects:

- Field physicochemical parameters – temperature, pH, electrical conductivity, total dissolved solids, redox, dissolved oxygen.
- Laboratory total dissolved solids, electrical conductivity, pH, total suspended solids.
- Major ions.
- Nutrients (specifically) – nitrate, nitrite, ammonia and total phosphorus.
- Biochemical oxygen demand, total organic carbon, chemical oxygen demand, total coliform bacteria, faecal coliform.
- Total and dissolved metals.
- Petroleum hydrocarbons.

Water sampling analyses will be conducted by a certified laboratory to ensure reliability in results and QA/QC procedures. In addition, the laboratory reporting limits for the prescribed suite will be considered to ensure results are comparable to the regulatory framework including environment permit conditions.

Baseline monitoring will start prior to the commencement of construction and the discharge of wastewater to enable determination of background values. Baseline monitoring is detailed in the Water Management Sub-plan.

Compliance by personnel with the procedures in this plan will be verified through both quarterly and spontaneous audits by FRL Environment Department personnel. Performance measured through monitoring, audits and inspections will be conducted by the FRL Environment Department.

Monitoring activities will be recorded, and annual reports prepared by in-house staff or suitably qualified and experienced third parties. Environmental performance reports will be submitted to the

Conservation Environment Protection Authority and other regulatory authorities as part of routine environmental reporting as per the conditions of the environmental permit and other FRCGP approvals.

Table 10-6 Waste management monitoring

Monitoring measure	Performance indicator	Target	Frequency
Review of waste register.	Reuse of waste products in a safe and effective manner.	Waste is reused for FRCGP activities wherever possible.	Annual
	Appropriate segregation of waste.	Waste is reused for FRCGP activities wherever possible.	Annual
	Appropriate disposal of waste.	Disposal of waste meets the requirements of this plan and environment permit.	Annual
Monitor downstream receiving environments.	Surface and groundwater quality downstream of landfill facility, effluent treatment plant discharge point, septic tank and fuel storage and refuelling facilities.	Water quality results meet required standards and environment permit conditions.	Monthly
Audit of environmental waste management facility.	Management of landfill.	Disposal of waste to landfill meets regulatory requirements and landfill managed as per the PNG Environmental Code of Practice for Sanitary Landfill Sites.	Quarterly
	Management of workshops.	Facilities to meet PNG Environmental Code of Practice for Vehicle/ Machinery Workshops and Petroleum Storage/ Resale/ Usage sites specifications.	Quarterly
	Records of waste types and quantities for Carbon Disclosure reporting requirements.	Waste disposed and recycled recorded by type and quantity.	Annual

Frieda River Limited

Frieda River Copper-Gold Project

Environmental Management and Monitoring Plan

Water Management Sub-plan

Construction and Operations

Environmental Management and Monitoring Plan
Water Management Sub-plan
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11. Tables

11. Water Management Sub-plan

11.1 Background

Construction activities associated with the Frieda River Copper-Gold Project (FRCGP) have the potential to impact on water quality, surface water flow regimes and groundwater aquifers.

Water is used for a range of 'beneficial uses' (also known as environmental values) in the FRCGP area. The beneficial uses of a water resource may range from a source of drinking water through to the maintenance or protection of an aquatic ecosystem. Each beneficial use may have different water quality requirements.

The potential impacts of the FRCGP construction activities upon surface water and groundwater include:

- Changes in environmental flow and barrier effects due to construction of mine infrastructure, with associated physical impacts on aquatic biota and habitat.
- Elevated suspended solids concentrations and sedimentation downstream of disturbed areas, with associated physical impacts on aquatic biota, and acceptability of water quality for human consumption or other beneficial values (e.g., use for cooking or washing, navigation, recreation and aesthetic enjoyment).
- Elevated concentrations of dissolved and particulate-associated metals downstream of the mine area, causing toxic effects on aquatic biota or people who may drink the water or consume the aquatic biota.
- Contamination of surface and/or groundwater resources due to leaks or spills of fuels, oils, chemicals, hydrocarbons, landfill leachate and sewage.

