



GB MINERALS

— LTD —

FARIM PHOSPHATE PROJECT
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT
VOLUME 1 – INTRODUCTION TO THE ASSESSMENT



Knight Piésold
CONSULTING



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GB MINERALS LTD. FARIM PHOSPHATE PROJECT

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

VOLUME 1 - INTRODUCTION TO THE ASSESSMENT NB301-520/2-1

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ABBREVIATIONS

AAS	atomic absorption spectrometers
ACP	African, Caribbean and Pacific
ADM	Air Dispersion Model
APGB	Administration of Ports of Guinea-Bissau
AQMP	Air Quality Management Plan
AQS	Air Quality Standards
ARD	Acid Rock Drainage
ARI	Average Return Interval
AUC	African Union Commission
BLM	Bureau of Land Management (United States Department of the Interior)
BMP	Biodiversity Management Plan
BRGM	Bureau de Recherche Géologiques et Minières (France)
CACR	Charter of African Cultural Renaissance
CAIA	Célula de Avaliação de Impacte Ambiental
CAPEX	Capital Expenditure
CCA	Cultural Charter for Africa
CCME	Canadian Council of Ministers of the Environment
CDP	Community Development Plan
CEFIC	European Chemical Industrial Council
CEQG	Canadian Environmental Quality Guidelines
CEQG-PAL	Canadian Environmental Quality Guidelines for the Protection of Aquatic Life
CFP	Chance Finds Procedure
CHSS	Community Health, Safety and Security
CI	Conservation Importance
CIA	Central Intelligence Agency
CISL	Computational Information Systems Laboratory
CITES	Convention on International Trade in Endangered Species
CM	Cashew Monoculture
COMEST	World Commission on the Ethics of Scientific Knowledge and Technology
CR	Critically Endangered
CRP	Cemetery Relocation Plan
DD	Data Deficient
DSO	Direct Shipping Option
ECP	Environmental Control Pond
EHS	Environment, Health and Safety
EHS Guidelines	World Bank Group Environment, Health and Safety Guidelines
EI	Ecological Integrity
EN	Endangered
EPCM	Engineering, Procurement, and Construction/Management
EPFI	Equator Principles Financial Institution
EPRP	Emergency Preparedness and Response Plan
ES	Ecoregion Status
ESCP	Erosion and Sediment Control Plan

ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
F	Farmland
FI	Floodplain
FOS	Factor of Safety
FPIC	Free, Prior and informed Consent
FS	Feasibility Study
GB Minerals	GB Minerals
GoGB	Government of Guinea-Bissau
GHG	Greenhouse Gas
GIIP	Good International Industry Practise
GIS	Geographic Information System
GREEEM	Géologic Exploration Environment Expertise Mine
GWP	Global Warming Potential
HDI	Human Development Index
HDPE	High-density Polyethylene
HGV	Heavy Goods Vehicle
HH	Household Head
HHERA	Human Health and Ecological Risk Assessment
ICMM	International Council on Mining and Metals
IFC	International Finance Corporation
IOB	In-pit Overburden Backfill
IPCC	International Panel on Climate Change
IWL	integrated waste landform
IUCN	International Union for Conservation of Nature
LD	Level of Degradation
LME	Large Marine Ecosystem
LOM	Life of Mine
LSA	Local Study Area
LVIA	Landscape and Visual Impact Assessment
M	Mangroves
MAD	Maximum Area of Disturbance
Mag	Magnitude
ML	Metal Leaching
MRCP	Mine Reclamation and Closure Plan
MRP	Mosque Relocation Plan
MSDS	Material Safety Data Sheets
NAAQS	National Ambient Air Quality Standards
NFSP	National Environmental Management Plan (of Guinea-Bissau)
NGO	Non-governmental Organisation
OECD	Organization for Economic Co-Operation and Development
OHS	Occupational Health and Safety
OPA	Open Pit Area
OSF	Overburden Storage Facility
PAP	Project Affected Persons

PET	Potential Evapotranspiration
PM.....	Particulate Matter
the Project.....	Farim Phosphate Project
Prox.....	Proximity to Formally Protected Areas
RAP	Resettlement Action Plan
RF	Rice Farm
RI.....	Rehabilitation Index
ROM.....	Run-of-Mine
RPF	Resettlement Policy Framework
RSA.....	Regional Study Areas
SoC.....	Species of Concern
SCP	Sediment Control Ponds
SD.....	Sustainable Development
SEP.....	Stakeholder Engagement Plan
SFC.....	Secondary Forest/Cashew
SI.....	Sensitivity Index
SOI.....	Significance of Impact
SP	Significance Points
SPM.....	Single Point Mooring
SSMP.....	Soil Salvage Management Plan
SSRP.....	Sacred Site Relocation Plan
STI.....	Sexually Transmitted Infection
TB.....	Tuberculosis
TDS	Total Dissolved Solids
TIN	Triangulated Irregular Network
ToR	Terms of Reference
TSD.....	Technical Supporting Document
TSF	Tailings Storage Facility
TSS	Total Suspended Solids
UNAIDS	Joint United Nations Programme on HIV/AIDS
US EPA.....	United States Environmental Protection Agency
USGS.....	US Geological Survey
UTM	Universal Transverse Mercator
V.....	Settlement
VIP	Ventilated Improved Pit
VU.....	Vulnerable
WAMP.....	Water Management Plan
WBCSD.....	World Business Council on Sustainable Development
WD	Waste Dump
WHO	World Health Organization
WMP	Waste Management Plan
WRI.....	World Resources Institute
WWF.....	World Wildlife Fund

1 – INTRODUCTION

1.1 BACKGROUND

The Farim Phosphate Project (the Project) is a proposed phosphate mine located in the central northern part of Guinea-Bissau, West Africa (Figure 1.1).

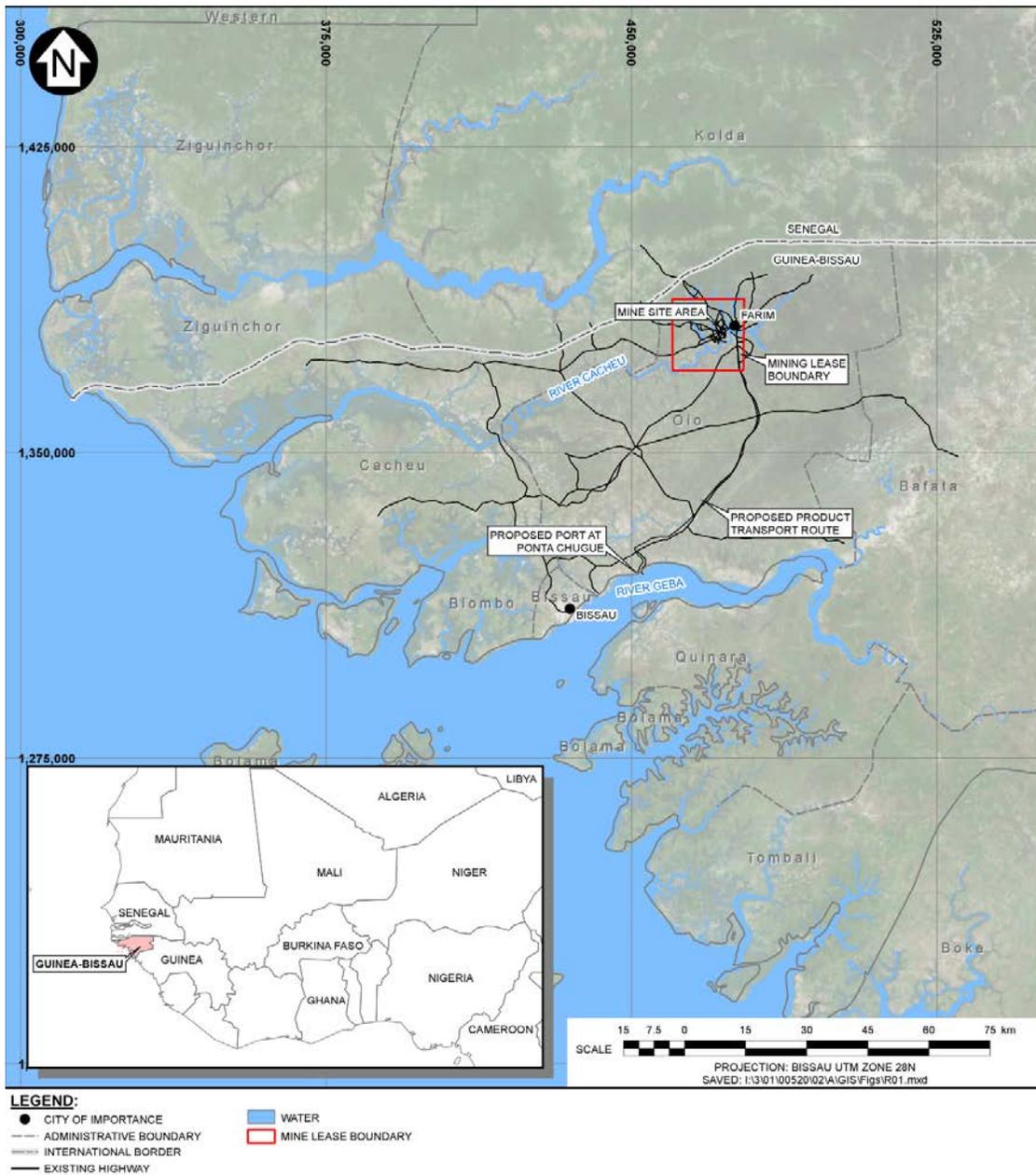


Figure 1.1 Project Location Map

The Project consists of the construction, operation and closure of a proposed open pit mining operation to exploit the Farim phosphate orebody, a process plant at the Mine Site to beneficiate the ore into a phosphate concentrate product, and an associated port facility to export the product to customers. The three main project components (Mine Site, Product Transport Route, and Port Site) and the Project's anticipated zone of influence are shown on Figure 1.2. The Project's zone of influence includes the area and local communities surrounding these project components, as well as the regional and national socio-economic environment at broader scales.

GB Minerals Ltd. (GB Minerals) is the 100% owner of GB Minerals AG, the licence holder for the Farim Phosphate Project (the Project). The Farim phosphate orebody consists of a high grade sedimentary phosphate deposit that extends over a known surface area of approximately 40 km².

Significant positive effects are expected from this Project, especially in economic terms at both national and regional levels. It is expected that there will be potentially adverse impacts on the environment and on the lives of local communities.

The overall aim of the environmental and social impact assessment (ESIA) is to identify and assess potential environmental and social impacts that may be a consequence of the Project. As such, potential adverse impacts can be avoided, reduced or offset, to the extent practicable, as part of the Project design. This is an iterative process during the Project design and requires the engineering, environmental and social specialists involved to have regular dialogue.

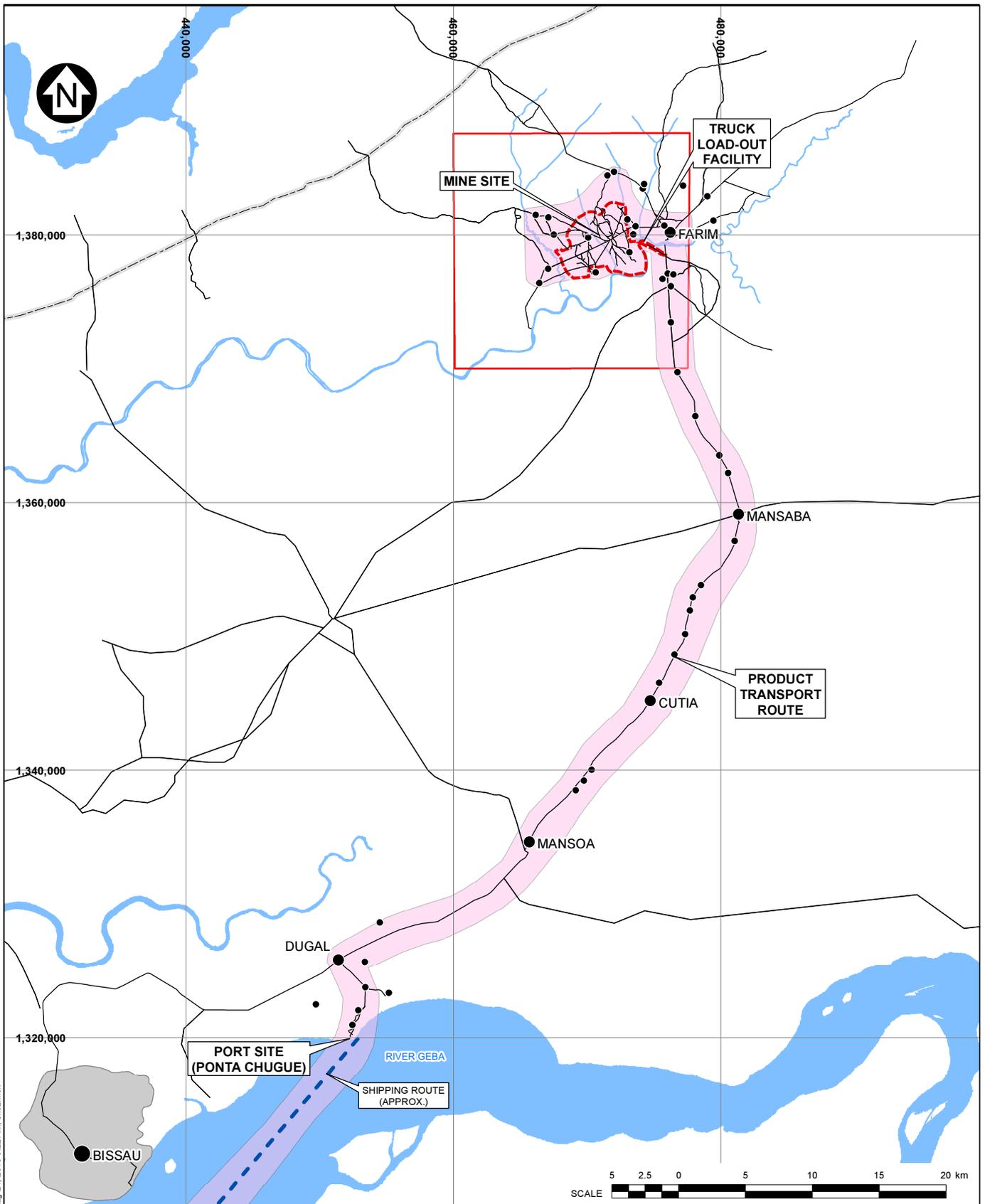
1.2 PROJECT OVERVIEW

The project design is based on a feasibility study (FS) recently completed for the Project by Lycopodium Minerals Canada Ltd. (Lycopodium, 2015a). The feasibility study concluded that the Project is a world class, high quality development project, which is robust from a technical and economic standpoint at selected long term phosphate prices.

Construction of the Project is expected to take two years. The Project will operate for 26 years, mining at a rate of 1.75 million tonnes per annum (Mt/a) to produce 1.32 Mt/a of phosphate rock at an average grade of 34.0% P₂O₅. The general arrangement of the proposed Mine Site is shown in Figure 1.3.

The Mine Site is comprised of the following components:

- Two Open Pits - Referred to as the south pit and the north pit, which will be developed using conventional open pit mining methods in two sequential phases.
- Run-of-Mine (ROM) pad - Stockpile of phosphate ore to feed the processing plant.
- Process Plant - for processing the phosphate ore to produce beneficiated phosphate product
- Conveyance System - A closed conveyor to move product from the product stockpile on the north side of the River Cacheu to the truck load-out facility located on the south side of the River Cacheu.
- Waste Dumps (WDs) - Waste overburden generated by the Project will be used to backfill the south pit and the north pit. Excess overburden will be placed within three ex-pit WDs and three above grade in-pit WDs.



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- LEGEND:**
- VILLAGE
 - TOWN
 - CITY
 - INTERNATIONAL BORDER
 - EXISTING HIGHWAY
 - - - MINE SITE FENCELINE
 - WATER
 - PROJECT ZONE OF INFLUENCE
 - MINING LEASE BOUNDARY

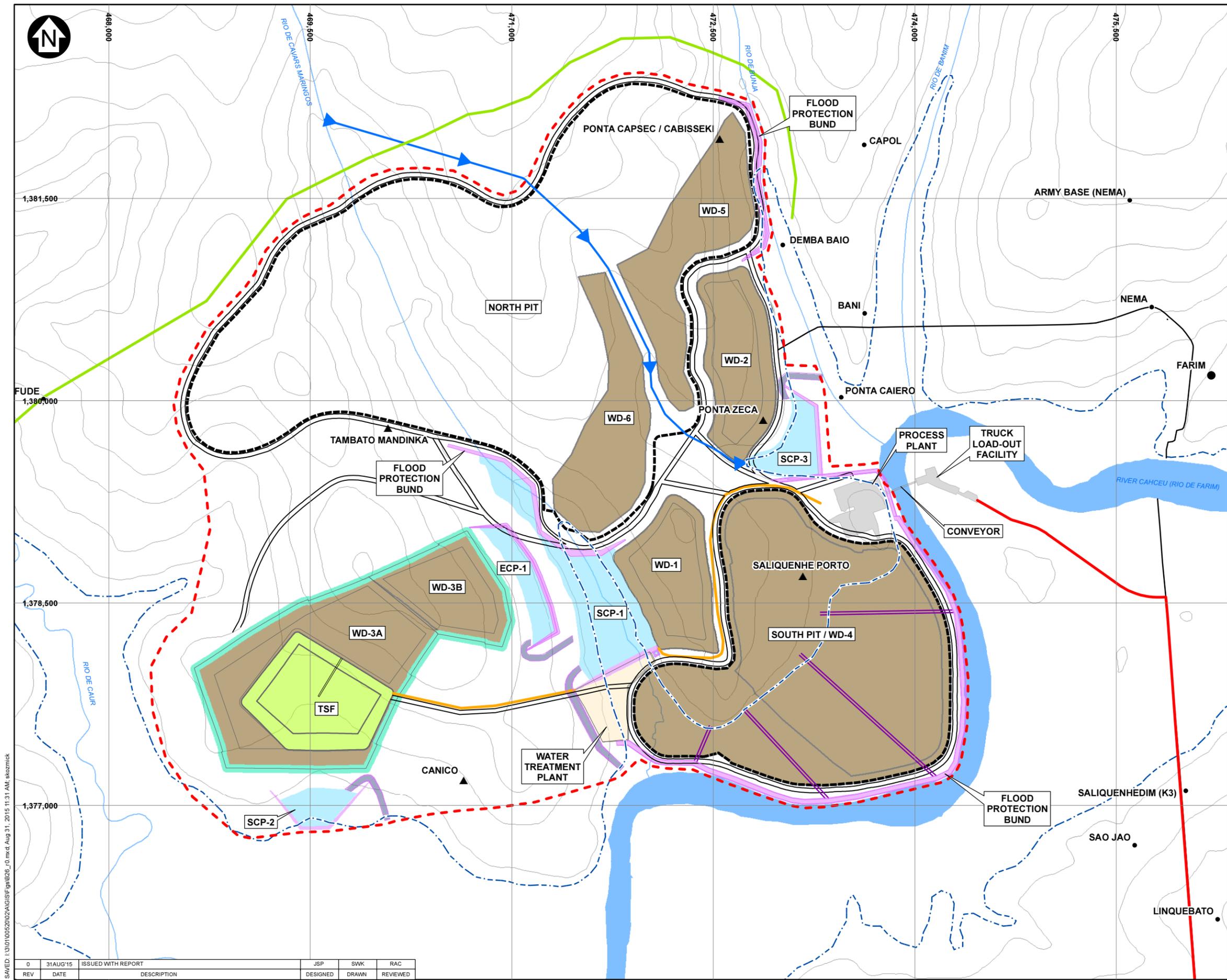
NOTES:

1. COORDINATE GRID IS IN METRES.
 COORDINATE SYSTEM: WGS 1984 UTM ZONE 28N.



GB MINERALS LTD.	
FARIM PHOSPHATE PROJECT	
PROJECT ZONE OF INFLUENCE	
<i>Knight Piésold</i> CONSULTING	P/A NO. NB301-520/2 REF NO. 1 FIGURE 1.2 REV 0

REV	DATE	DESCRIPTION	RAC DESIGNED	SWK DRAWN	RAC REVIEWED
0	21AUG15	ISSUED WITH REPORT			



- LEGEND:**
- COMMUNITY
 - ▲ VILLAGE TO BE RESETTLED
 - EXISTING ROAD
 - HAUL ROAD
 - INFRASTRUCTURE
 - WATER MANAGEMENT FACILITY
 - PRODUCT TRANSPORT ROUTE
 - TAILINGS AND DECANT RETURN PIPELINE TRENCH ALIGNMENT
 - TEMPORARY FLOOD PROTECTION BUND
 - PROPOSED BYPASS ROAD
 - - - 100 m FENCELINE
 - ▶ DIVERSION CHANNEL
 - RIVER/STREAM/DRAINAGE
 - WATER
 - POND EXTENT
 - TAILINGS STORAGE FACILITY
 - SPILLWAY
 - WASTE DUMP
 - INTEGRATED WASTE LANDFORM
 - - - 1 IN 100 YEAR FLOODPLAIN EXTENT
 - - - OPEN PIT EXTENT

- NOTES:**
- MINE INFRASTRUCTURE AND BASEMAP DATA PROVIDED BY LYCOPODIUM MINERALS CANADA LTD. (MARCH 18, 2015). UPDATED AUGUST 17, 2015 BASED ON FIGURES PROVIDED BY KNIGHT PIESOLD PERTH.
 - COORDINATE GRID IS IN METRES.
COORDINATE SYSTEM: WGS 1984 UTM ZONE 28N.
 - CONTOUR INTERVAL IS 5 METRES.
 - IVL - INTEGRATED WASTE LANDFORM
TSF - TAILINGS MANAGEMENT FACILITY
WD - WASTE DUMP
ECP - ENVIRONMENTAL CONTROL POND
SCP - SEDIMENT CONTROL POND



GB MINERALS LTD.
 FARIM PHOSPHATE PROJECT
 MINE SITE GENERAL ARRANGEMENT

Knight Piésold CONSULTING	PIA NO. NB301-520/2	REF NO. 1
	FIGURE 1.3	

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REV	DATE	DESCRIPTION	JSP DESIGNED	SWK DRAWN	RAC REVIEWED
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- Tailings Storage Facility (TSF) - Tailings will be generated as a result of the process and will be pumped to the TSF.
- Water Management Facilities - Dewatering wells and in-pit sumps will be used to dewater the active mining areas; flood protection berms, watercourse diversions and sediment and environmental control ponds will be employed to manage water across the site.
- Water Treatment Plants - One water treatment plant will provide potable water and another will treat mine effluent prior to discharge.
- Storage and maintenance facilities associated with the mine operation.
- Landfill for disposal of solid, non-hazardous waste.
- Fuel storage facility to store and supply fuel for power supply and vehicles.
- Ablution facilities for mine staff.
- Accommodation facilities for ex-patriate mine staff.
- Administration and additional support facilities.
- Haul roads for mining equipment transporting ROM materials from the pits to the process plant and WDs.
- Site access roads for non-mining mobile equipment.

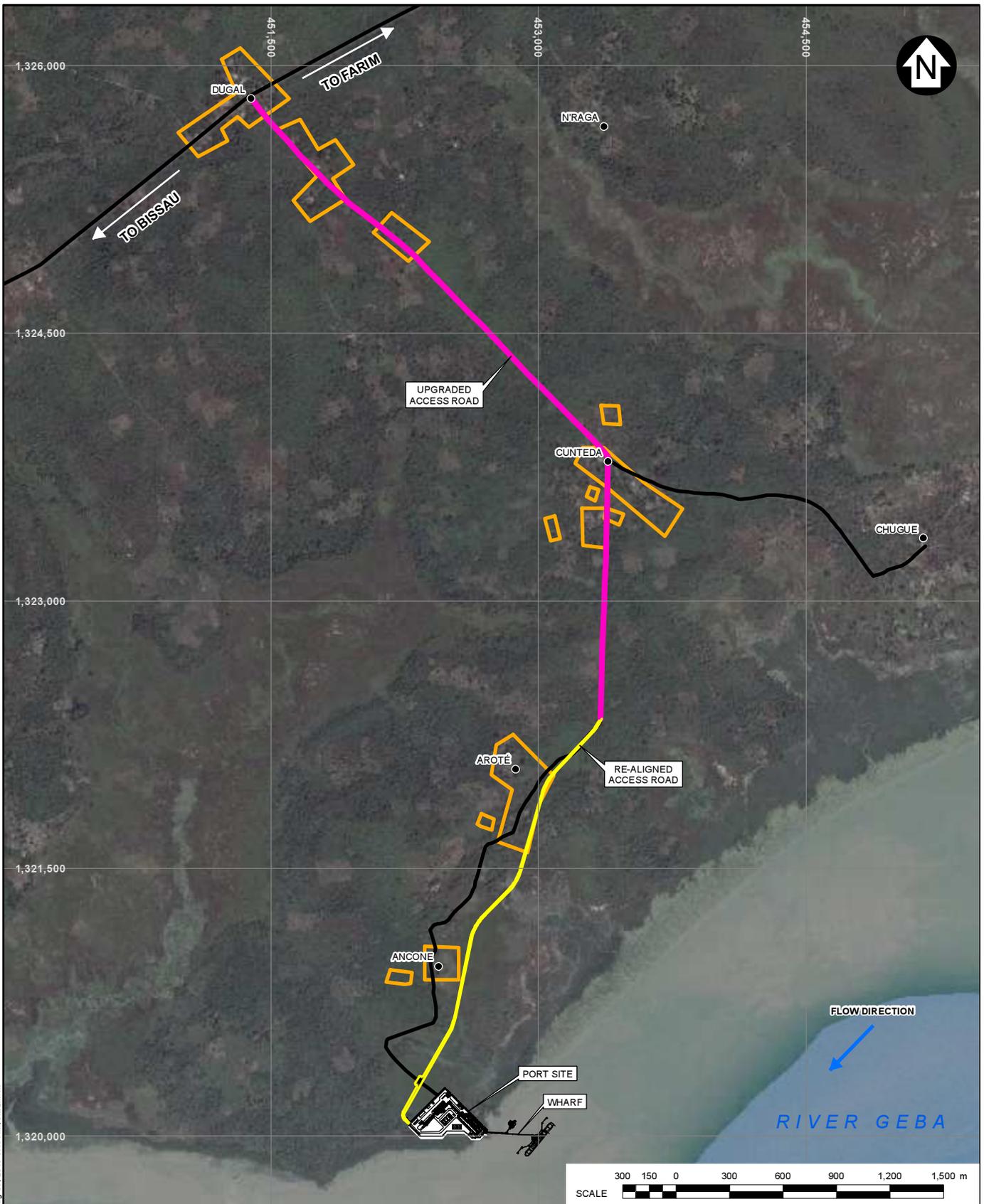
The Product Transport Route will consist of the following components (Figure 1.2):

- A truck load-out facility located on the south side of the River Cacheu, consisting of an elevated bin to store and transfer product to trucks.
- A 2-km gravel access road to be constructed to connect the truck load-out facility to the existing paved highway.
- Use of an existing 68-km section of the existing paved road between Bissau and Dugal.
- A 6-km gravel access road from the highway turnoff at Dugal to the Port Site.
- A fleet of 31-t capacity road haulage trucks operating year-round during daylight hours to transport product from the mine to the port.

The Port Site will consist of the following components (Figure 1.4):

- Truck unloading facilities
- A closed drier shed (to dry the product from 8% to 3% moisture content)
- A second closed product storage shed
- A 200 m long wharf extending into the River Geba
- Shiploading system to convey the product into the storage holds of 35,000 DWT (dead weight tonne) capacity ships
- Administrative building

A detailed description of the Project is provided in Section 2.



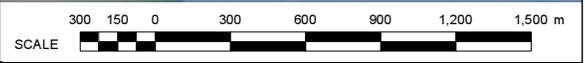
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LEGEND:

- VILLAGE
- EXISTING ROAD
- RE-ALIGNED ACCESS ROAD
- UPGRADED ACCESS ROAD
- POPULATED SETTLEMENT

NOTES:

1. PORT SITE INFRASTRUCTURE AS WELL AS BASEMAP DATA PROVIDED BY LYCOPODIUM MINERALS CANADA LTD. (MARCH 18, 2015). MODIFIED BY KNIGHT PIESOLD LTD. TO SHOW PROPOSED INFRASTRUCTURE CHANGES (APRIL 24, 2015).
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: WGS 1984 UTM ZONE 28N.
3. IMAGERY: ESRI DATA AND MAPS [ONLINE] (2015). REDLANDS, CA: ENVIRONMENTAL SYSTEMS RESEARCH INSTITUTE. ALL RIGHTS RESERVED.



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PORT SITE AREA AND ACCESS ROAD	
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PIA NO NB301-520/2	REF NO 1
FIGURE 1.4	
REV 0	

REV	DATE	DESCRIPTION	RAC DESIGNED	SWK DRAWN	RAC REVIEWED
0	31 JUL 15	ISSUED WITH REPORT			

1.3 PROJECT NEED AND PURPOSE

The global requirement for phosphate is mainly for the production of fertilizers. In 2010, approximately 90% of the world market was for the manufacture of wet-process phosphoric acid for fertilizers and animal feed supplements. Other uses of phosphate include the production of phosphorus compounds for use in a range of food-additive and industrial applications. There is no substitute for phosphorus for use in agriculture. Phosphate fertilizers stimulate root development, promote flowering and help prevent diseases and environmental stress. Fertilizers applied to correct deficiencies in soils are typically chemically manufactured materials containing compounds of phosphate that are readily soluble in water.

The largest reserves in the world can be found in Morocco and the Western Sahara, China, South Africa, the United States and the Middle East. There are also large reserves of phosphate worldwide which currently are not economically viable or technologically obtainable due to the phosphate grade and/or deposit location.

Development of the Project is proposed to deliver a return on investment to GB Minerals' shareholders, and to bring economic benefits to the national government of the Republic of Guinea-Bissau and to the people in the country and in the Farim region in particular. As the first modern mining development in Guinea-Bissau, the Project represents an important opportunity for the country to derive benefits from mining and demonstrate its capacity to support a world-class mining development. Development of the Project can be expected to attract additional foreign investment into the country.

1.4 ENVIRONMENTAL, SOCIO-ECONOMIC AND CULTURAL SETTING

Environmental studies were initiated by GB Minerals in 2011. Socio-economic and cultural heritage baseline studies were undertaken from 2011 through 2012 by Tropica Environmental Consultants Ltd. of Senegal. Physical and biological baseline studies were undertaken by Golder Associates (UK) Ltd. and are summarized in an environmental baseline study report (Golder, 2014a). Environmental baseline studies were undertaken between 2011 and 2013 and included study areas associated with project options that are no longer part of the Project. This includes an option to barge the product down the River Cacheu to a transshipment location, and an option to transport ore to the current port using a slurry pipeline that would have run parallel to the existing roads. Limited baseline studies were conducted along the highway between Farim and Bissau to support the pipeline option.

A summary of previous (2011 to 2013) and 2015 supplemental baseline studies is presented in Table 1.1.

Table 1.1 Summary of Environmental Baseline Studies

Discipline	Previous Baseline Studies (2011-2013)	Supplemental Baseline Studies (2015)
Meteorology	A meteorology station has operated nearly continuously at Farim since 2011.	Updated analysis of additional meteorological data completed; Port Site meteorology was described from Bissau climate records.
Air Quality	Measurements of particulate matter (PM), sulphur dioxide (SO ₂), nitrogen oxides (NO _x) and dustfall collected in 2012 at the Mine Site, along Product Transport Route and near the Port Site.	No supplemental air quality data collection.

Table 1.1 Summary of Environmental Baseline Studies

Discipline	Previous Baseline Studies (2011-2013)	Supplemental Baseline Studies (2015)
Noise	Noise measurements collected at receptor locations near the Mine Site and along the Product Transport Route.	Noise measurements collected at the Port Site.
Geochemistry	Overburden samples (50) were collected from 2 boreholes in each of the north and south pits. Samples were composited and analyzed for acid rock drainage/metal leaching (ARD/ML) potential. Chemical analysis for metals completed on 156 ore samples.	The collection of additional overburden and tailings samples for ARD/ML potential.
Soils	Comprehensive soil sampling program and land capability assessment within the Mine Site area.	Supplemental soil sampling conducted at the Mine Site (metals only), and the Port Site (metals and soil fertility parameters).
Surface Water	Surface water sampling conducted over multiple wet and dry seasons at the Mine Site.	Surface water sampling was conducted at the Mine Site and in the vicinity of the Port Site.
Groundwater	Comprehensive groundwater investigations completed, and one dry season and wet season sampling campaign completed.	Additional wells installed at the Mine Site and pump tests conducted. Revised groundwater model prepared. Supplemental groundwater quality sampling (dry season) conducted at select wells in the mine and port areas.
Radioactivity	No radiological testing completed.	Radiological testing (Gamma spectrometry) of baseline soils, surface water, and groundwater, as well as ore, phosphate rock and waste overburden to characterize these materials and the potential radiological exposure.
Aquatic Ecology	Aquatic studies conducted in the River Cacheu and tributaries near the Mine Site.	Supplemental aquatic studies in the River Cacheu at the Mine Site, and in the River Geba at the Port Site.
Terrestrial Ecology	Terrestrial ecology studies conducted in the Mine Site area.	Terrestrial studies conducted at the Port Site, with supplemental terrestrial ecology studies at the Mine Site focusing on biodiversity.
Socio-economics	Preliminary socio-economic surveys and data collection.	Household surveys at the mine and port site areas (308 households). Detailed land use mapping at the mine and Port Site areas.
Cultural Heritage	The Mine Site area surveyed by a qualified international archaeologist.	The Port Site area was surveyed by a qualified international archaeologist, and a follow-up survey was completed at the Mine Site. Cultural history baseline work was completed by a local expert.

1.4.1 Physical and Biological Setting

Geographic Location

Guinea-Bissau is located at approximately 12° Latitude and 15° Longitude. Much of the country is close to sea level, and the Farim Mine Site area is similarly flat with an elevation change of approximately 40 m over a distance of 4 km between the Cacheu River and the north western edge of the Mine Site area. The elevation of the wider project study area (mine to port) varies between 5 m and 50 m.

Natural resources found in Guinea-Bissau include: fish, timber, clay, granite, limestone and unexploited deposits of petroleum, phosphates and bauxite. Approximately 10.67% of the land is arable and 235.6 square kilometres is irrigated (Central Intelligence Agency, 2015).

Natural hazards include a hot, dry, dusty harmattan haze that may reduce visibility during the dry season and brush fires. Environmental issues include deforestation; soil erosion; overgrazing and overfishing.

Meteorological and Atmospheric Conditions

The land area of Guinea-Bissau is mostly savannah with low coastal plains either colonised by freshwater wetlands (most converted to rice paddies), salt marshes or fringing mangroves that line the river banks. The climatic and seasonal variations are very distinct in Guinea-Bissau and follow the general West African climate conditions. It is hot and humid year-round with little fluctuation in average temperature. Data collected at the Bissau station indicates that temperatures range from 16.6°C to 38.6°C, with the minimum temperatures occurring in January and the maximum temperatures occurring in April (Golder, 2014a).