FRL will establish an independent advisory committee for downstream water quality and resource use matters as part of ensuring the technical rigour, accountability and transparency of environmental investigations for downriver communities. This committee will be established prior to the commencement of construction and will comprise representatives of the PNG Government, prominent PNG citizens, expert international specialists and FRL. The committee will provide direction and technical oversight for environmental monitoring and investigations, to improve public understanding of the Sepik Development Project's environmental issues and to review FRL's environmental performance and accountability. The findings of the committee will routinely be made public.

11.2 Objectives

The objectives of surface water and groundwater management are to:

- Limit the increase in the loads and/or concentrations of pollutants (including sediment) entering watercourses downstream of construction activity.
- Maintain existing water flow regimes, where possible.
- Limit the volume of surface water becoming contaminated and reaching downstream watercourses.
- Limit the contamination of groundwater resources.

11.3 Responsibility

Implementation of the Water Management Sub-plan will be the responsibility of the Safety, Health and Environment (SHE) Manager, who is also responsible for ensuring that activities associated with the project are undertaken in compliance with relevant statutory environmental regulations and FRL's environment policy and FRCGP Environmental Management and Monitoring Plan (EMMP).

11.4 Definitions

Beneficial use. An identified use of water that is of social, environmental and/or economic use.

Bund. An impermeable barrier constructed of earth, rock or concrete to prevent the inflow or outflow of liquids.

Runoff. The draining away of water (or substances carried in it) from the surface of an area of land, a building or structure, etc.

Watercourse. A river, creek or stream in which water flows permanently or intermittently in a visibly defined channel with:

- Continuous bed and banks.
- An adequacy of flow that sustains basic ecological processes and maintains biodiversity.

11.5 Procedures

The following procedures detail FRL's water management measures that will be implemented prior to and during the FRCGP construction and operations phases.

11.5.1 Planning and preparation

Planning and preparation management measures for surface and groundwater are detailed in Table 11-1.

Table 11-1 Planning and preparation

No.	Management measure	Performance measure	Target	Responsibility
MM030	Locate, design and construct linear infrastructure to avoid impacts on the hydrology of off-river waterbodies (ORWBs).	Final design demonstrates consideration of surface water flow paths.	Natural water flows are maintained where practical.	Engineering Manager
MM044	Where practicable, locate valley-bottom access alignments so as to provide a buffer strip of natural vegetation between the access ways and watercourses.	Final design demonstrates consideration of vegetation buffer.	Location of access alignments meet design requirements.	Engineering Manager
MM053	Design and construct project facilities involving the storage, handling, or use of hazardous materials to intercept potentially contaminated water for treatment if required prior to discharge.	Final design demonstrates consideration of potentially contaminated water.	Potentially contaminated water is intercepted where practicable.	SHE Manager
MM092	For roads required within riparian vegetation, utilise areas of disturbed riparian vegetation as far as practicable. Keep road alignment approaches to watercourses as close to right angles as practicable to limit disturbances to the banks of watercourses.	Completion of survey leads to refinement of routing of access ways.	Documentation of survey results. Inspection of engineering records.	Construction Project Manager

Table 11-1 Planning and preparation (cont'd)

No.	Management measure	Performance measure	Target	Responsibility
MP004	Train and induct personnel and contractors in potential project impacts to water quality and the management measures detailed in this management plan.	Maintenance of induction register.	Completion of induction by all employees and contractors where relevant to their role.	SHE Manager
MP158	Train and induct personnel and contractors in spill prevention and response procedures, in accordance with the Hazardous Materials, Fuel Handling and Spill Response Management Sub-plan.	Maintenance of induction register.	Completion of induction by all employees and contractors where relevant to their role.	SHE Manager
MP160	Inform local villagers in areas downstream of construction works of upcoming work that may be affected by water quality degradation (via the FRL Community Relations team).	Stakeholder engagement records	Engagement with affected villages.	SHE Manager, Community Relations Manager
MP171	Ensure that sewage treatment facilities are designed to meet water quality requirements of sewage treatment plant effluent specified in the environment (waste discharge) permit.	Records of design specifications.	Sewage treatment facilities meet design requirements.	SHE Manager

11.5.2 **Hydrology**

Management measures to limit changes to hydrology are provided in Table 11-2.