There are two distinct seasons in Guinea-Bissau, the wet season and the dry season. During the wet season (June to October), most of the average rainfall is accounted for and the winds are predominately southwesterly. The dry season (November to May) accounts for very little rainfall and the winds are predominately northeasterly. The annual total rainfall at the Farim meteorology station in 2012 was 1,594 mm, which is representative of long-term annual precipitation values reported for Bissau. The majority of the rainfall events are short in duration and have a high intensity. Wind speeds are generally light all year round and are typically less than 5 m/s (18 km/h) (Golder, 2014a).

Air quality data collected at the Mine and Port Sites indicates that the air quality is representative of a natural environment with low concentrations of anthropogenic gases. Particulate matter is elevated (measured at the Mine Site only) due to naturally high concentrations of dust (Golder, 2014a; Knight Piésold, 2015a). This is further elevated during late November to middle March when the Harmattan winds blow dust from the Sahara in the direction of the study region.

The daytime and night time noise levels in the vicinity of the Project sites regularly exceed the noise limits identified in the IFC's noise guideline values of 55 and 45 LAeq 1 hour, respectively (Golder, 2014a; Knight Piésold, 2015b). Baseline noise surveys indicate that measured daytime noise levels are typically higher than the lowest measured night-time noise levels. Daytime noise levels are most influenced by human activities. Noise levels increase around dusk due to the calling of crickets and toads, which steadily reduce as the night passes.

Mine Site Hydrogeological Conditions

Knight Piésold (2015c) has conceptualized the hydrostratigraphy of the Mine Site as follows:

- An overburden layer comprising sands, clays and gravels, extends from the land surface to the absolute elevation of -30 m masl. This unit can be considered an unconfined aquifer and is shown to be in limited hydraulic connection with the River (Rio) Cacheu due to the presence of extensive superficial clay in the lowland plain.
- A blue clay horizon is not continuous, occurring in localized areas only and ranging in thickness.
- A calcareous layer (limestone) lies beneath the orebody. Water levels in this unit sit at a higher elevation than those of the overburden suggesting that groundwater in this unit is under pressure with a vertically upwards hydraulic gradient. Field observations do not support this being a dolomitic limestone and instead indicate that the unit be better characterized as a calcareous clayey friable sandstone, justifying the low hydraulic conductivities of this layer.

Water levels respond to seasonal rainfall, dropping in the dry season and rising during the wet season. Groundwater provides baseflow to surface water bodies, including the River Cacheu and its tributaries. Groundwater elevations indicative of upward flow and groundwater discharge have been observed in the south area of the Mine Site. As a result, surface water bodies are potentially sensitive to losses in baseflow due to reductions in groundwater levels. These reductions could lead to a shorter duration for ephemeral stream flows (Golder, 2014b).

The quality of groundwater collected by Golder (2014a) and Knight Piésold (2015d) in the Mine Site area is reflective of the undeveloped environment. Most of the samples collected met the World Health Organization drinking water guidelines (WHO, 2011). The salinity of the water measured as electrical conductivity is between 23.7 and 922 $\mu\text{S}/\text{cm}$. The chloride and sodium concentrations for all hydrogeological units are generally low, indicating rainwater recharge rather than a tidal influence from the River Cacheu. Groundwater recharge and quality immediately adjacent to the River Cacheu and Rio de Bunja (a tributary in the Mine Site area) are influenced by the tidal river during the wet season. Of the trace metal elements tested in groundwater, only the iron and manganese content were identified at concentrations above the aesthetic objectives for drinking water. The pH was also found to be outside the aesthetic objectives range in several of the samples.

Aquatic Environment in the Mine Site Area

The Mine Site is located adjacent to the River Cacheu, a major river that meanders through the study area in a southwesterly direction. There are also four streams within the Mine Site area that report to the Cacheu River: Rio de Banim, Rio de Bunja, Rio de Cavaras Marinhos, and Rio de Caur.

Adjacent to the Mine Site, the channel width of the River Cacheu is approximately 150 to 200 m and the maximum flow velocities in the river range between 1.1 to 1.5 m/s during the dry and wet seasons, respectively. The River Cacheu experiences a semi-diurnal tidal influence (two high tides and two low tides each day), thus forming part of the estuarine environment. By strict definition, any part of a river that is tidal is considered estuarine. This is further supported by the development of the mangroves and salt marsh areas, and the presence of marine/estuarine species of fish captured within the River Cacheu in the vicinity of the Mine Site (Aquatic Ecosystem Services (AES), 2015). The maximum tidal variation at Cacheu near the mouth of the estuary is about 3 m, and the tidal

variation at a survey location downstream of Farim at Binta was measured at about 2 m (AES, 2015). Each of the streams transecting the Mine Site is also tide influenced.

The River Cacheu banks to the north and south are relatively flat and are susceptible to inundation during periods of high rainfall and/or high tides. The floodplain extends 1,500 m to the north and south. The river banks are composed of fine-grained sediments and are well vegetated with mangroves and other vegetation. Most of the river is in a relatively pristine state with the majority of the mangrove and beach shorelines being undisturbed. The fine-grained sediments are exposed at low tides and are subject to erosion by wave action and currents. The river is dominated by ongoing transport of fine-grained sediments; river bed sediments range from silt to clay at Farim, to sand sized particles near the estuary mouth. The monitored section of the river exhibits a quick response to rainfall events given sufficient antecedent rainfall. During the recent surveys in 2015, grab samples indicted areas of excessive scour within the larger river bends, which yield mostly weathered ferricrete in the samples.

The aquatic ecosystem is driven primarily by the natural wet and dry season fluctuations resulting in nutrient and sediment transport to the coastal areas, coupled to the daily tidal regime. The highest diversity of fish and invertebrates (in faunal and water column) was observed in the more saline sections of the river. Seagrasses were not observed within the length of the river studied; their absence likely owing to the naturally high turbidity and lack of suitable intertidal habitat (sandy areas). Shellfish and other invertebrates reproduce throughout the length of the river and estuary. The mangrove ecosystems along the tributaries serve as nursery areas for fish. A study of fish tissue analysis shows that the system is not contaminated from anthropogenic sources/activities (Golder, 2014a).

Surface water in the Mine Site area is brackish with elevated conductivity, total dissolved solids (TDS) and chloride levels within all tidally connected watercourses, including the River Cacheu and its tidally influenced tributaries (Rio de Caur, Rio de Bunja, Rio de Cavaras Marinhos, and Rio de Banim). The River Cacheu is turbid, with circum-neutral pH and high dissolved oxygen concentrations. Physical parameters vary significantly between the wet and dry seasons; during the dry season, pH ranges from 7.0 to 7.6, total suspended solids (TSS) is lower and both TDS and conductivity are higher compared to the wet season. In the wet season, the pH ranges from 6.5 to 7.0.

High levels of iron and manganese were recorded in samples taken from the Rio de Cavaras Marinhos and the Rio de Caur.

Concentrations of metals including zinc, cadmium and nickel increase from upstream of Farim to the lowest regional sample location (SW1 near Binta). This could be related to the influence of tributaries draining into the river along this reach, where relatively high concentrations of these metals have been recorded.

Elevated metals levels were recorded in baseline laboratory analysis results when compared to the Canadian Environmental Quality Guidelines for the Protection of Freshwater Aquatic Life (CEQG-PAL; CCME, 2015). Exceedances of the CEQG-PAL have been recorded for iron, cadmium, lead and zinc (Golder, 2014b).

Aquatic Environment at the Port Site

Like the River Cacheu, the River Geba is estuarine and heavily influenced by ocean tides. At the Port Site location, the river is almost 7 km across, with depths measured during the spring high tide ranging from 3 m to 28 m (AES, 2015). The tide within the River Geba ranges from 3 m at the most eastern end of the Canal de Caio and 6 m near Ponte Chugue (Baird, 2015). These winds combined with the large volume of water that moves during the tidal cycle accounted for strong currents (7 to 8 m/s) and local occurrences of large standing waves (0.6 to 1.2 m) during the sampling period. The substrate in the vicinity of the Port Site consisted of fine mud with a depth of 5 to 8 m.

The freshwater wetland areas are located along the floodplains, most of which have been converted to rice paddies, with only a band of mangrove remaining along the shorelines.

Terrestrial Ecology

Flora

A total of 341 plant species were recorded during various project surveys undertaken between 2011 and 2015 (Hudson Ecology, 2015). Floral species diversity in the area is moderate to high, but not as high as many regions of West Africa, such as the Upper Guinea Forest zone. A large proportion of the species recorded are indigenous with few exotic species occurring in the area although, in areas of higher anthropogenic disturbances, some exotic species are more prevalent.

Based on physiognomy, moisture regime, rockiness, slope and soil properties, seven main communities were recognized, namely:

- *Rhizophora - Avicennia* Mangrove community (Mine and Port Site study areas)
- Natural Forest vegetation community (Mine Site study area only)
- Secondary Forest community (Mine Site study area only)
- *Elias - Cyperus* Floodplain community (Mine and Port Site study areas)
- *Oryza* Paddy vegetation community (Mine and Port Site study areas)
- *Dialium - Sterculia* coastal woodland vegetation community (Port Site study area only)
- *Anadelphia afzeliana* seasonally wet grassland community

The *Oryza* Paddy vegetation community occurs in areas of freshwater wetlands which are not affected by tidal ebbs and flows throughout the country, these areas of freshwater wetlands have been modified to facilitate the planting of rice, so alterations to the flow of freshwater systems create large inundated areas where rice is planted. The only species found which is known to be listed by the IUCN Red Data list is *Raphia palma-pinus*, which is found along rivers and is listed as Data Deficient. The possible presence of two Red Data species *Floscopa axillaris* and *Digitaria patagiata* will be confirmed during follow up ecological surveys at the end of the rainy season in September or October 2015. A total of 103 flora species were recorded in this vegetation community.

Large sections of natural forests have been cleared in order to grow Cashew nuts and other crops. This vegetation community encompasses areas that have been cleared and that have been replanted with Cashew trees. The cashew plantations vary from areas which are dominated by Cashew trees (cashew monoculture), to areas of mixed cashews and secondary forest. A total of 145 flora species were recorded in this vegetation community.

Another halophytic community recorded in the study area is the salt water *lala*, a grassland. This vegetation community is found on Fluvisols in the floodplain areas adjacent to the larger rivers which are tidally influenced. The salinity of the water which floods these areas has resulted in the dominance of salt-tolerant species. The denuded areas of these areas are widely utilized by local communities for the gathering of salt during the dry season and this vegetation community appears to be an important dry season grazing area. A total of 76 flora species were recorded in this vegetation community.

The natural forest community occupies large areas of the northern part of the study area, with some variation in structure and composition. This vegetation community is currently under threat due mainly to slash and burn agricultural practices for the cultivation of food crops or cashew nuts. Although only one Red Data species was recorded in this vegetation community, the likelihood of occurrence of Red Data species in this community is high. A total of 209 flora species were recorded in this vegetation community.

Mangrove forests line all the larger rivers in the region. No Red Data species were recorded in this vegetation community and, due to the specialization required for plants to survive in the tidal saline conditions, it is unlikely that any of the Red Data species known to occur in the area occur in this vegetation community. Though species diversity is low, the species occurring are highly specialized, and therefore this vegetation community is characterized as unique. This vegetation community is integral in the functioning of the estuarine nature of the larger rivers in the area. A total of 29 highly specialized flora species were recorded in this vegetation community.

The *Dialium* - *Sterculia* coastal woodland vegetation community occurs in the transition zone between the terrestrial and the halophytic communities in the coastal regions. Much of the substrata of the transitional zone in the vicinity of Ponta Chugue has been severely transformed due to cropping of mainly millet and peanuts.

The most extensive wetland vegetation in the country is the locally called *lala*, a wet grass savannah. This vegetation community is prevalent on gleysols, which are fine textured soils, deep, grey-coloured, from alluvial origin, with the upper layers often rich in organic matter. Furthermore, this vegetation community prevails in the inner lowland plains flooded by rainwater during the wet season, located mostly in the lower zones of the mainland. Noticeable in the area of Ponta Chugue, is that this vegetation community is particularly homogenous. It is likely that this is the result of human intervention through the use of fire, or harvesting of this grass species for thatching purposes.

Fauna

Non-chordate diversity within the study area was relatively high with a total of 124 arthropod species being recorded during the study. Most species recorded were common species with some specialized species being recorded in the mangrove communities. Although the mangrove species are highly specialized for this habitat type, they are locally common and not of conservation importance. Most of the species recorded are not restricted in terms of range and habitat preferences. Common species included Red Winged Dropwing and locust.

The herpetofauna of the region can be classified as having moderate diversity, of the 69 reptile species known to occur in Guinea-Bissau, only 11 species recorded. This may be due to the proximity of the Project area to the town of Farim and other settlements in the area. Common species occurring in the area include Ornate Monitor and Tree Agama.

The region can be classified as having low amphibian diversity; of the 34 amphibian species recorded in Guinea-Bissau, only five species were recorded during Project surveys, none of which are IUCN listed. None of the five recorded species appear to be utilized by the local community for food, although some species are said to have superstitious importance or medicinal uses. The rivers in the area are tidal and have a very high salinity, characteristics to which amphibians are very sensitive. For this reason most of the rivers in the study area are uninhabitable for amphibian species, and only freshwater systems host this taxon.

Avifaunal diversity in the study area was very high with a large number of upper trophic level species occurring in the area. The Hooded Vulture is currently listed as Endangered by the IUCN (2010). Seventy-five species were recorded, including the Palmnut Vulture, Long-crested eagle, Hooded vulture *and* Gymnogene. In general, species diversity was moderate to high throughout the study area with the rice paddies and natural forests showing the highest levels of species diversity.

Mammal species diversity was very low in the study area, probably due to severe subsistence hunting. Hunters were regularly seen or heard during the surveys often with animals ranging from snakes to monkeys. This not only reduces the number of animals and species in the area, but also causes the remaining animals to be very shy of humans, which in turn makes accurate survey of species occurring in the area very difficult. Fifteen of the 192 mammal species known to occur in the study area were recorded during Project surveys. The species recorded in the study area include Striped Ground Squirrel, Musk shrew, Lesser Spot-nosed Guenon, and Red colobus, all of which are common species, with the exception of Red colobus, listed as Endangered by IUCN (2010), which was recorded dead and being transported by a hunter from some distance away in the natural forests to the north.

Summary of Species of Conservation Concern

A total of 28 Red Data fauna species may occur in the area, according to the IUCN Red Data list. Some of the animals listed are believed to be locally extinct and suitable habitat for others is not available. The Red Data species that may occur in the study area consist of two reptile species, 15 avian species and 11 mammal species. The habitat suitability for Red Data species ranges from low to high with four species for which the habitat suitability can be classified as high. Only two Red Data species were recorded during Project surveys, namely the Red Colobus (recorded dead and being transported from the north, as mentioned above) and the Hooded Vulture. All indications of this study appear to show that the African slender –snouted crocodile and the West African dwarf crocodile do not occur in this area. Features of the demographics of the crocodile population in the Cacheu River system showed that the crocodile population increases exponentially with an increase in distance from the Cacheu River mouth. Young crocodiles use the area close to the Mine Site along the river as a nursery area.

Although the Hooded Vulture is currently listed on the IUCN Red Data List as critically endangered (CR), it is a locally common species in the area with a total of more than 600 individuals being recorded during the surveys. This species has become highly human commensal throughout West Africa and is well adapted to anthropogenic disturbance. The Palm Nut Vulture's range is restricted in the study area due to its specialized nature.

Exotic Species

Guinea-Bissau has one of the lowest number of exotic species in Africa with only eight exotic invasive species occurring in the country:

- *Lantana camara*
- *Eichhornia crassipes* (aquatic plant)
- *Leucaena leucocephala* (tree)
- *Prosopis spp.* (tree, shrub)
- *Adenanthera pavonina* (tree)
- *Columba livia* (bird)
- *Rattus rattus* (mammal)
- *Mus domesticus* (Mammal)

Ecological Function and Conservation Importance of the Mine Site and Port Site Areas

The ecological function of the Mine Site study area can generally be described as moderate for the majority of the study area, although this does vary from low (in the highly transformed areas due to slash and burn cropping techniques) to high in the more inaccessible areas. Areas in which prospecting and slash and burn farming has taken place, as well as areas in which settlements have been established are considered as areas where ecological function is reduced. The cashew plantations and secondary forests appear to both have moderate ecological function, particularly in areas where indigenous species have been allowed to intersperse the Cashew trees. Although areas such as the rice paddies are transformed to some extent, the fauna species composition of these areas seem to indicate that the ecological integrity can still be considered high.

At the Ponta Chugue Port Site, the ecological integrity of the site varies between high for the Mangrove community, the Floodplain community and the less degraded coastal woodland vegetation community; moderate for the more degraded coastal woodland vegetation community and the seasonally wet grassland community, and low for the *Oryza* Paddy vegetation community. The *Oryza* Paddy vegetation community in this area are considered more degraded than those at the Mine Site due to the fact that there is a monoculture of *Oryza* spp. in these areas, whereas the *Oryza* Paddy vegetation community near the Mine Site show far greater species diversity, with a large number of indigenous species represented in these areas.

The Mine Site study area falls within the dry tropical forest biome of the Guinean Forest zone. Due to the high species diversity and intrinsic conservation value of the area it is classified as having high conservation importance overall, with subareas of low, moderate and high conservation importance due to the presence of Red Data species or other intrinsic factors. Areas that have been severely disturbed such as settlements are considered of low conservation importance. These areas are, however, quite small in relation to the overall study area (>30% of the study area). Areas that have been disturbed by farming are considered of moderate conservation importance due to the fact that rehabilitation of these areas is possible. The natural forest, floodplain and mangrove areas are considered of very high conservation importance due to the presence of Red Data species in these areas and the intrinsic importance of these areas. Finally, the rice paddies may host two of the red data plant species endemic to the region (*Floscopa axillaris* and *Digitaria patagiata*); follow up surveys are planned for September or October of 2015 to confirm.

The conservation importance at the Ponta Chugue Port Site can generally be described as moderate due to the disturbance in the area.

1.4.2 Socioeconomic and Cultural Setting

National Socioeconomic Setting of Guinea-Bissau

The national socio-economic environment of Guinea-Bissau has been influenced by a history of political instability since the country gained its independence from Portugal in 1973. In 2012, the national population of the country was 1.7 million. Only 14% of the population speak the official language (Portuguese). Guinea-Bissau is ranked 177 out of 187 countries according to the 2014 UNDP Human Development Index and has one of the lowest per capita gross domestic products in the world (United Nations Development Programme, 2014). Most of the population (44%) speaks Crioulo, a Portuguese-based creole language. There are many ethnic groups, with 7% of the population classified as an indigenous ethnic group (Papels). Indigenous ethnic groups such as the Papels were not identified in the vicinity of the Project.

Guinea-Bissau is divided into eight administrative regions in addition to the autonomous district of Bissau. The regions are subdivided into districts that are administered by District Administrators. In total, there are 37 districts. The region of Oio, where the project is located, is in the northern part of the country and consists of five districts: Bissora, Farim, Mansaba, Mansoa and Nhacra. The Oio region is predominantly rural, with a population estimated at approximately 215,000 inhabitants (15% of national population), and characterised by a diverse range of ethnic groups. The total population in the three districts (Farim, Mansoa and Mansaba) is estimated to comprise 64% of the population of the Oio Region. The populations of these districts live in rural villages, with only one or two towns in each district. Farim is the second most populous district in the region, with approximately 8,681 inhabitants. Outside of Farim, the population in the villages rarely exceeds 500 inhabitants.

The local social environment can be described as rural villages that are largely dependent on small-scale agriculture for both household subsistence and income generation, and larger peri urban settlements where there is more social infrastructure such as schools and religious establishments. In general, the whole project area lacks adequate social infrastructure such as health care facilities, schools, sanitation, water systems, and waste management. Many households reside in compounds and land ownership is followed through the integration of traditional law such as customary land management practices and legal forms of ownership. Decision-making is primarily through consensus facilitated by the village leaders or committees.

The larger villages have trade businesses and a more cash-based local economy. The smaller communities in the project area and along the transport route engage predominantly in subsistence agriculture, with the trade of any agricultural surplus for cash income. Natural resource-based livelihoods are also predominant. Livelihood activities entail cultivation of cashew, maize, millet, sorghum, rice and fonio, which are commonly grown in the area for consumption or sale; the production of natural resources use as home building materials and medicinal products; fishing, especially in villages along the River Cacheu and near the Port Site on River Geba; livestock rearing; and the production of salt, which is undertaken predominantly by women.

Socioeconomic Conditions in the Local Study Area

The conditions at the Mine Site and Port Site are similar, except that Fishing activities at the mine are focused on the River Cacheu, and fishing at the Port Site is focused on the River Geba. The Cacheu River is considered to be a more important fisheries resource than the Geba River based on discussions with the local fishermen and the Department of Fisheries. Together both river systems only contribute a small fraction of the volumes yielded from offshore fishing activities. The following summarises the social conditions within the LSA:

- **Ethnicity** - The Mine Site area includes eight ethnic groups: the Mandingas (66% of the population), the Mansonkas (17%), Fula (7.6%), and Balantes (6%). Minority groups include the Manjak, Pepel and Mancagnes. Households in the Farim area are predominantly inhabited by Mandingo (40%), followed by the Fulani (27.6%) and Balante (21.5%). The Port Site area, by contrast, is predominantly occupied by the Balante (ERM, 2015).
- **Housing** - Households are located in clusters as rural villages rather than widely distributed. Households may comprise of a single family home with a single residential structure or a compound comprised of multiple buildings that support multi-generational family members. Household sizes vary between four members to over 25 members, with an average household size consisting of 10 members. Houses are predominately made of clay, corrugated iron roofing and have between four and seven rooms. With regard to ownership, 25% of households have title to the land, 11% have an occupancy permit and more than half (55%) have traditionally determined residential authorisation.
- **Mobility** - Considerable mobility is experienced in Farim and its surrounding villages, especially among the young adult population. Mobility is often driven by a search for employment in Bissau, neighbouring countries (e.g., to Senegal, Gambia, and Cape Verde), and Europe (Portugal and France). The villages of Tambato, Canico, Tumana, Salikénié and Farim town are mostly affected by migration.
- **Religion** - Islam is the predominant religion (71% of the population) in the area and is practiced by the Mandingo and Fulani. Christians represent 25% of the population, while paganism is practiced by 4% of the population. These latter religions are mainly practiced by the Balante.
- **Social Organization** - Compounds or homesteads are often shared by more than one related family headed by a 'chief' who is the father or the grandfather. Families also share the agricultural land. Monogamy is more common (51.8% of respondents) than polygamy. In general, women and youth have the responsibility for most domestic tasks.
- **Decision-Making** - Decision-making is primarily through consensus facilitated by the village leaders or committees. The village chief (or committee) invites the heads of families and youth representatives and, in some cases, women's representatives when matters need to be discussed and decided upon. Decisions are made only after sufficient discussion and when each had the opportunity to express their opinion. Heads of villages are under the authority of the administrator of the district to which they report. The status of village head is usually held by the founding family of the village and is transferred within the family over generations.
- **Social Infrastructure/Amenities** - There is a basic hospital in Farim that has been supported by the Project to improve ward facilities. There is also a Christian church and mosque in Farim. There is a shortage of schools in the study area. Where schools are present, they are mostly temporary shelters.

- **Water Supply** - Villages and Farim town use traditional wells and hand pump-operated boreholes for domestic water. There is no reticulated sewerage system in the area and domestic (solid) waste is dumped in uncontrolled spaces.
- **Roads** - Roads within the LSA are generally unpaved dirt roads. Farim attracts daily visitors from surrounding villages to access services (mosques, churches, health care, education, and recreation) and commerce such as buying and selling at the market. Most travel is by foot or bicycle with motorcycles being the most frequently used form of motorized travel.

Economic Activities

The following summarises the economic conditions within the LSA:

- **Access to Land** - Land is administered following traditional law by customary authorities. Thus, the law has changed the basis of ownership through the integration of customary land management practices with legal forms of ownership. Most households in the Mine Site area (93% of households surveyed in 2012) are actively cultivating land. Of this, only 13% reported holding title to the land they cultivate, while 55% were granted access to land through traditional administrative means, and 3% cultivate fields without any formal approval.
- **Subsistence Agriculture** - Maize, millet, sorghum, rice and fonio are commonly grown in the area for consumption or sale. Maize is the most important crop, being cultivated by more than 51% of the households. However, the cultivation of cashew plantations is critical to generating cash income. The strong market links in the region support significant local investment in cashew tree planting and processing of cashew nuts. In terms of land-take, Cashew trees are the dominant form of local land-use. The proportion of households involved in other crops (e.g., millet and beans) is between 3% and 15%. Rice, although a staple food, is cultivated by only 12% of households. There are food gardens in several villages, managed mostly by women who have their gardens either around water sources (ponds, wells or boreholes) or in their own compound. Vegetables such as okra and tomatoes are intercropped with the main field crops.
- **Food Security and Income Generation** - Food deficit was widely reported by households despite the availability of farmland. Food shortages are caused by limited access to agricultural equipment and fertilizers, poor soil quality and impacts on productivity by local salt water intrusion from the River Cacheu. Some of the produce that is cultivated in home gardens and fields is consumed by the growers and the remainder sold. Peanuts, cashews, cassava and beans are particularly important cash crops. The Project area is one of the most important regions in the country for producing peanuts, which are primarily sold in Senegal through a complex network of traders.
- **Salt Production** - Almost all women in the mining area are engaged in salt harvesting during the dry season. Using rudimentary equipment, the salt is mined from sand taken from rice fields that became salt-affected (tann) as a result of saltwater flooding the plains.
- **Livestock** - Almost 93% of surveyed households had livestock (cattle, sheep, and goats). Pig farming is generally practiced by the Balante and Manjak women, with an average of ten animals per household. Family ceremonies create the main opportunity for the sale of livestock.
- **Fisheries** - Fishing in the Farim area is practiced by 31% of households. Daily catches vary between 10 kg and 15 kg per individual and between 400 kg and 450 kg for group expeditions. There are roughly 43 fishermen grouped in an association in Farim, using a fleet consisting

of 15 canoes. Within the River Geba and in the vicinity of the Port Site, preliminary results indicate that the local fishing groups are divided in fishing areas based on the location of their village and closest landing site (Porto). The proposed port is located within the Chugue community's fishing area, which is fished mainly between August and April, using 100 to 200 m long lines baited with small fish bought elsewhere. Due to the rocky nature of the river bed directly adjacent to the Chugue shoreline, the fisherman prefer to set their lines on the opposite bank near Jabada, which is 10 to 11 km from the proposed Port Site. The remaining months (May to July), all fishing activities are halted due to the strong currents and the presence of large numbers of shark that damage their long lines. These communities then revert to Cashew production/harvesting. The Chugue community also produces rice. Small nets are utilized when the paddies are flooded to catch the small fish trapped in the adjacent wetland/paddy areas.

- **Natural Resource Harvesting** - Forest products are used as food products, for home building material, and for medicinal products. Edible fruit (baobab fruit, palm fruit) is harvested in season, as are fibres, leaves (baobab leaf), sap extracts (palm wine), wood (90% of domestic energy), honey, and several medicinal plants. Products that are used and marketed include charcoal, baobab fruit, palm wine and palm fruit. Houses are built using material directly harvested from the natural surroundings (e.g., thatch, palm leaves, and wooden poles).
- **Landscape** - Four main landscape types were identified in the Mine Site area during the baseline assessment: river corridor, cultivated river valley, undulating farmland and woodland, and dense forest. None of these landscapes were determined to be particularly rare. Apart from the River Cacheu, there are no nationally or internationally recognized geographical features or landmarks in the Mine Site study area. There are many very old trees, including giant Baobab trees within the LSA, which have become the focus of the villages and the surrounding area. Some villages such as Tabandinto have been named after local tree species. Some of these mature specimens have spiritual and/or cultural significance.

Cultural Heritage

A number of cultural heritage features were identified within the Mine Site area, including archaeological sites, cemeteries and spiritual sites (living/intangible cultural heritage). Cultural heritage features were identified in the vicinity of the Port Site, but beyond the proposed footprint. No evidence of critical cultural heritage (as defined by IFC Performance Standard 8; IFC, 2012a) was identified at either of the project development areas (ERM, 2015). Archaeological remains were predominantly pottery sherds and other fragmentary remains of low to moderate cultural heritage significance. Field surveys confirmed the presence of three Muslim cemeteries within the mine study area (Golder, 2014a; ERM, 2015). One of these cemeteries is of high sensitivity and located near the village of Saliquenhe Ba. It contains the grave of a well-known imam who lived over 100 years ago and is sometimes visited by people from within and outside the region during an annual festival. In addition, a sacred grove (or holy forest) is located south of Saliquenhe Ba and is of local to regional importance (ERM, 2015).

1.5 ESIA AND ESMP STRUCTURE AND CONTENTS

An Environmental and Social Impact Assessment (ESIA) has been prepared to evaluate and address the Project's environmental and social impacts and risks. Significant positive effects are expected from this Project, particularly in economic terms at both the national and local levels. It is

expected that there will be potential adverse impacts on the environment and on the lives of local communities. The overall aim of the ESIA is to identify and assess potential environmental and social impacts that may be a consequence of the Project. As such, potential adverse impacts can be mitigated (avoided, reduced or offset), to the extent practicable, as part of the Project design. This is an iterative process during the Project design and requires the engineering, environmental and social specialists involved to have regular dialogue.

The ESIA consists of the following components:

Non-Technical Summary - Provides a concise summary of the ESIA in non-technical language.

Volume 1 - Introduction to the Assessment - The context for the assessment; includes the following:

- This introductory section
- A description of the Project
- The applicable regulatory and legal framework
- A summary of the environmental and social setting and area of influence of the Project
- The Project alternatives and alternative means of completing the Project that were considered
- The outcomes of public consultation undertaken for the Project

Volume 2 - Impact Assessment - The detailed impact assessment of mining activities within the Mine Site area, road transport of supplies and ore, and port operations. The assessment analyzes all potential impacts from the Project, whether they are positive, negative, short term, long term, direct and indirect, reversible and irreversible. The identification and analysis of impacts includes all phases of the Project, from construction through operation to closure and into post-closure.

Volume 3 - Environmental and Social Management Plan (ESMP) - A significant output of an ESIA are the systems and plans that will guide the environmental, health, safety and social management for the Project. Presented in Volume 3 is the following:

- **Management System** - The Level 1 management system that provides the high level processes and procedures that will govern and guide the company's management, monitoring and reporting of environmental performance. The Management System identifies the corporate and external policies, guidelines and standards to be met, the roles and responsibilities of company staff in environmental management, and how the internal and external processes for reporting.
- **Discipline-specific Management Plans** - The Level 2 management plans that detail the predicted effects on various environmental and social components, the operational mitigation measures identified in the ESIA, and any monitoring proposed to validate that effects are as predicted. The individual management plans also provide additional detail regarding roles and responsibilities and reporting.

Volume 4 - Technical Supporting Documents - Information collected and analyses completed to support the ESIA.

This ESIA has been completed in accordance with draft Terms of Reference (TOR), to be issued in final by Célula de Avaliação de Impacte Ambiental (CAIA), the lead Guinea-Bissau agency responsible for coordinating the National environmental assessment process in Guinea-Bissau. The draft TOR is included in Appendix 1C, and a table of concordance to the draft TOR is provided in Appendix 1D. The ESIA will be available in both printed and electronic formats.

1.6 PROJECT OWNER AND ESIA TEAM

Project Owner Information is provided in Table 1.2.

Table 1.2 Project Owner Identification

Name	Farim Phosphate Project
Developers	GB Minerals Ltd.
Creation Date	GB Minerals Ltd. was incorporated on July 24, 2007 as Resource Hunter Capital Corp.
Activity Sector	Mining
Nominal Production Capacity	Mine rate of 1.75 Mt/a producing 1.32 Mt/a of phosphate rock product
Project Life	26 years
Construction Start Date	2016
Production Start Date	4Q 2017
Head Office	Suite 1500, 701 West Georgia Street, Vancouver, B.C., Canada, V7Y 1C6
Facility Address	Farim and Ponta Chugue, Guinea-Bissau
Ore Qualities and Price Rate	34.0% P ₂ O ₅ ; spot price for phosphate rock on June 20, 2015 was USD \$115/t
Name of the First Charge	Luis da Silva - President, Chief Executive Officer, and Director
Company Directors	Chairman - Owen Ryan Directors - Luis da Silva; Kirill Zimin; Walter Davidson; Brent de Jong; Robert Edwards
Environmental Director	Olga Kovalik, Project Director
Company Logo	

The Knight Piésold ESIA team details are provided in Table 1.3.

Table 1.3 ESIA Consultant Identification

Name	Knight Piésold Ltd.
Complete Address	1650 Main Street West, North Bay, Ontario, Canada, P1B 8G5
Reference Impact Studies	A list of prior ESIA experience is listed below.
Number and Personnel	Knight Piésold employs a global team of over 800 consultants, providing engineering and environmental consulting services to the mining, power, water resources and construction industries.
Name of the First in Charge	Ken Brouwer, President of Knight Piésold Ltd. (Canadian Practice)
Composition and Qualifications of the Study Team	ESIA lead contributors' CVs and signatures are included in Appendix 1E.
Names of the Subcontractors used in the Study and Details of their Missions	Eco Progresso - Risk assessment, facilitation of public consultation sessions, field program assistance (noise monitoring, traffic survey, aquatic and terrestrial ecology, soil and groundwater sampling) Scherman, Colloty & Associates; Aquatic Ecosystem Services; and Hudson Ecology Pty Ltd. - Aquatic and terrestrial ecology Intrinsic Environmental Sciences Inc. - Human health and ecological risk assessment Northern Environmental Consulting and Analysis Inc. - Radiological assessment ERM - Cultural heritage Nomad Socioeconomic Management and Consulting (Pty) Ltd. - Livelihood and resettlement lead, socio-economic support

Knight Piésold is an international consultancy providing services to the mining, power, water, transportation and construction sectors (www.knightpiesold.com). Though a global multi-disciplinary company, Knight Piésold is an internationally renowned “name brand” in the mining sector. This brings a unique combination of strengths to the developers and lenders, notably:

- An in-depth understanding of the mining industry, from grassroots exploration to post-closure monitoring.
- Effective integration of the technical, political, financial, regulatory, social and environmental aspects of a mining project into strategically balanced financial program support.
- Unique global grasp of the politics of mining project development, permitting and finance.
- Clear understanding of government and regulatory affairs both in the developed and developing world.
- Serious commitment to effective stakeholder engagement and gaining strong local community support.
- On-the-ground expertise in grievance processes and conflict resolution.
- Detailed understanding of international standards and best practices in the mining industry.
- Seamless management of project development, technical work and project finance needs.

Knight Piésold has completed a number of ESIA assignments of large scale mining projects in Africa and internationally over the past 7 years, the timeline specified in the TOR (Appendix 1C). Select projects are listed below:

- Asmara Project, Eritrea - ESIA, water and waste management components of feasibility study
- Zara Project, Eritrea - ESIA, water and waste management components of feasibility study
- Guinea Alumina, Guinea - ESIA
- Nkamouna/Mada Project, Cameroon - ESIA
- Samira Hill Project, Niger - EIA Owner’s Review and SIA and ESMS preparation
- Mary River Project, Canada - Environmental baseline studies, ESIA preparation, feasibility study contributions, licensing and environmental monitoring
- Eagle’s Nest Project, Canada - Environmental baseline studies, ESIA preparation, feasibility study contributions
- Kinsevere Copper Mine, Democratic Republic of the Congo - Stakeholder engagement support and ESIA updates
- Kayelekera Uranium Mine, Malawi - ESIA

Key ESIA contributors, their role(s) in preparing this ESIA, a summary description of their qualifications, and signatures are presented in Appendix 1E.1. Summary 1-page resumes of the key contributors are in Appendix 1E.2.