Table 11-2 Hydrology management measures

No.	Management measure	Performance measure	Target	Responsibility
MM033	Maintain environmental flows downstream of the ISF embankment in the Frieda River at 50 m^3/s except for a short period during initial impoundment.	Flow monitoring records.	No flows recorded less than 50 m^3/s at AP7.	FRHEP Operations
MP159	Design mine infrastructure to limit deviation of natural surface water flow paths and to ensure existing downstream flow regimes are maintained.	Final design demonstrates consideration of surface water flow paths.	Natural water flows are maintained where practicable.	Engineering Manager

11.5.3 **Contamination**

Management measures to limit contamination of watercourses (including sedimentation) and groundwater are provided in Table 11-3.

Table 11-3 Contamination management measures

No.	Management measure	Performance measure	Target	Responsibility
MM020	Limit potential impacts to groundwater during all Project phases including: • Comply with the relevant statutory requirements and Australian standard AS 2243.10 (Standards Australia, 2004) for hazardous materials transportation, storage, handling and disposal. • Conduct leak detection during commissioning of pipelines and manage hydrotest water appropriately. • Develop and implement a waste minimisation, waste handling and disposal strategy.	Compliance with design criteria. Water quality monitoring.	All pipeline leaks recorded and rectified.	Construction Manager, Operations Manager, SHE Manager
MM028	Do not place any infrastructure, permanent or temporary, in ORWBs. These areas will be marked as 'No Go Zones' on relevant figures.	Incorporate constraint into detailed engineering design.	No infrastructure placed in off-river waterbodies.	Construction Manager
MM029	Do not use ORWBs for waste disposal, including for domestic and industrial waste, or for discharge of treated or untreated waste waters.	Records of visual inspections.	Waste disposed of in designated areas. No unresolved incidents.	Construction Manager

Table 11-3 Contamination management measures (cont'd)

No.	Management measure	Performance measure	Target	Responsibility
MM053	Design and construct project facilities involving the storage, handling, or use of hazardous materials to intercept potentially contaminated water for treatment if required prior to discharge.	Records of visual inspections. Water quality monitoring.	Bunded open drain areas are constructed to intercept runoff. Water quality monitoring downstream of sediment ponds meets waste discharge permit conditions.	SHE Manager
MM096	Conduct washing, servicing and refuelling of equipment, vehicles or machinery at designated, appropriately designed facilities, away from watercourses.	Records of visual inspections.	Equipment and machinery cleaned, serviced or refuelled in designated bunded areas.	Mobile Plant Manager
MM101	Implement good industry-practice management of in-stream activities to limit the downstream extent of turbid water created by fords, trenching or bridge building as far as practicable.	Records of visual inspections. In-stream infrastructure design considers good industry-practice management.	Implementation of good industry-practice management of in-stream activities.	Construction Project Manager

Table 11-3 Contamination management measures (cont'd)

No.	Management measure	Performance measure	Target	Responsibility
MP006	Visually monitor runoff from construction sites. Uncontained surface water contamination from AMD, hydrocarbons or sediment must be recorded. Where practicable and where required, appropriate steps will be taken to remediate the problem.	Records of visual inspections for large rainfall events	Large runoff events monitored.	SHE Manager
MP007	Document and investigate all complaints about water quality and work with local communities to resolve any issues via the project grievance mechanism.	Maintenance of grievance register.	No unresolved complaints.	Community Relations Manager SHE Manager
MP143	Line landfill facilities to limit the potential for seepage to groundwater.	Landfills constructed with lining.	No non-compliances downstream of landfill facilities.	SHE Manager
MP163	Place excavated material, cleared vegetation or fill away from gullies, creeks or other natural drainage lines.	Records of visual inspections	No excavated material is stockpiled in gullies, creeks or other natural drainage lines, with the exception of engineered waste rock and spoil dumps.	Construction Manager
MP164	Pass any water used in workshops through an oil-water separator trap prior to discharge.	Records of visual inspections.	Workshop water captured and directed through trap before discharge.	Mobile Maintenance Manager

Table 11-3 Contamination management measures (cont'd)

No.	Management measure	Performance measure	Target	Responsibility
MP167	Divert water of poor quality to the sedimentation ponds and/or use this water as make-up water during construction (e.g., vehicle washdown).	Records of visual inspections.	Divert poor water quality to a sedimentation pond or is reused prior to discharge.	SHE Manager
MP169	Check the quality of ponded water prior to discharge near a waterbody, treating to remove sediment, hydrocarbons and chemicals if necessary. Discharge ponded water away from cleared areas to stable (vegetated) areas.	Records of water quality checks before discharge.	No discharge of unchecked ponded water.	SHE Manager
MP182	Management of hazardous materials to prevent negative impacts on water quality will be conducted in accordance with the Hazardous Materials, Fuel Handling and Spill Response Management Sub-plan.	Visual inspections and maintenance or incident register.	Management of hazardous materials conducted in accordance with sub-plan.	SHE Manager

11.5.4 Domestic wastewater

Measures for the management of domestic wastewater are provided in Table 11-4.