1.7 RELIANCE ON OTHERS

Knight Piésold has compiled the Farim Phosphate Project Environmental and Social Impact Assessment (ESIA) based on the following information:

- Previous ESIA work completed by Golder Associates (UK) Ltd. on behalf of GB Minerals (Golder, 2014a, b)
- The feasibility study level of Project design provided by Lycopodium (2015a)
- Site visits and supplemental baseline studies completed by the Knight Piésold ESIA team in April and May 2015

Some of the information presented in this document has been imported verbatim from the referenced reports, including the previous ESIA report prepared by Golder (2014b). Because much of the basic information presented herein is the work product of others, nearly all sections require at least some credit being assigned to the original author (Golder). Sections 1, 2, and 6, have been substantially re-written with limited reliance on text previously written by Golder; whereas Sections 3, 4 and 5 closely resemble previous work by Golder with edits by Knight Piésold. The assessment methodology described in Section 6 is generally consistent with the methodology presented by Golder and used by other ESIA practitioners. The impact assessments in Sections 7 through 20 are based on the previous Golder ESIA but have been updated and revised based on new information and Knight Piésold's judgement, unless otherwise specified. For ease of reading, Knight Piésold has not included quotations when direct quotes have been used. Much of the substantive information presented in this document is the work product of those listed in the references section (Section 24).

In some instances, Knight Piésold has interpreted the data that was developed and provided by others and has drawn conclusions independent of the original authors. These conclusions are predicated on the accuracy and suitability of the basic information presented in the referenced documents, on which Knight Piésold relied for accuracy without verification beyond cursory visual inspection. The conclusions are also based on Knight Piésold's substantial experience with similar mining projects in Africa and in other parts of the world.

The content of this report has been reviewed by GB Minerals and Knight Piésold for completeness, accuracy, and appropriateness of conclusions. To the best of our knowledge, the information presented in this report is accurate to the limits specified herein.

2 – PROJECT DESCRIPTION

The Project consists of the construction, operation and closure of a proposed open pit mining operation to exploit the Farim phosphate orebody within two open pit mines (the south pit and north pit), a process plant at the Mine Site to beneficiate the ore into a phosphate rock concentrate (product), and an associated port facility to export the product to customers. The mining production rate will be 1.75 Mt/a of ore, which will be beneficiated to produce 1.32 Mt/a of product.

The three main project components (Mine Site, Product Transport Route, and Port Site) and the Project's anticipated zone of influence are shown on Figure 1.2.

2.1 PROJECT PHASING

The Project design has been developed through a feasibility study recently completed by Lycopodium Minerals Canada Ltd. (Lycopodium) on behalf of GB Minerals (Lycopodium, 2015a).

The Project will have a life of approximately 30 years over the following Project phases:

- **Construction Phase (2 years; Years -2 and -1)** - The mine and port components of the Project will be constructed over a 2-year period. This will involve establishment of key infrastructure at both the Mine and the Port Site, including offices, workshops, accommodation, storage areas, the process plant, power supply, access and haul roads. At the Mine, this also includes initial clearing, grubbing and stripping of the south open pit area of vegetation, soil, and overburden, the installation and operation of groundwater dewatering wells to lower the water table in readiness for mining, and the construction of phosphate product handling systems (conveyor, truck load-out facility). At the Port Site the construction phase includes the erection of storage sheds, product drying and handling facilities, the wharf and the shiploading system.
- **Operations Phase (26 years; Years 1 to 26)** - The operation phase of the Project, when the ore will be extracted, processed and transported to markets. Two distinct phases of mining have been identified:
 - Phase 1 involving mining of the south pit starting in Year 1 and ending in Year 8
 - Phase 2 involving mining of the north pit from Year 8 to Year 26

The operations phase also includes progressive reclamation of areas that have been mined out in accordance to the preliminary Mine Reclamation and Closure Plan (MRCP; Volume 3).

- **Active Closure Phase (2 years; Years 26-28)** - Following completion of mining, the MRCP will be executed. This includes the reclamation of the open pits, waste management facilities, and the decommissioning and dismantling of buildings and infrastructure where required (some buildings and infrastructure may be handed over to local authorities or communities, if agreed to by all parties).

In addition, a **Passive Closure Phase** of approximately 5 years, consisting of post-closure monitoring and maintenance activities which is outlined in the MRCP, will take place at the conclusion of the active closure phase. During this phase, monitoring will confirm that the closure objectives have been achieved. It is possible that the passive closure phase could extend beyond the expected 5 years to achieve the stated closure objectives.

A high-level life of mine schedule is presented as Figure 2.1. Additional descriptions of the activities that will take place during each Project phase are provided in the following subsections.

2.2 CONSTRUCTION PHASE OVERVIEW

The formal construction phase will take approximately two years (i.e., Year -2 and Year-1). However, development of the mine will be an on-going process, particularly considering that there are two distinct mining phases (Phase 1 - mining of the south pit; and Phase 2 - mining of the north pit) and therefore there will be construction activities associated with the transition between phases. The following activities will occur during the initial mine construction in Years -2 and -1:

Mine Site

- Preparation of the south pit area for mining:
 - Installation and operation of dewatering wells within the initial south pit extent
 - Clearing, grubbing and pre-stripping of overburden and topsoil from the south pit area
 - Construction of access and haul roads
 - Construction of the initial permanent and temporary flood protection bunds around the process plant and south pit perimeter
- Construction of waste and water management systems, such as:
 - Waste dumps (WDs)
 - Stage 1 tailings storage facility (TSF)
 - Topsoil stockpiles
 - Sediment control ponds (SCPs) and the environmental control pond (ECP)
 - Potable water supply
 - Water treatment system
- Construction of the process plant, including:
 - Initial site development, including clearing, grubbing and bulk earthworks
 - Run-of-mine (ROM) pad
 - Building foundations, building erection and commissioning
 - Conveyor across the River Cacheu
- Construction of access roads, haul roads, fencing and security infrastructure
- Construction of ancillary infrastructure, including:
 - Truck maintenance facility and workshop
 - Warehouse and laydown areas
 - Fuel farm and distribution system
 - Accommodation and administration facilities
 - Power supply and distribution
 - Landfill
 - Communication systems

Product Transport Route

- Truck load-out facility
- Access roads into the truck load-out facility and Port Site
- Upgrades to the existing road network

PROJECT COMPONENT AND ACTIVITY	Years	Project Phases																																			
		Construction		Operation																								Closure		Post-closure							
		-2	-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	1	2	1	2	3	4	5	
Year	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2043	2044	2045	2046	2047	2048	2049		
MINE SITE																																					
Construction Phase Activities																																					
South Pit Activities																																					
Pre-strip and Dewater South Pit																																					
Mine Ore from the South Pit																																					
Backfill South Pit																																					
Haul Waste Overburden to WD-1 and WD-2																																					
Construct Surcharge Overburden Storage within South Pit Extents (WD-4)																																					
North Pit Activities																																					
Pre-strip and Dewater North Pit																																					
Mine Ore from the North Pit																																					
Continue to Haul Waste Overburden to WD-4 and Backfill North Pit																																					
Construct Surcharge Waste Dumps (WD-5 and WD-6)																																					
Construct Rio De Cavaras Marinhos Diversion Channel																																					
General Mine Site Operation Activities																																					
Haul Ore to and Operate Process Plant																																					
TSF Embankment Construction and Subsequent Raises																																					
Pump Tailings to the TSF																																					
Haul Waste Overburden to WD-3a and WD-3b																																					
Closure Phase Activities																																					
Progressive Reclamation (WDs, open pits, access/haul roads, landfill, revegetation, etc.)																																					
Implement Mine Reclamation and Closure Plan																																					
Post Closure Monitoring and Maintenance																																					
ROAD TRANSPORT																																					
Upgrade Product Transport Route																																					
Haul Consumables to the Mine and Port Site from Bissau Port																																					
Haul Product from the Truck load-out Facility to the Port Site																																					
PORT SITE																																					
Erect and Commission Port Site Infrastructure (power plant, sheds, dryers, conveyors, wharf)																																					
Operate Port Site (product delivery, drying and storage, ship-loading)																																					
Decommissioning of Buildings and Infrastructure and Re-purposing of Port Site for Future Industrial Use																																					

\\NB4\Project\3\01100520\02\AI\Report\Volume 1 - 0 Intro\Tables\Knight Piesold Figure 2 1 - Life of Mine Schedule_JSP 06_30_15.xlsx\Sheet1

Figure 2.1 Life of Mine Schedule

Port Site

- Initial site development, including access road upgrades and realignments, clearing, grubbing and bulk earthworks
- Installation of fuel supply and power supply
- Construction of product unloading, storage and processing facilities
- Establishment of water management facilities, such as:
 - Collection ditches and storm water storage ponds
 - Potable water supply and water treatment plant
 - Effluent treatment plant
- Wharf and shiploading infrastructure
- Installation of navigational aids
- Construction of ancillary infrastructure, including:
 - Warehouse and laydown areas
 - Administration facilities

Implementation of the Project will involve the involuntary resettlement of households that will be physically and/or economically displaced by the Project. A Resettlement Policy Framework (RPF), included in the ESMP in Volume 3, will form the basis for a future detailed Resettlement Action Plan (RAP) to be developed in consultation with the Government of Guinea-Bissau (GoGB) and communities. The RPF identifies five villages to be resettled in the Mine Site area, with only compensation for economic losses and no household resettlement required in the Port Site area. The future RAP will be developed and implemented prior to and during the initial stages of construction.

A perimeter fenceline will be installed around both the Mine and Port Sites to restrict access as a public safety measure. Construction will start with surface preparation activities, applicable to all infrastructure development areas. Surface preparation involves the clearing of vegetation and the mechanical removal of topsoil and subsoil. Where subsoils (including waste overburden) are intended for use in construction activities, such as road base or embankment material, additional testing will be carried out, including geochemical and geotechnical characterization to confirm strength of material and risk of environmental impact.

Erosion and sediment control measures to be implemented during construction are described in the Erosion and Sediment Control Plan (ESCP), a discipline-specific management plan in the ESMP (Volume 3). The ESCP also includes direction on topsoil salvage and storage. In general, topsoil will be stockpiled in areas adjacent to extraction points to keep haul distances short and provide a barrier between operational and non-operational areas. The stockpiles will be used for reclamation, either at the end of the construction period, as areas are mined out, or during final closure. Topsoil will be stockpiled to a maximum height of 5 m, and the slopes graded such that long term physical and biological stability objectives are met for the duration of the operation phase.

Specialized fabrication work associated with the heavy infrastructure will require supervision. An international firm will be awarded the Engineering, Procurement, and Construction Management (EPCM) contract to facilitate the design and installation of the process plant, mine waste and water management facilities. The appointed EPCM firm will employ the bulk of the construction workforce, both expatriate and local.

As there is no power supply grid in the area of the Mine or Port Sites, power will be supplied using diesel powered generators. Mobile generators will also be relied upon during the construction phase. Fuel for all generators will be stored in suitable containers with secondary containment on impermeable surfaces. Spill kits will be available at each storage facility, and an Emergency Preparedness and Response Plan (EPRP; Volume 3) will outline the preparedness training and response procedures should an accidental release occur.

At both the Mine and Port Sites, water supply infrastructure will need to be established using groundwater wells to supply potable water and water for industrial uses (i.e., concrete mixing, dust suppression, truck wash, etc.). Wastewater will be disposed of using soakaways and septic systems.

At the Mine Site there will be two main solid waste streams during construction (1) mineral waste (overburden, topsoil and subsoil) and (2) domestic and industrial solid wastes. Mineral waste will be stored in suitable facilities in accordance with the ESCP and the Water Management Plan (WAMP), while domestic and industrial wastes will be managed in accordance to the Waste Management Plan (WMP), both of which are discipline-specific management plans that form part of the ESMP in Volume 3.

The WMP includes management measures for hazardous wastes, such as waste oil, batteries and sewage solids that are applicable to both the Mine and Port Sites.

The WAMP describes water management plans for the Project, focusing on the management of contact water (water coming into contact with mineralized materials that have the potential to leach metals). Diversion ditches and structures will be used to separate clean and dirty water at the Project sites. Sediment-laden water will be collected in sediment control ponds (SCPs) or other erosion and sediment control features prior to being released to the environment. Runoff from mining and other areas that may contain elevated metals will be collected in ECP-1, treated and tested to ensure that it meets the required site discharge standards prior to release.

In-water infrastructure to be built includes the conveyor over the River Cacheu next to the Mine Site, and the wharf within the River Geba at the Port Site. The conveyor will be supported by approximately six concrete piers constructed within the river. The piers will be constructed by isolating the work area using cofferdams. Wharf construction will involve pile driving and no dredging is expected. Pile driving will occur from a barge and will not require isolation of the work area.

2.3 OPERATION PHASE OVERVIEW

Two open pits (named the south pit and north pit) will be developed sequentially to extract the phosphate ore over a period of 26 years (Years 1 to 26). The operation phase can be further split between Phase 1, when the south pit is mined in Years 1 through part of Year 8, and Phase 2 involving mining of the north pit starting in Year 8 and ending in Year 26, as follows:

- Phase 1 - South Pit Mining (Years 1 to 8)
 - Mine ore from the south pit, partially backfilling the pit as mining progresses
 - Continue the process of installing, operating and decommissioning perimeter dewatering wells as mining progresses
 - Construct and operate in-pit sumps to manage surface water runoff (e.g., precipitation and excess groundwater infiltration)

- Extend the permanent flood protection bund around the south pit as mining progresses and construct temporary flood protection berms in advance of mining activities
- Utilize above-grade and external to pit (ex-pit) waste dumps for disposal of waste overburden (i.e., WD-1, WD-2 and WD-3a, WD-3b and WD-4)
- Progressively reclaim WD-1 and WD-2 and portions of WD-3a and WD-4
- Operate the TSF including biannual embankment raises
- Operate and maintain water management facilities, including SCPs and ECP-1
- Phase 2 - North Pit Mining (Years 8 to 26)
 - Initiate north pit overburden stripping, construction of roads and required infrastructure
 - Install and operate dewatering wells within starter north pit in preparation for mining (Year 8); and continue to install, operate and decommission dewatering wells following the progress of mining (Year 9 to 26)
 - Construct and operate in-pit sumps to manage surface water runoff
 - Construct a diversion of the ephemeral Rio de Cavaras Marnhos in Year 20 to allow for mining of the western portion of the north pit
 - Dispose of waste overburden as in-pit backfill within the north pit, as well as within above grade surcharge WDs (i.e., WD-4, WD-5 and WD-6 located within the north and south pit limits)
 - Pump tailings to the TSF and construct biannual embankment raises
 - Progressively reclaim WD-3a, WD-3b, WD-4, WD-5 and WD-6

Figure 2.2 presents the Year 7 mine plan near the end of Phase 1 of mining, and Figure 2.3 presents the Year 25 mine plan showing site conditions near the end of Phase 2 of mining. Appendix 1B.1 contains engineering general arrangements and 3-dimensional pictorial views of the Mine Site.

Conventional open pit mining methods will be used with excavators and trucks. No blasting is expected to be required to remove either the waste overburden or the ore, given the unconsolidated nature of both materials.

Port Site

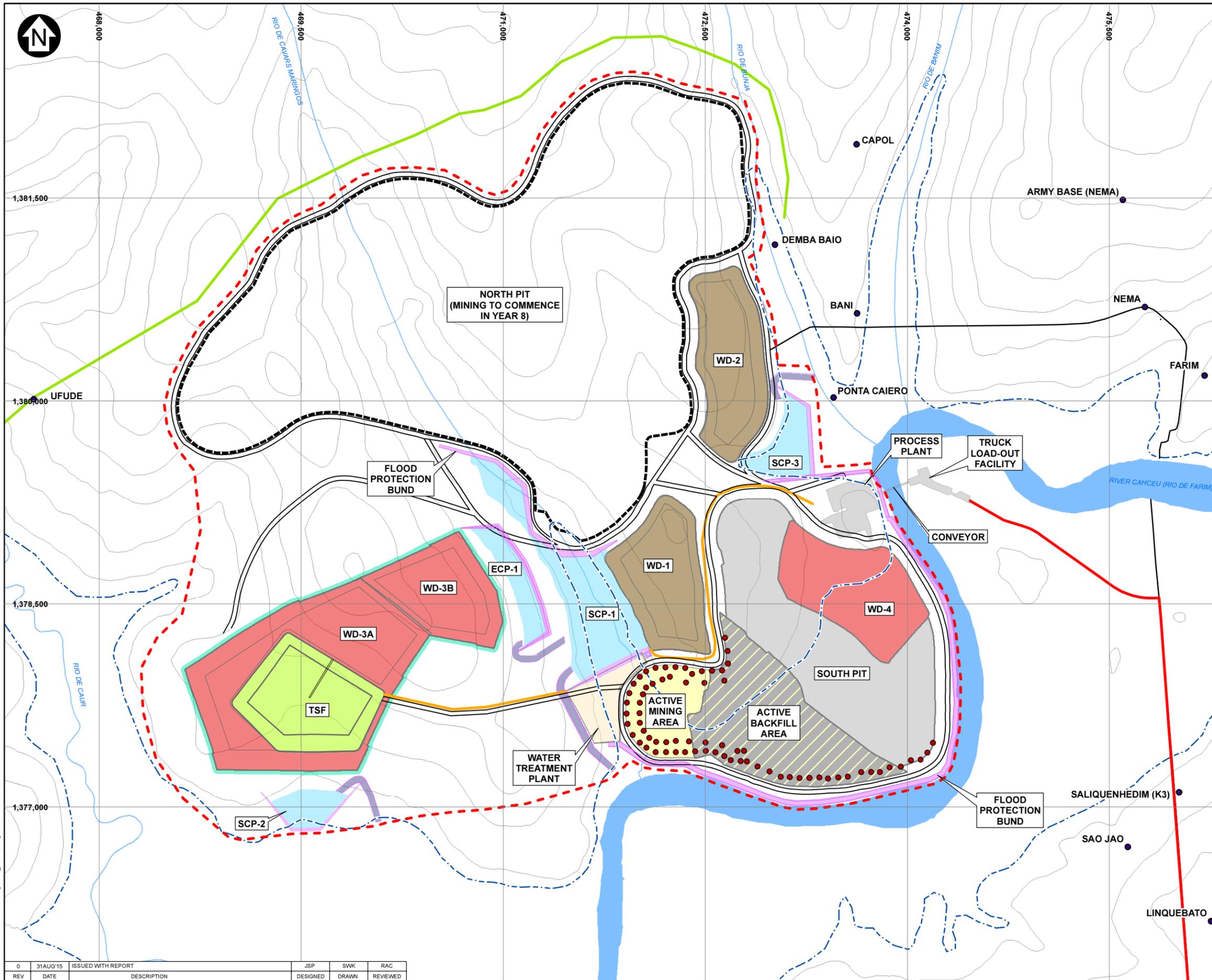
Operation phase activities at the Port Site include phosphate rock unloading, drying, storage and shiploading. Approximately 38 ships will be loaded to transport the 1.32 Mt of product to market each year. The Port operations will be similar from year to year throughout the operation phase. The Port Site layout is shown on Figure 2.4, and engineering drawings are included in Appendix 1B.1.

Other Project Operations

Irrespective of the mining phase or location, the following additional activities will occur during the operation phase:

- Operation of the process plant
- Operation of the truck load-out facility and haulage of phosphate rock over the product transport route to the Port Site
- Transport of supplies and equipment from Bissau Port to the Mine and Port Sites
- Progressive reclamation

The Project is described in further detail in the subsequent sections.



LEGEND:

- COMMUNITY
- DEWATERING WELL (YEARS 7-8)
- EXISTING ROAD
- HAUL ROAD
- INFRASTRUCTURE
- WATER MANAGEMENT FACILITY
- PRODUCT TRANSPORT ROUTE
- TAILINGS AND DECANT RETURN PIPELINE TRENCH ALIGNMENT
- PROPOSED BYPASS ROAD
- - - 100 m FENCELINE
- RIVER/STREAM/DRAINAGE
- WATER
- POND EXTENT
- TAILINGS STORAGE FACILITY
- SPILLWAY
- RECLAIMED WASTE DUMP
- ACTIVE WASTE DUMP
- ACTIVE MINING AREA
- ACTIVE BACKFILL AREA
- BACKFILLED TO SURFACE GRADE
- INTEGRATED WASTE LANDFORM
- - - 1 IN 100 YEAR FLOODPLAIN EXTENT
- - - NORTH OPEN PIT EXTENT

- NOTES:**
- MINE INFRASTRUCTURE AND BASEMAP DATA PROVIDED BY LYCOPODIUM MINERALS CANADA LTD. (MARCH 18, 2015). UPDATED AUGUST 17, 2015 BASED ON FIGURES PROVIDED BY KNIGHT PIESOLD PERTH.
 - COORDINATE GRID IS IN METRES.
COORDINATE SYSTEM: WGS 1984 UTM ZONE 28N.
 - CONTOUR INTERVAL IS 5 METRES.
 - IVL - INTEGRATED WASTE LANDFORM
TSF - TAILINGS MANAGEMENT FACILITY
WD - WASTE DUMP
ECP - ENVIRONMENTAL CONTROL POND
SCP - SEDIMENT CONTROL POND



GB MINERALS LTD.
 FARIM PHOSPHATE PROJECT
**MINE SITE LAYOUT
 YEAR 7 - NEAR END OF SOUTH PIT MINING**

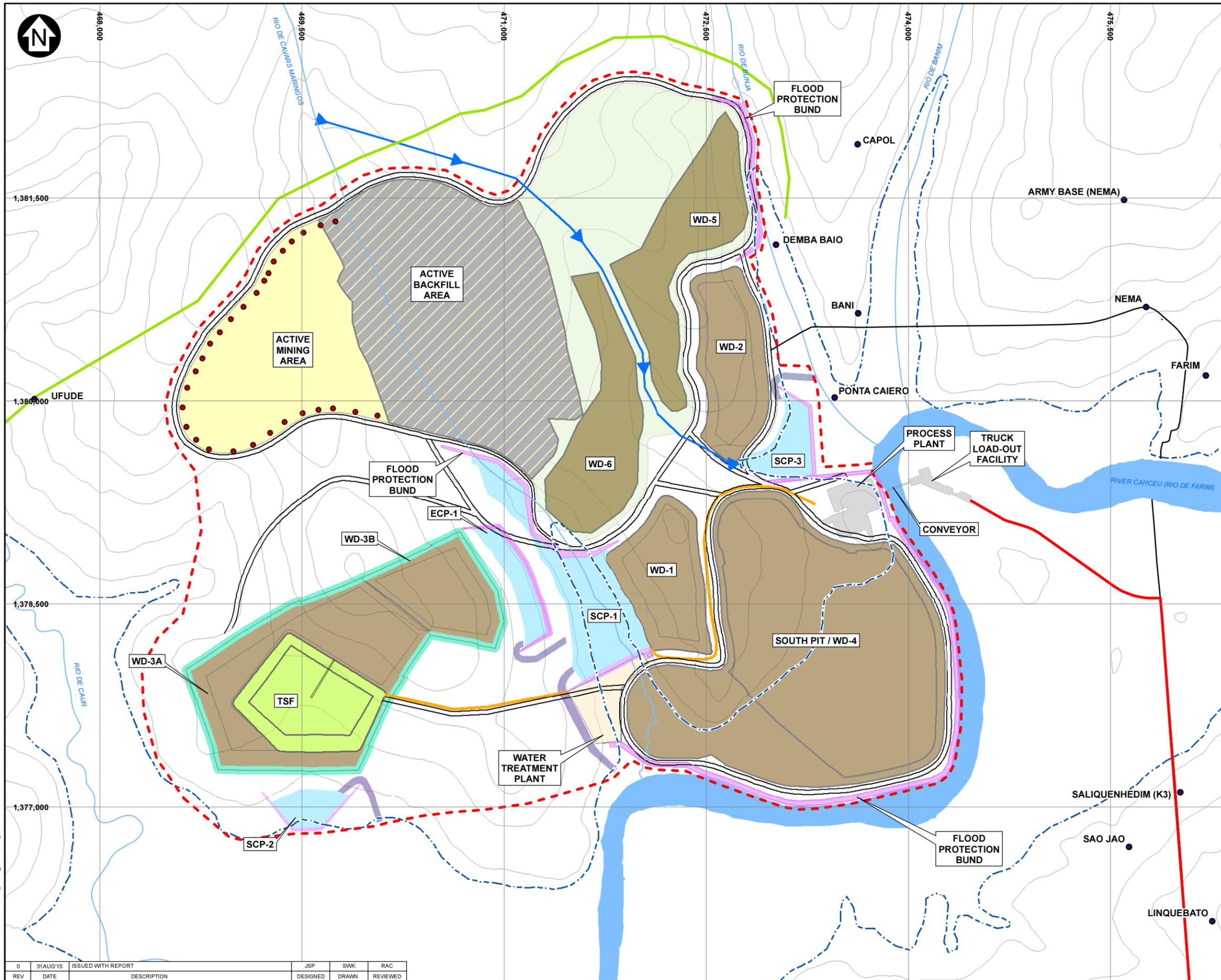
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 CONSULTING

PIA NO. NB301-520/2	REF NO. 1
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FIGURE 2.2

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REV	DATE	DESCRIPTION	JSP DESIGNED	SWK DRAWN	RAC REVIEWED
0	31AUG15	ISSUED WITH REPORT			



- LEGEND:**
- COMMUNITY
 - DEWATERING WELL (YEARS 25-26)
 - ROAD
 - HAUL ROAD
 - INFRASTRUCTURE
 - WATER MANAGEMENT FACILITY
 - PRODUCT TRANSPORT ROUTE
 - TAILINGS AND DECANT RETURN PIPELINE TRENCH ALIGNMENT
 - PROPOSED BYPASS ROAD
 - - - 100 m FENCELINE
 - DIVERSION CHANNEL
 - RIVER/STREAM/DRAINAGE
 - WATER
 - POND EXTENT
 - TAILINGS STORAGE FACILITY
 - SPILLWAY
 - ACTIVE BACKFILL AREA
 - RECLAIMED WASTE DUMP
 - ACTIVE MINING AREA
 - RECLAIMED PORTION OF NORTH PIT
 - INTEGRATED WASTE LANDFORM
 - - - 1 IN 100 YEAR FLOODPLAIN EXTENT

- NOTES:**
1. MINE INFRASTRUCTURE AND BASEMAP DATA PROVIDED BY LYCOPODIUM MINERALS CANADA LTD. (MARCH 18, 2015). UPDATED AUGUST 17, 2015 BASED ON FIGURES PROVIDED BY KNIGHT PIESOLD PERTH.
 2. COORDINATE GRID IS IN METRES.
COORDINATE SYSTEM: WGS 1984 UTM ZONE 28N.
 3. CONTOUR INTERVAL IS 5 METRES.
 4. IWL - INTEGRATED WASTE LANDFORM
TSF - TAILINGS MANAGEMENT FACILITY
WD - WASTE DUMP
ECP - ENVIRONMENTAL CONTROL POND
SCP - SEDIMENT CONTROL POND



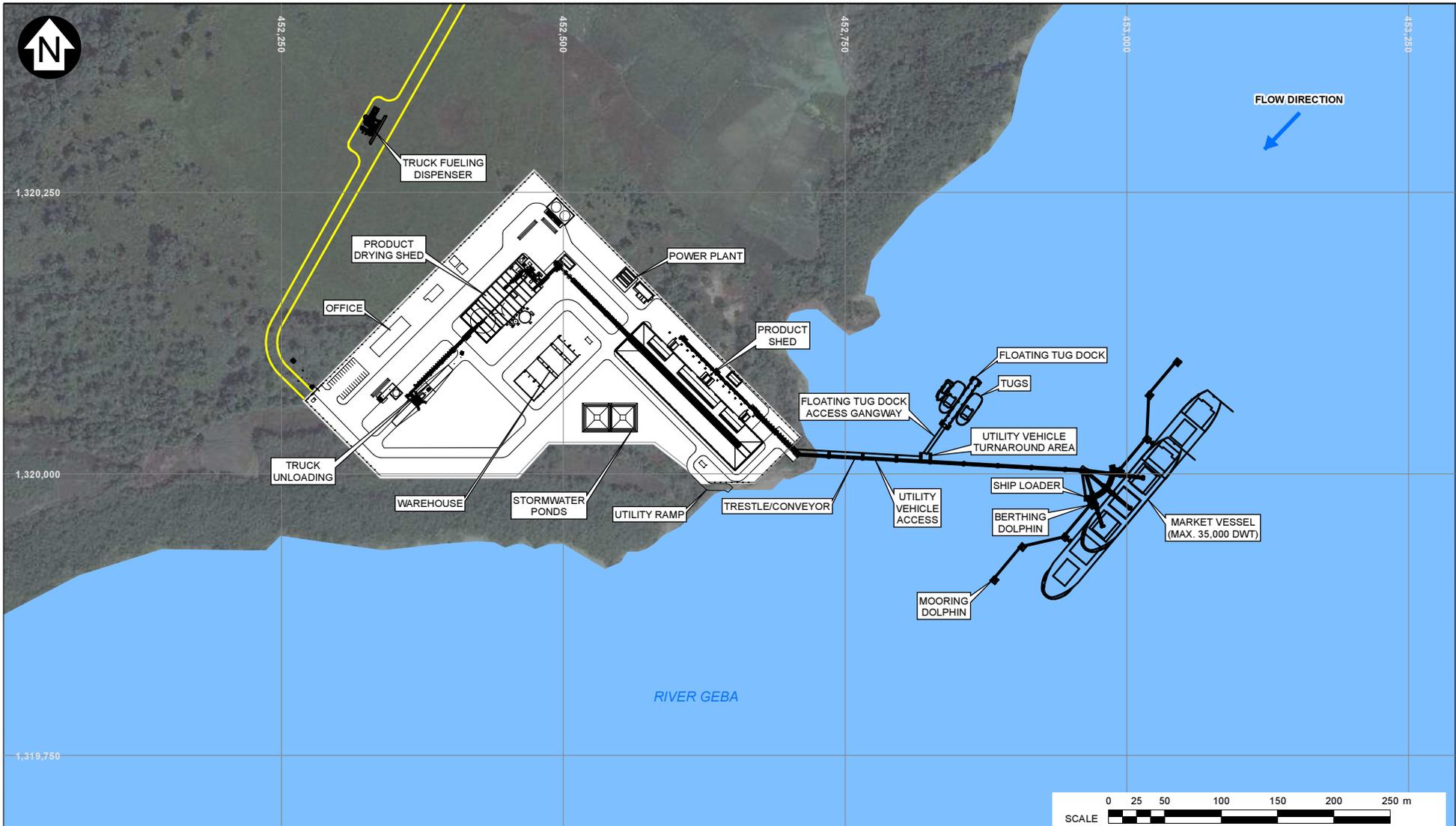
GB MINERALS LTD.
FARIM PHOSPHATE PROJECT

**MINE SITE LAYOUT
YEAR 25 - NEAR END OF NORTH PIT MINING**

<i>Knight Piésold</i> CONSULTING	PIA NO. NB301-520/2	REF NO. 1
	FIGURE 2.3	

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REV	DATE	DESCRIPTION	JSP DESIGNED	SWK DRAWN	RAC REVIEWED
0	31AUG'15	ISSUED WITH REPORT			



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- LEGEND:**
- PROPOSED INFRASTRUCTURE
 - PROPOSED ROAD
 - WATER

- NOTES:**
1. MINE AND PORT SITE INFRASTRUCTURE AS WELL AS BASEMAP DATA PROVIDED BY LYCOPODIUM MINERALS CANADA LTD. (MARCH 18, 2015). MODIFIED BY KNIGHT PIESOLD LTD. TO SHOW PROPOSED INFRASTRUCTURE CHANGES (APRIL 24, 2015).
 2. COORDINATE GRID IS IN METRES.
COORDINATE SYSTEM: BISSAU UTM ZONE 28N.
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GB MINERALS LTD.			
FARIM PHOSPHATE PROJECT			
PORT SITE LAYOUT			
<i>Knight Piésold</i> CONSULTING		PIA NO. NB301-520/2	REF NO. 1
FIGURE 2.4			REV 0

REV	DATE	DESCRIPTION	RAC DESIGNED	SVK DRAWN	RAC REVIEWED
0	19AUG'15	ISSUED WITH REPORT			

2.4 OPEN PIT MINES

This section describes how mining will be undertaken, including a description of the major mine components and the sequencing of mining. The overall layout of the Mine Site in Years 7 and 25 are shown on Figures 2.2 and 2.3, respectively.

2.4.1 Deposit Geology

The site contains a high-grade sedimentary, flat-lying phosphate deposit located within a single phosphate ore bed known as the FPA ore zone.

Three phosphate-bearing horizons (referred to as the FPO, FPA and FPB) have been identified at the Farim phosphate deposit. The FPA unit is the economic phosphate bed. The FPB underlies the FPA and is of less economic interest due to the lower phosphate and high limestone content. The FPO is a clayey dolomitic limestone that is weakly phosphatic with limited economic potential. The phosphate deposit is underlain by a soft, white and porous limestone unit. The phosphate bearing strata are unconformably overlain by a sandy-argillaceous sequence comprising soft alternating sandy, clayey and sandy-clay layers with a blue/green soft clay or black lignitic clay at the base.

The Mine Site stratigraphy in the vicinity of the deposit is summarized in Table 2.1.

Table 2.1 Indicative Site Stratigraphy

Age	Unit	Description	Thickness (m)
Post Eocene	Sandy/Argillaceous Overburden	Alternating sandy, clayey and sandy clayey layers	27 to 58
	Basal Clay Overburden	Blue/green soft clay and black lignitic clay (anoxic depositional environment)	
Eocene	Sand including FPO (phosphatic interval)	Grey/white fine grained sand including phosphate bearing clayey dolomitic limestone (FPO)	7 (single intercept)
	Upper Dolomitic Limestone	Clayey limestone	>2 ¹ (single intercept)
	Decarbonised Phosphate Unit (FPA)	Ore zone comprising beige to brown, poorly cemented very fine grained phosphatic sand	1 to 11
	Calcareous Phosphate Unit (FPB)	Cemented phosphatic limestone	2 to 8
	Limestone	Soft, white and porous limestone	>6 to 17 ¹

NOTES:

1. BASE OF UNIT NOT ENCOUNTERED.

2.4.2 Ore and Waste Geochemistry

Geochemical testing was completed on samples of ore and product, tailings and waste overburden as outlined below.

- **Phosphate Ore and Product Geochemistry** - 156 ore samples were tested previously for mineralogy and metals (Golder, 2014b). More recently, one phosphate composite ore sample and one associated phosphate rock product sample from pilot plant metallurgical testing were analyzed for metals (Knight Piésold, 2015e). Based on the testing completed the following conclusions were made:
 - **Metals in Ore** - The ore is enriched in a number of metals, some of which may be of an environmental concern (i.e., silver, antimony, beryllium, cadmium, chromium, copper, lead, zinc, and possibly arsenic, strontium, thallium and uranium).
 - **Phosphate Rock** - The metals concentrations within the phosphate rock product appear to be similar to that of the ore, based on a single metals scan of product and the corresponding feed ore.