Table 11-4 Domestic wastewater management measures

No.	Management measure	Performance measure	Target	Responsibility
MM051	Manage sewage in an appropriate manner to limit environmental contamination.	Records of discharge quality monitoring.	Discharge water quality to meet relevant guidelines.	SHE Manager
MM100	Prohibit disposal of domestic and industrial waste outside of designated waste storage and disposal areas.	Records of visual inspections. Waste observed in forest streams or sinkholes to be recorded as environmental incident.	Waste disposed of in designated areas. No unresolved incidents.	SHE Manager
MP172	Divert kitchen wastewater through grease traps before diverting to the sewage treatment plant.	Records of visual inspections.	No discharge of untreated kitchen wastewater.	SHE Manager

11.5.5 Watercourse crossings

Management measures for watercourse crossing during construction are provided in Table 11-5.

Table 11-5 Watercourse crossing management measures

No.	Management measure	Performance measure	Target	Responsibility
MM026	Install rip-rap or other forms of armouring for stabilisation around the base of bridges to avoid scour and river bed erosion.	Records of visual inspections.	Armouring installed on all bridges.	Construction Manager
MM032	Construct culverts in creeks and streams, as necessary during road construction, to allow the normal cross-flow of water.	Records of visual inspection.	Natural water flows are maintained where practical.	Construction Manager
MM040	Use rip-rap, gabions and check dams to reduce velocity flow of water in constructed drainage channels where practicable.	Records of visual inspections.	Drainage channels installed with appropriate flow control.	Construction Manager
MM093	Preserve riparian vegetation to the greatest extent practical and create a buffer of natural vegetation between watercourses and construction areas, where practicable.	Clearance does not exceed areas approved in land clearance permit (clearance beyond permitted areas must be reported as an incident). Evidence of examples of project design preserving riparian vegetation.	No clearance beyond demarcated buffer where marked.	Construction Manager

Table 11-5 Watercourse crossing management measures (cont'd)

No.	Management measure	Performance measure	Target	Responsibility
MP174	Construct all roads and access tracks in accordance with approved plans, including all drainage requirements (e.g., gentle slopes on roads to ensure runoff, adequate table and cross drains).	Records of approved plans and final construction. Records of work site inspections.	Roads constructed in accordance with approved plans.	Construction Manager
MP175	Keep heavy machinery away from watercourses, unless access is required to construct crossings.	Records of visual inspection.	Heavy machinery kept in demarcated areas.	Construction Manager
MP176	Prior to any machinery access to a watercourse, ensure that hydraulic, fuel and lubricating systems are in good repair to limit the risk of site contamination.	Records of regular maintenance and service of machinery.	Machinery to be maintained and serviced in accordance with manufacturers' specifications.	Mobile Maintenance Manager

11.6 Performance, monitoring and reporting

The FRCGP Water Management Sub-plan and any other associated procedures will be reviewed annually to ensure that they remain valid.

Applicable plans and procedures will be reviewed after any non-conformance with a measure in this plan to ensure that they were effective and to identify where improvements can be made.

Monitoring relevant to water quality and management will include:

- Daily visual monitoring of water runoff from work sites to identify signs of water contamination from unexpected sediment release, rubbish or hydrocarbons.
- Quarterly monitoring of water quality at representative water sources used by local communities for drinking purposes.
- Surface water quality baseline monitoring program to establish the ambient water quality of the receiving environment to validate the initial water quality results provided in the EIS.
- Groundwater baseline monitoring program to provide the basis for the assessment of impacts during operation of the FRCGP.
- Continued monitoring of the already-established sites:
    - A compliance point at AP7 in the upper Frieda River. At this compliance point, water quality shall comply with PNG Ambient Water Quality Standards (Schedule 1) and PNG Drinking Water Guidelines as a regulatory requirement. This compliance point shall be the downstream boundary of the mixing zone and the waters between the discharge location and the compliance point will be the mixing zone where PNG water quality standards and guidelines shall not be required to be met. Where maximum background concentrations of (dissolved and total) parameters measured in the Frieda Rivers (at AP7) exceed the regulatory criteria, the 90th percentile background concentrations will be adopted as the site-specific criteria. Site-specific criteria for copper (based on experimentally measured copper data) and aluminium (based on US EPA Draft Aquatic Life Ambient Water Quality Criteria for Aluminium (2017)[1]) have been developed.
    - Compliance criteria will be as per the environment permit.
    - Flow from the ISF prior to its discharge into the Frieda River (either through the hydroelectric power facility intake or spillway). IFC effluent discharge standards shall be met at this location with the exception of TSS, which is naturally highly variable, and iron which are naturally elevated.
- Continued use of gauging stations to monitor water level and stream flow as well as establishing additional stream gauging stations.
- Monitoring of the freshwater environment will be conducted monthly and will assess the following aspects:
    - Field physicochemical parameters – temperature, pH, electrical conductivity, total dissolved solids, redox, dissolved oxygen.
    - Laboratory total dissolved solids, electrical conductivity, pH, total suspended solids.

[1] USEPA. 2017a. Draft Aquatic Life Ambient Water Quality Criteria for Aluminium – 2017, July 2017, U.S. Environment Criteria Division Washington, D.C.

- Major ions.
- Nutrients (specifically) – nitrate, nitrite, ammonia and total phosphorus.
- Biochemical oxygen demand, total organic carbon, chemical oxygen demand, total coliform bacteria, faecal coliform.
- Filtered (<0.45 µm) and unfiltered metals: Al, As, Ba, Be, Cd, Co, Cr, Cu, Mn, Ni, Pb, V, Zn, Fe, Hg.
- Labile copper concentrations in the Frieda and Sepik rivers.

If water quality criteria are not met, further action would be taken and may include:

- Investigation into the cause of the exceedance.
- Further site-specific copper or aluminium speciation investigations.
- Biological monitoring in the Frieda and Sepik rivers to determine if there are any impacts to aquatic biota occurring during operations.
- Laboratory toxicity testing of selected macroinvertebrates collected from the Frieda River.
- If warranted, investigation of further water treatment options.

Monitoring activities will be recorded and annual reports prepared by in-house staff or suitably qualified and experienced third parties. Environmental performance reports will be submitted to the Conservation Environment Protection Authority and other regulatory authorities as part of routine environmental reporting as per the conditions of the environmental permit and other project approvals. Water quality results will also be routinely reported to local communities.

Monitoring is detailed in Table 11-6.

Table 11-6 Water monitoring

Monitoring measure	Performance indicator	Target	Frequency
Loads and/or concentrations of pollutants (including sediment) entering watercourses downstream of construction activity.	Monitoring the quality of water discharged from the sedimentation dams and comparison against baseline water quality data to confirm the performance of sediment control structures and the prediction of downstream impacts.	Downstream impact on water quality as predicted in EIS.	Monthly or as required
Monitor downstream water quality	Water quality in watercourses downstream of project activities.	Monitoring results comply with environment permit conditions.	Monthly (ambient water quality sites) or as required
	Number of complaints about project-related water quality.	Complaints recorded and investigated in compliance with grievance procedure.	As required
Monitor flow regimes in the Frieda River at AP7	Regular monitoring of water flow regimes.	Maintain a flow of 50 m^3/s downstream of the ISF embankment.	Monthly
Monitor groundwater levels, pressures and quality.	Monitoring undertaken.	Validation of model assumption to verify EIS predications.	Monthly to annually (depending on parameter)
Rate of dewatering and groundwater inflow into the open pits	Monitoring undertaken.	Validation of model assumption to verify EIS predications.	Monthly
Monitor water quality at representative water sources used by local communities for drinking purposes	Monitoring undertaken.	Compliance with criteria.	Quarterly

Frieda River Limited

Frieda River Copper-Gold Project

Environmental Management and Monitoring Plan

Weed, Pest and Quarantine Management Sub-plan

Construction

Environmental Management and Monitoring Plan

Weed, Pest and Quarantine Management Sub-plan

Construction

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12. Weed, Pest and Quarantine Management Sub-plan

12.1 Background

This sub-plan has been developed to manage the potential for the introduction and spread of weeds, pests, and pathogens as a result of the construction of Frieda River Copper Gold Project (FRCGP). The sub-plan will ensure the most appropriate methods for the management of weeds, pests, and diseases during construction activities are implemented.