The ore and phosphate rock have higher metals concentrations overall, but both are expected to have lower environmental exposure. The waste overburden contains lower metals concentrations compared to the ore or phosphate rock, but is enriched in a number of metals, some of which are of an environmental concern. The environmental exposure of the waste overburden is high compared to the ore and phosphate rock.

- **Tailings Geochemistry** - Geochemical test results for tailings are limited to a single sample derived from pilot plant testing as part of the feasibility study (Knight Piésold, 2015f).

The tailings were found to be acid consuming. As such, there is no perceived risk from acidification of the tailings and there are no specific controls required. However, the high sulfide content of the tailings has the potential to lead to high sulfate and saline drainage.

The results of the analysis indicate that the tailings have moderate levels of element enrichment, with cadmium, phosphorous and selenium found to be highly enriched. In addition, silver, fluoride, sulfur, antimony and uranium were found to be significantly enriched, with arsenic, bismuth, chromium and lead slightly enriched. The tailings did not meet the ecological soil screening guidelines, with several metals also exceeding the remediation intervention values. Therefore, during operations the facility must be designed and operated in such a way as to fully contain the tailings solids and minimise dusting. On closure, a cover system will be required to isolate the tailings from the environment. From a multi-element perspective, this would likely comprise a basic store and release cover, consisting of a coarse rockfill layer to form a capillary break and prevent upward migration of salts, overlain by rock mulch for storage of rain water and capped with a growth medium to aid re-vegetation. The closure cover system should also be domed such that once the rock mulch storage layer is fully saturated, excess water will flow towards and over the spillway rather than through the consolidated tailings. However, consideration must also be given to the radiometric results.

The supernatant sample was found to be of a reasonable quality, but did not meet all guideline concentrations and was found to exceed baseline surface water and groundwater concentrations for several parameters. As such, the tailings storage facility will require controls to limit seepage to surface water and groundwater. This will likely comprise an engineered low permeability liner

across the base and sides of the facility, and a storage capacity sufficient to contain all stormwater runoff within the adopted design standard. An underdrainage system constructed over the basal liner will also reduce the hydraulic head acting on the liner to further reduce seepage.

- **Waste Overburden Geochemistry** - Based on testing completed by Knight Piésold (2015g), an estimated 75% of waste overburden is likely to be non-acid forming (NAF), with about 25% classified as potentially acid forming (PAF). The PAF materials consisted of samples of overburden, including the basal sand / clay and lignite zone but also to a lesser extent the upper sequence of sands and clays. Therefore, although the basal zone represents a higher risk of acid generation compared to the upper overburden, there is potential for a small proportion of overburden materials to generate acid due to the presence of pyrite. The samples of sand / FPA returned varied results, with two samples found to be NAF and two found to be PAF. Therefore, based on the limited testing conducted to date, a significant proportion of material in proximity to the ore zone may be PAF. As would be expected the clayey dolomitic limestone samples were found to be strongly acid consuming. Acid-neutralizing capability was generally absent throughout the majority of overburden samples tested and, therefore, the waste overburden has limited potential to buffer any acidity produced from the oxidation of sulfides.

Based on the data available from the testing to date, it appears that pyrite may exist in discrete or discontinuous zones. If this were the case then attempting to segregate the mine waste based on acid forming potential could be problematic. However, given the limited scope of testing relative to the proposed waste volumes, it should be possible with a more comprehensive testing programme to identify and selectively handle PAF waste.

The results of the analysis indicate the samples to have low levels of enrichment, with phosphorous, selenium and tellurium the only elements found to be highly enriched. The four samples logged as sand / FPA had higher levels of element enrichment than the overburden samples. The results of the multi-element analysis were compared to a set of soil quality screening guidelines, which indicated that all samples met the criteria for human health and soil remediation/intervention. However, no samples met the ecological criteria. As such, the waste dumps will require a closure cover to isolate the materials from plant uptake.

The distilled water extract testing indicated that leaching of a proportion of the waste and FPA will contain environmentally significant metals above the assessment criteria applied in the geochemical evaluation (Knight Piésold, 2015g).

Based on the limited scope of testing relative to the proposed waste volumes, additional testing is required prior to operations to estimate the amount of leachable waste to be mined and the need for additional management measures beyond what is currently proposed. Operational testing may then be required to delineate leaching and non-leaching materials to allow segregation during mining.

2.4.3 Radiological Characteristics of Ore, Tailings and Waste

The radiological properties of the ore, tailings and waste overburden are as follows:

- **Radiological Characteristics of Ore** - Limited radiometric analyses of the ore indicated that the activity of certain radionuclides exceed the activity guidelines set out in the Canadian Guidelines for the Management of Naturally Occurring Radioactive Material (NORM Guidelines; Canadian NORM Working Group, 2000). The ore is not expected present a major occupational health and safety risk, but will require some level of management and monitoring of exposures (Northern Consulting and Analysis, 2015).
- **Radiological Characteristics of Tailings** - The tailings solids radiometric analyses completed by Knight Piésold (2015f) indicated that the activity of certain radionuclides exceed the activity guidelines set out in the NORM Guidelines.
- **Radiological Characteristics of Waste Overburden** - Radiometric analysis of fourteen waste overburden samples, compared to the NORM Guideline limits, indicate the radioactive hazard associated with the waste overburden is considered insignificant. No further management controls on the waste overburden material are necessary on radiological protection grounds (Knight Piésold, 2015g). Where the activity exceeds the devised release limits for diffuse naturally occurring radioactive material, a site-specific radiation dose assessment needs to be carried out to estimate the doses to workers and members of the public, and to determine appropriate radiation protection measures.

Geochemical evaluations of the tailings and waste overburden are presented in Volume 4 as TSD-7a and TSD-7b, respectively. An assessment of the risks to human health and the ecological environment is presented in TSD-16 and is summarized in Section 21.

2.4.4 Mining Method

Because the phosphate ore resource is relatively shallow at Farim, the maximum depth of mining in each of the pits will be a maximum of 60 m below surface grade. This allows for the development of a mine plan involving concurrent backfilling of mined out areas of the open pits, which facilitates a low cost and effective means of disposing of the majority of the waste overburden generated during the course of mining. This reduces the external to the pit (ex-pit) storage area requirements for mine waste. It also will allow GB Minerals to maintain a relatively compact open pit area throughout the mining life, thereby reducing water management requirements.

Both the phosphate ore (the FPA unit) and all surrounding overburden are unconsolidated materials, and therefore all mining can be conducted with excavators without the need for blasting. The ore will be mined using a multiple-bench open pit haul-back method using excavators and trucks. This approach was selected over dredging and dragline methods based on initial capital cost, lower investment risk, better grade control, limited power supply, and flexibility.

Once a sufficient volume has been excavated, the overburden will be back-hauled into the mined-out area. Overburden not stored in-pit (in-pit overburden backfill, or IOB) will be sent to an external-pit (ex-pit) waste dump.

Overburden excavation will advance ahead of the ore extraction in maximum 10 m height production benches. Multiple overburden stripping benches will be developed and maintained in advance of ore

extraction. Figure 2.5 shows a typical pit configuration for this method of mining. The drawing is also presented in Appendix 1B.2.

2.4.5 Mine Design Criteria

A pit slope design geotechnical study was undertaken as part of the feasibility study. Open pit slope parameters have been developed based on a 20° overall permanent wall angle at an operational factor of safety of >1.3.

A temporary dig face angle of 65 degrees is an assumed typical temporary slope angle cut by an excavator or loader that, over time, will slough and erode to a flatter slope angle. The benches in the higher cohesion clay soils will maintain steeper bench faces over the lifetime of the pit wall.

Based on material density and moisture content lab results for the clay and sand horizons, an average overburden swell factor of 27 percent has been calculated. This swell factor applies to the ex-pit waste dumps, IOB, and surcharge waste dumps. Surcharge waste dumps are areas of overburden storage within the pit footprint but overfilled a maximum of 25 m above original topography. Overburden will be stacked in external to the pit (ex-pit) waste dumps early in the mine life, and will be subsequently backfilled into the mined-out pit when pit advance provides sufficient room for backfilling. External waste dumps will have an overall slope of 1V:4H, and surcharge waste dumps and IOB are designed to an overall slope of 1V:6H. Waste dumps will be built in lifts and compacted with a dozer and a compactor.

Excavator/truck mining will require stable haul roads and mine working surfaces for all pit levels and for all material, including the extraction of the ore. Furthermore, the excavator/truck method will require the construction and maintenance of permanent mine haul roads to the ex-pit waste dumps, the truck maintenance facility, and ROM stockpile adjacent to the process plant. Because of the concentrated annual rainfall from July through September, the mine plan limits mining activities at full production to nine months out of the year; mining during the other three months of highest rainfall is assumed to occur at reduced productivity.

Table 2.2 summarizes mine plan parameters and factors.

2.4.6 Mining Equipment Fleet

Overburden will be stripped and removed with 12 m³ front end loaders or other similar excavator matched with 97 t capacity haul trucks. The ore will be mined with 5 m³ bucket class excavators matched with 36 t capacity trucks to minimize mining dilution and maximize matrix recovery. The ore will be hauled to a 175,000 t (dry basis) ROM stockpile adjacent to the plant, and segregated by quality. The ore will be reclaimed and carefully blended into a plant feed hopper by front-end wheel loaders with 12 m³ buckets to achieve the desired P₂O₅ grade. The plant feed hopper will be installed so that ore haul trucks can directly feed ore to the plant if possible.

The remote nature of the Farim operation, with limited power supply, precludes the use of electric mining equipment. All mining equipment selected for the Project is diesel mobile equipment.

Table 2.3 summarizes the maximum number of equipment units required at any time throughout the LOM.

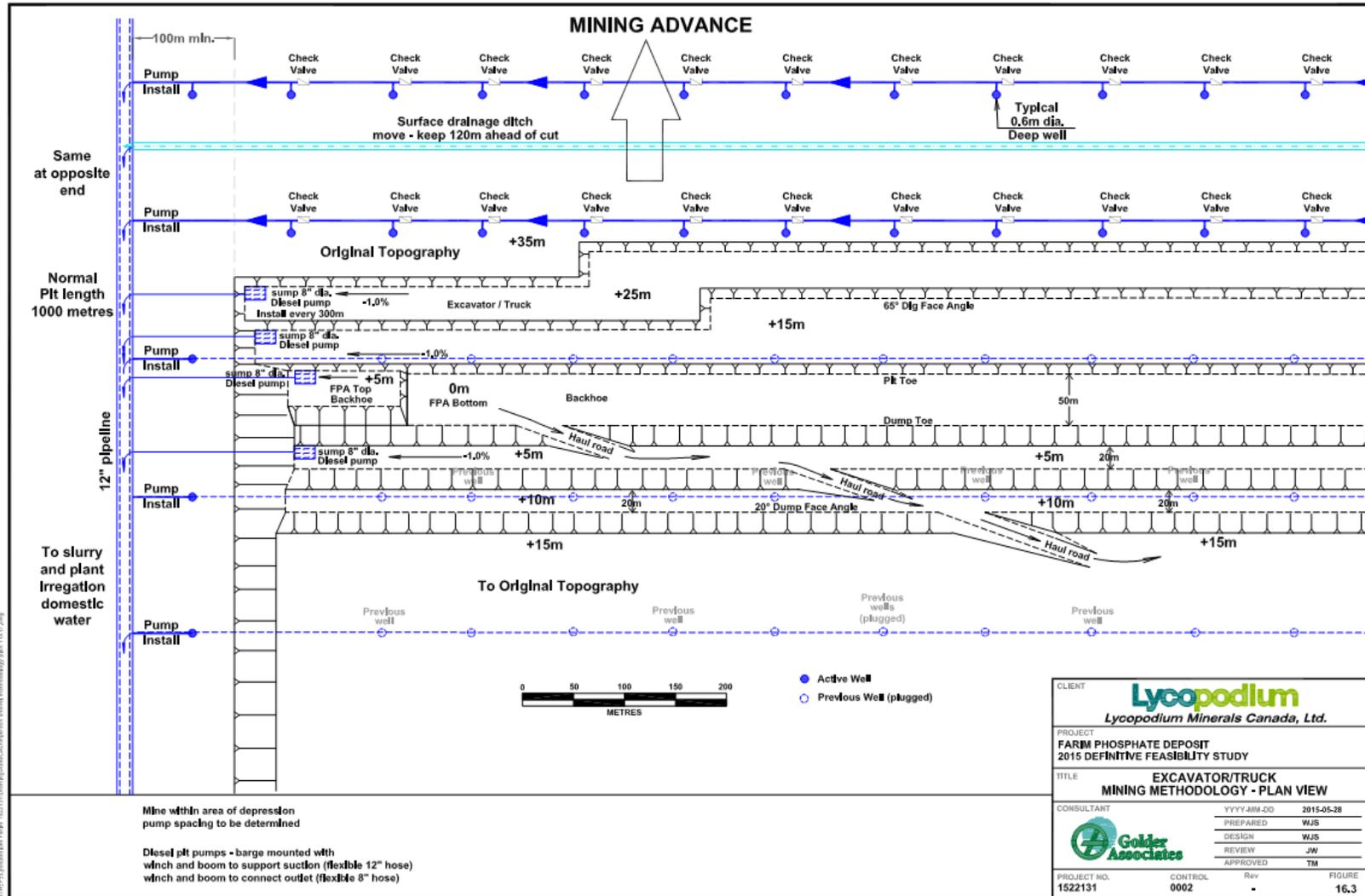


Figure 2.5 Excavator/Truck Mining Methodology

Table 2.2 Mine Design Parameters

Description	Value
Permanent Wall Angle	20°
Permanent Wall Operation - Factor of Safety (FOS)	>1.3
Bench Height	10 m
Short-Term Bench Face (Batter) Angle	65°
Short Term Berm Width	14.9 m
Long-Term Bench Face (Batter) Angle (After Sloughing)	25°
Long-Term Berm Width (After Sloughing)	6.5 m
Overburden Angle of Repose Ex-pit WDs/IOB/SWDs	1V:4H / 1V:6H / 1V:6H
Overburden Spoil Swell Factor	27%
Total Moisture (As-Received Basis) Overburden	20%
Overburden Density As Received Basis	2.10 t/m ³
Overburden Density (Dry Basis)	1.68 t/m ³
Ore Total Moisture (As-Received Basis)	20%
Ore Density (As-Received Basis)	1.75 t/m ³
Ore Density (Dry Basis)	1.40 t/m ³
Minimum Mineable Ore Thickness	1 m
Mining Roof Loss	100 mm
Mining Floor Dilution	75 mm
Geology and Mining Recovery Factor	95%
Buffer between Pit and River	100 m
Full Production Mining Months per Year	9 months
Reduced Production Mining Months per Year	3 months
Mine Dewatering Possible	Yes
Material to Support Truck Traffic	Yes
Spoil Stackability	Yes

NOTES:

1. SOURCE: GOLDBERG, IN LYCOPODIUM 2015a.

Table 2.3 Equipment List

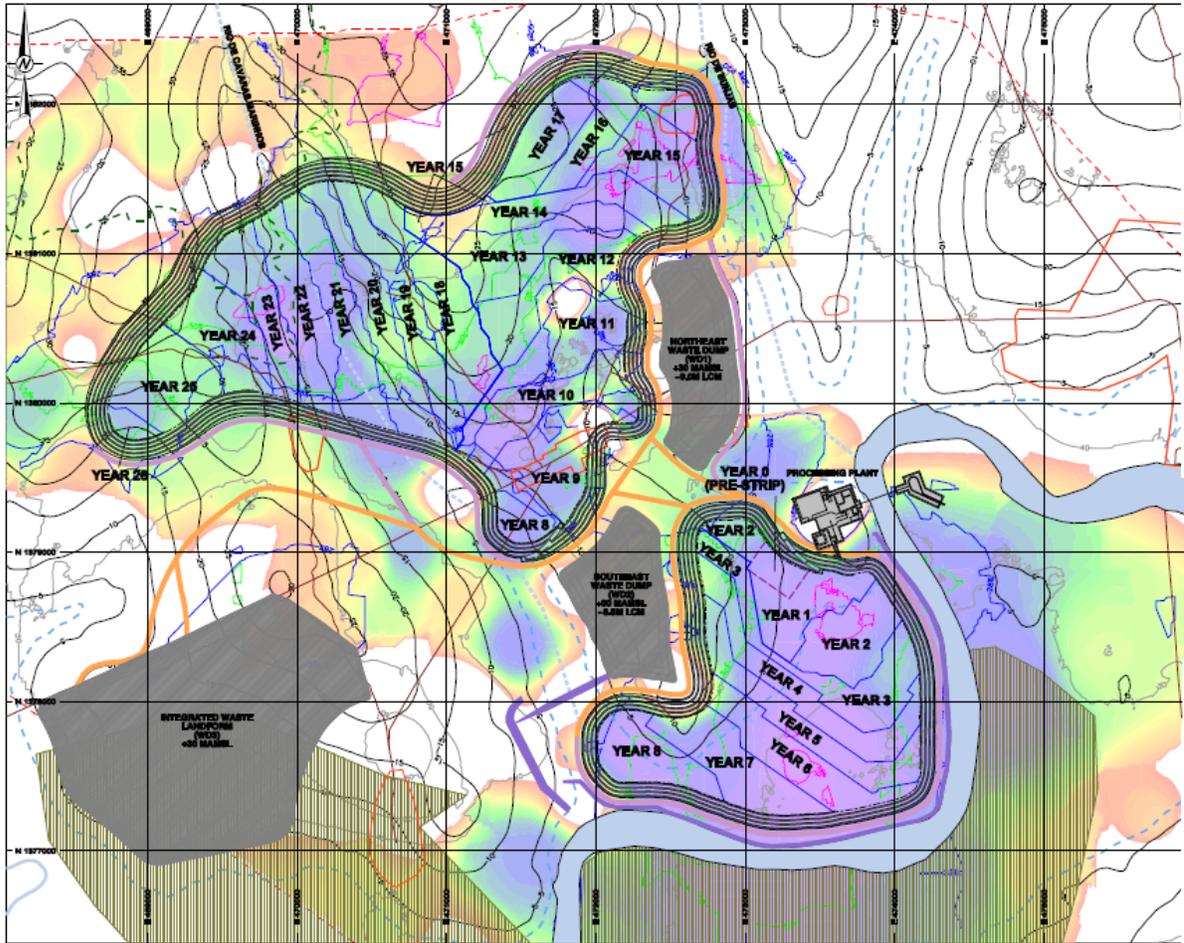
Description	Construction Phase (Max)	Operations Phase (Max)
Caterpillar 374DL - Backhoe	3	3
Caterpillar 336DL - Backhoe	1	1
Caterpillar 992K - Wheel Loader	5	8
Caterpillar D9R - Dozer	4	7
Caterpillar 777G - End Dump Truck	14	33
Caterpillar 770 - End Dump Truck	6	12
Caterpillar 16M - Motor Grader	2	3
Caterpillar CS-56 - Compactor	4	8
Caterpillar 428F - Backhoe Loader	1	1
Caterpillar 770 - Water Truck	2	2
Fuel/Lube Truck	3	4
Mechanic's Truck	2	3
Pickup Truck	12	12
Liebherr LTM 1095 - Mobile Crane	1	1
10-tonne Forklift	1	1
Welding Machine	2	2
Light Plant	8	14
Screening Plant	1	1

2.4.7 Mine Sequencing

The open pit sequence has been designed based on the following key factors: annual product production, grade, strip ratio, backfill opportunities and hydrogeological considerations. A constant annual production of 1.32 Mt of product is targeted. The mine plan is sequenced with stripping ratio increasing from low-to-high to the extent possible to defer capital and operating costs and to minimize investment risk. Additionally, the south pit will be developed from north to south, south pit allowing mine operations to gain experience in groundwater and geotechnical conditions as mining approaches the River Cacheu. The sequence through the north pit also accounts for dewatering demands associated with the western ephemeral stream (Rio de Bunja) to reduce stress on the open pit.