This sub-plan has been developed to address the following:

- Introduction of new weed species.
- Spread of existing weed species.
- Introduction of new pest species and the diseases they may carry.
- Spread of existing pest species and the diseases they may carry.

12.2 Objectives

The objectives of this Weed, Pest and Quarantine Management Sub-plan are to:

- Ensure personnel are aware of prohibited activities relating to the import or movement of exotic plants and animals during construction of the project.
- Prevent exotic weeds, pests and diseases from entering, spreading or becoming established in the project area during construction works.
- Identify and contain, suppress or manage significant weeds, pests and diseases already in the project area to limit their spread by FRCGP activities.
- Limit the potential for the FRCGP to cause a significant reduction in the abundance of native species.

12.3 Responsibility

Implementation of the Weed, Pest and Quarantine Management Sub-plan will be the responsibility of the Safety, Health and Environment (SHE Manager. The SHE Manager is responsible for ensuring that activities associated with the FRCGP are undertaken in compliance with relevant statutory regulations, and the FRL environment policy and the FRCGP EMMP. All staff, including contractors, are responsible for compliance with this sub-plan.

12.4 Definitions

Weed or pest. A weed or pest is defined as an invasive (native or introduced) species that causes an adverse impact on the ecology and/or communities.

12.5 Procedures

12.5.1 Planning and preparation

Planning and preparation management measures to address weed, pest and pathogens and quarantine management are detailed in Table 12-1.

Table 12-1 Planning and preparation

No.	Management measures	Performance measure	Target	Responsibility
Inductions, training and awareness				
MP014	Ensure that personnel are familiar with this sub-plan and the importance of controlling impacts on terrestrial, freshwater and nearshore environments during construction.	Maintenance of induction register.	Completion of induction by all employers and contractors where relevant to their role.	SHE Manager
MP092	Ensure relevant site personnel are inducted regarding pest and weed control in and around the FRCGP area, and the requirement to minimise disturbance to vegetation.	Maintenance of induction register.	Completion of induction by all employers and contractors where relevant to their role.	SHE Manager

12.5.2 Quarantine

Quarantine measures (Table 12-2) will establish and enforce FRCGP wide systems that will encompass personnel and freight movements in and out of the FRCGP area, and establish inspection and treatment standards and procedures for all freight types, including imported bulk materials.

Table 12-2 Quarantine measures

No.	Management measures	Performance measure	Target	Responsibility
MP093	Establish and enforce a FRCGP-wide quarantine program. Focus on sites where equipment and supplies will be imported into PNG or brought into the FRCGP area from elsewhere in PNG.	Documented, updated and audited quarantine program, with input from relevant stakeholders.	Documentation of program and 100% success of regular audits.	SHE Manager
MM083	Prohibit keeping or temporary housing of pets or wild fauna at project facilities other than trained guard dogs under the control of a handler.	Regular inspections of accommodation and facilities for pets.	Zero reported incidences.	SHE Manager
MM077	Prohibit hunting, collecting, or harassing of wildlife, keeping wildlife as pets and/or the possession and/or transport of wildlife products by Project employees and contractors at Project sites.	Regular inspections of employees and contractors for wildlife or wildlife products.	Zero reported incidences.	SHE Manager
MM069	Prohibit transportation of live plants or seeds to the project sites unless part of an approved rehabilitation plan or approved community development program.	Regular inspections of employees and contractors for plants or seeds.	Zero reported incidences.	SHE Manager
MM071	Establish procedures to prohibit project workers/contractors from establishing gardens or introducing any plants, seeds or animals, including fish species, within the project area.	Regular inspections of accommodation and facilities for pets.	Zero reported incidences.	SHE Manager

Table 12-2 Quarantine measures (cont'd)

No.	Management measures	Performance measure	Target	Responsibility
MP094	Cargo must meet PNG Quarantine guidelines before being packed into containers at origin to ensure compliance with regulatory quarantine requirements.	Quarantine audits of cargo for each importation.	Zero reported incidence of failure to meet PNG guidelines.	Port, Supply & Logistics Manager
MM070	Establish and implement procedures to ensure soil and weed seeds are cleaned from plant and machinery brought into the project area from overseas, logging areas or agricultural areas elsewhere in PNG prior to reaching the project site (applies to Company and Contractors).	Inspections of vehicles and equipment arriving on the mine site for all new deliveries.	Inspection of FRCGP vehicles and equipment that arrive on the mine site.	Port, Supply & Logistics Manager
MM073	Establish permanent chemical wash down point(s) to prevent weeds and pathogens being transported to work sites, where appropriate.	Evidence of constructed wash downs points and registers of their use.	Wash down points included in detailed engineering design based on consultation with weed expert as to their locations.	Port, Supply & Logistics Manager
MP095	Contain the material washed from machinery/equipment for appropriate disposal.	Inspection of wash down points for containment of washed material within wash down point for disposal.	90% success of completion.	Port, Supply & Logistics Manager
MP096	Ensure shipping contractors comply with International Maritime Organization requirements and industry good practice with respect to ballast water discharge.	Records of ballast discharge. Quarantine audits of cargo for each importation.	Zero reported incidence of failure to meet International Maritime Organization requirements.	Port, Supply & Logistics Manager

12.5.3 Pre-construction

Pre-construction management measures to address biodiversity management are detailed in Table 12-3.

Table 12-3 Pre-construction measures

No.	Management measures	Performance measure	Target	Responsibility
MM013	Carry out pre-construction survey of work sites for weeds, exotic fauna and dieback using a risk-based approach to identify areas susceptible to invasion of exotic species. If dieback is recorded, testing for Phytophthora will be completed and if present, procedures for managing the spread of dieback will be developed.	Documentation of completed pre-construction survey.	Understanding of weed, exotic fauna and dieback, type, distribution and abundance.	Environment Superintendent
MM072	Control infestations of high priority weeds prior to commencement of construction.	Records of treatment and eradication within a weed treatment register.	All high priority weeds outbreaks controlled.	Environment Superintendent

12.6 Performance, monitoring and reporting

This FRL Weed, Pest and Quarantine Management Sub-plan, and any other associated procedures will be reviewed annually to ensure that they remain valid.

Applicable plans and procedures will be reviewed periodically to ensure they remain effective and to identify where improvements can be made.

General monitoring relevant to weeds, pest, pathogens and quarantine response will include documenting any incident, maintenance works and training records. Pathogens and quarantine reports will be completed, and appropriate measures will be taken to ensure the management of goods will be control and monitored to limit any incidents or accidents. Specific monitoring of weeds and pests are outlined in Table 12-4.

Ongoing monitoring of construction activities will be undertaken to assess the success of management measures and identify areas where changes to management measures will minimise the risk of spreading uncontrolled weeds, pest and pathogens. Where monitoring identifies deficiencies in the control methods described above, the procedures in this plan will be reviewed and updated as required.

Compliance by personnel with the procedures in this plan will be verified through both routine and unannounced inspections and monitoring by the SHE Manager (or their delegate).

Monitoring activities will be recorded, and annual reports prepared by in-house staff or suitably qualified and experienced third parties. Environmental performance reports will be submitted to the Conservation Environment Protection Authority and other regulatory authorities as part of routine environmental reporting as per the conditions of the environmental permit and other FRCGP approvals.

Table 12-4 Weed, pest and quarantine monitoring

Monitoring measure	Performance Indicator	Target	Frequency
Rodent monitoring at major infrastructure sites, to ensure that exotic pest rodents are detected early, followed by appropriate eradication measures. Wherever exotic rodent pests are detected, implement sample collection for disease screening for major pathogens.	Records kept of rodent monitoring.	No new introduced pest species.	Ongoing
Weed and pest control techniques.	Comparison of weed and pest control techniques against monitoring data.	Successful controls demonstrated.	Ongoing

Table 12-4 Weed, pest and quarantine monitoring (cont'd)

Monitoring measure	Performance Indicator	Target	Frequency
Monitoring areas along roadsides, recently cleared areas and newly rehabilitated areas for weed invasion.	Presence (or absence) of weeds species.	No new introduced weed species.	Ongoing
Visual inspections and monitoring on the existing weeds and pests already present in the project area.	Abundance and cover of weeds species that are known to occur.	Weeds and pests must be contained at all times.	Ongoing