As described in Section 2.3, the open pits will be developed in two phases, with the south pit being exploited first, where the higher grade ore is closer to surface. There will be a transition period in Year 8 where both pits will be mined. The complete mining sequence is shown on Figure 2.6, and the production schedule is presented on Figure 2.7.

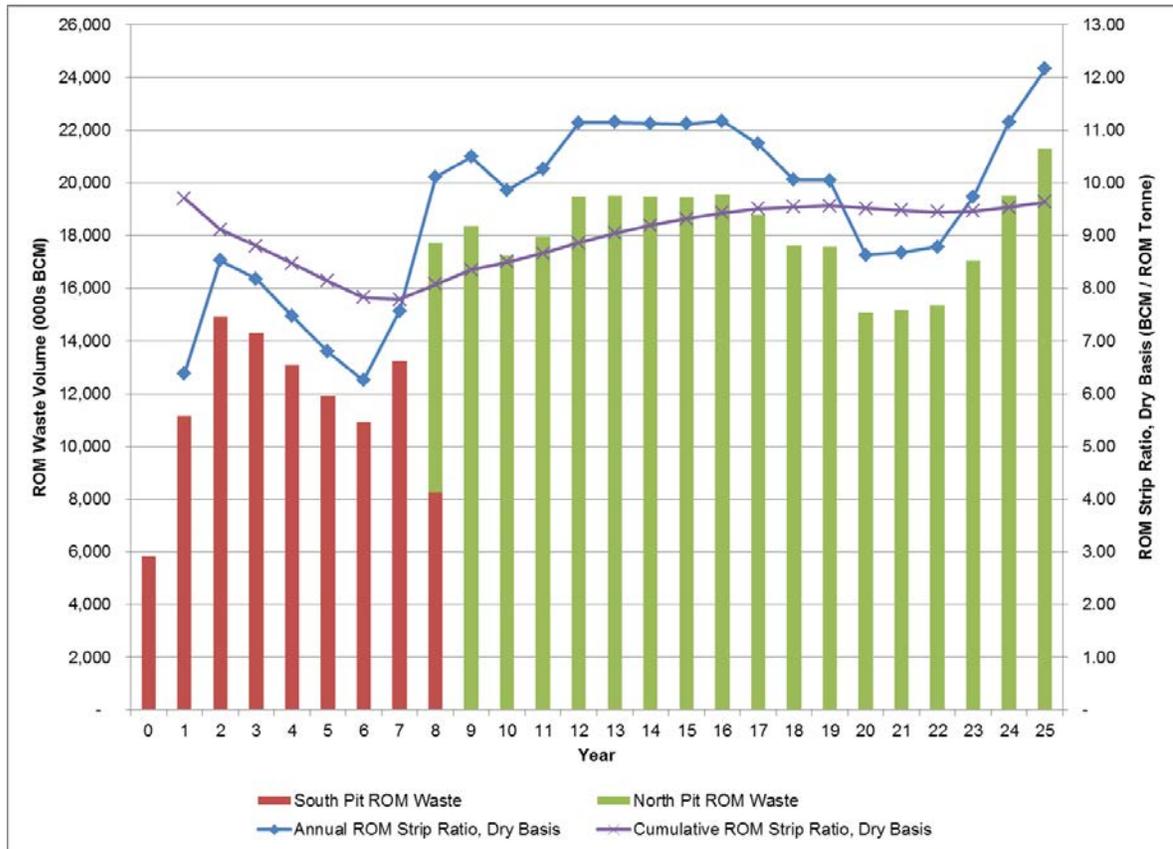
The south pit will be opened up in a relatively high grade area adjacent to the plant that is outside the extents of the 1 in 100 year flood event. This approach minimizes risk by providing adequate time for the incremental construction of a flood protection bund around the perimeter of the River Cacheu to prevent pit flooding, and allows appropriate lead-in time for pit dewatering ahead of the mining advance.



NOTES:

1. SOURCE: GOLDER, IN LYCOPODIUM 2015A.

Figure 2.6 Sequencing of Open Pit Mining



NOTES:

1. SOURCE: GOLDER, IN LYCOPODIUM 2015A.

Figure 2.7 Annual Mine Production Schedule

The overburden material pre-stripped in Year 0 will be used for construction of both the flood protection bund and the initial TSF embankment.

After pre-stripping overburden in Year 0, mining will progress to the southwest along the south pit highwall towards the River Cacheu, targeting the lowest strip ratio resources in Years 1 and 2. The sequencing of mining in the south pit looks to balance targeting low strip ratios with maximizing in-pit backfill opportunities. Independent access is maintained to each mining bench throughout the mine life, allowing flexibility for mining advance and ore extraction. After the mining advance expands across the full width of the 25-year south pit extents by the end of Year 3, the mine face advances in a linear progression to the southwest until the south pit is mined out in Year 8.

The north pit is opened up in Year 8 as the final area of the south pit is mined out to allow for a complete transition of ore production to the north pit in Year 9. The mine face then progresses north-northeast from Years 9 through 14 to avoid disturbing the western ephemeral stream (Rio de Cavaras Marinhas) and allow time for a diversion ditch to be constructed (described below). High strip ratio reserves from the north pit are incrementally mined with the lower strip ratio in Years 12 through 17 to balance strip ratio and equipment requirements to the extent possible.

In Year 18, the mining face shifts to the west across the full width of the north pit extents and progresses linearly from east to the west through the remainder of the mine life.

In Year 20, the overburden advance will progress westerly through the Rio de Cavaras Marinhos. The ephemeral stream will therefore be re-routed in Year 19/Year 20 by constructing a diversion channel and bund to connect to the ephemeral Rio de Bunja stream located southeast of the north pit. The Rio de Cavaras Marinhos diversion will involve excavating a cut through the existing hillside to meet the northern edge of the north pit, and across the backfilled portion of the north pit to connect to the existing channel of the ephemeral Rio de Bunja. The diversion channel will be designed to meet the 1:10 year return period, and will have a channel base-width of approximately 2.5 m, batter slopes of 1 in 3.5, and channel slopes of 0.2% through the cut and 0.4% through the backfilled pit area. The maximum water depth in the new channel is estimated to range between 1.5 m (through the backfilled pit portion) and 1.6 m (through the new cut area). A minimum 50 m offset from the diversion ditch centerline was considered in designing the adjacent surcharge waste dumps WD-5 and WD-6. The distance between these two waste dumps is about 125 m.

Riprap will be installed along the entire length of channel, with geotextile installed through the portion located within backfilled pit. The diversion channel will outflow into the Rio de Bunja, an existing ephemeral stream, at approximately 4 metres above sea level (masl). The resultant cut will require approximately 800,000 m³ of excavation work. Once the diversion channel has been constructed, a bund will be constructed across the existing natural channel to divert seasonal flows into the diversion channel.

End-of-period maps showing the mine progression for Years 0 through 5, and Years 8, 10, 15, 20, and 25 are provided in Appendix 1B.3.

2.4.8 Open Pit Dewatering

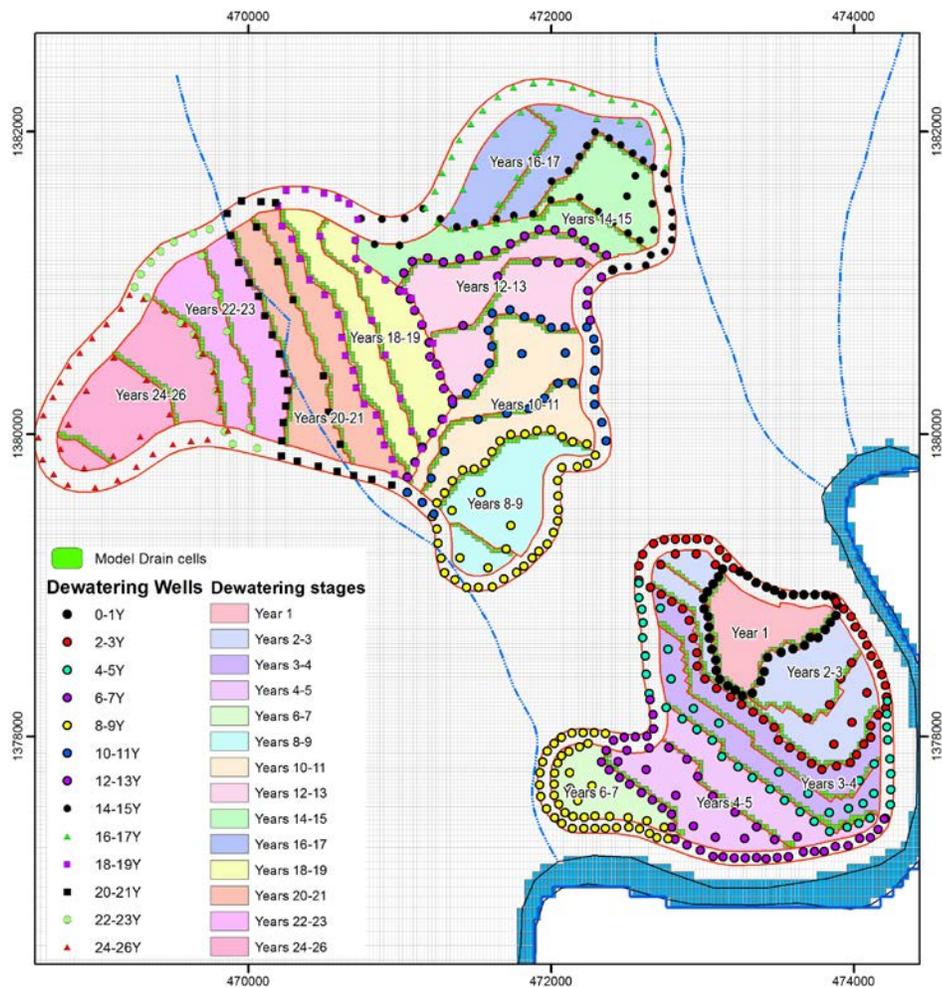
The following provides and a summary of the proposed open pit dewatering plan, a detailed description of the proposed open pit dewatering plan is provided in the WAMP (Volume 3). The following infrastructure is proposed:

- A system of pumped wells around the perimeter of the open pits
- A grid of “sacrificial” internal pumped wells to form dewatered “cells” approximately aligned with the edges of the proposed mining cells, to dewater ahead of the working strip
- Additional shallow perimeter wells in the overburden in areas where significant sand layers are identified and where pumping from the deep aquifer does not provide sufficient drawdown in the overburden
- Drainage ditches or trenches in pit slopes to collect residual seepage water where it emerges from isolated sand zones exposed within the slopes
- An in-pit pumping system to manage residual seepage water and surface water from precipitation
- Monitoring boreholes to allow external groundwater levels to be observed

A groundwater inflow model was developed for the open pits based on the proposed mine plan (Knight Piésold, 2015c). The model was developed to predict the groundwater inflows into the southern and northern open pits during the various stages of development. The predicted pit inflows are as follows:

- South Pit - Average daily pit inflow is approximately 13,000 m³/day (150 L/s), ranging between 9,800 m³/day (113 L/s) and 16,700 m³/day (193 L/s).
- North Pit - Average calculated inflow is 6,500 m³/day (75 L/s) ranging between a peak of 8,900 m³/day (103 L/s) and 5,100 m³/day (59 L/s) at the end of mining (Year 25).

Based on these predicted inflow rates and an assumed yield of 10.5 L/s per dewatering borehole approximately 546 bores and 26 sumps will be required over the mine life. The bores will be drilled to 75 m below average sea level and spaced approximately 150 m apart inland and 75 m apart along the River Cacheu, as illustrated in Figure 2.8.



NOTES:

1. SOURCE: KNIGHT PIESOLD, 2015c.

Figure 2.8 Dewatering Sequence Plan

The water pumped from the dewatering system will either be discharged directly to the River Cacheu or directed to a sediment control pond. Suspended solids will be allowed to settle out within the pond prior to discharge and if required the water will be sent to the water treatment plant for additional treatment prior to discharge.

2.4.9 Induced Settlement from Dewatering

Pit dewatering will lead to a lowering of groundwater within the overburden soils. This will lead to an increase in effective stress conditions within the dewatered soils and will induce settlement that will lower ground surface levels. The lowered ground levels could affect surface water management and the design levels of flood protection or earthwork containment structures.

It will be necessary, to ensure stability of the pit walls, to depressurize the pit slopes in advance of mining through pit dewatering. The pore pressure conditions within a bench planned for mining should be investigated through installation of piezometers or push-in probes before mining into a new area. The water table condition at the periphery of the pit limits will be monitored to verify the dewatering expectations are being met. Dewatering will take place ahead of the mine excavations to allow sufficient depressurization and dissipation of pore water pressures within the clay layers.

It is estimated that settlement up to 500 mm could occur due to the dewatering of the Mine Site. Sand units are likely to settle quickly where they are not confined by clay layers. The majority of the settlement will be due to the longer term consolidation of the clay layers within the ground profile and the total settlement that will be realized will be controlled by the duration of dewatering.

2.4.10 Open Pit Monitoring

Due to the variability in the extent and types of soils, the excavations will require a high degree of visual inspection and monitoring of ground conditions. This is anticipated to include the following:

- Regular inspections of slope conditions
- Installation and regular inspection of monitoring piezometers to confirm groundwater conditions
- Regular surveying to monitor settlement
- Installation and measurement of slip indicators (inclinometers) in areas of suspected slope instability and to verify design assumptions, particularly in high slopes consisting primarily of clay units
- Undertaking and monitoring the timely remediation of identified unstable areas

A monitoring and action plan should be developed before mining begins to define the monitoring goals, activities, and frequencies and actions to be taken at specific reading levels.

2.5 PROCESS PLANT

Run-of-mine ore will be delivered to an on-site process plant. The process plant will be situated next to the south pit on the north side of the River Cacheu. The Truck load-out Facility will be located on south side of the River Cacheu and connected to the process plant via an enclosed conveyor system (Figure 2.9).

2.5.1 Process Description

Run-of-mine ore will be delivered to an on-site process plant where it will be beneficiated using several techniques to create an enriched phosphate product that will be shipped to the market.

Bench-scale followed by pilot plant metallurgical testing was undertaken as part of the feasibility study to determine the most suitable processing methods and to estimate the recovery rate (the portion of the ore that becomes product). The selected process involves scrubbing and screening, sizing, thickening and filtration of the ore to produce a concentrate (phosphate rock product, or product) of 34.0% P₂O₅. Mining will provide 1.75 Mt/a of ore that will be beneficiated to produce 1.32 Mt/a of product, at an overall P₂O₅ recovery rate of 78.4%. Unlike many phosphate mines, processing does not require floatation to achieve a marketable phosphate rock product, though a floatation circuit could be added to further improve recoveries.

A schematic diagram of the process is shown in Figure 2.10. The following steps are included in the selected flowsheet:

- Ore storage and reclaiming of Run-of-Mine (ROM) ore
- Two stage scrubbing and screening to reject +1.18 mm material
- Sizing with hydrosizers and cyclones to separate -1.18 x 0.106 mm material to a coarse concentrate, -0.106 x 0.020 mm material to a fine concentrate material, and to reject -20 µm material to tailings
- Fine concentrate thickening
- Concentrate filtration, stockpile storage and reclaim
- Thickening and disposal of reject material to the TSF and return of decant water to the process plant
- Concentrate reclaim, drying, stockpiling and shiploading at the Port Site (Section 2.13)

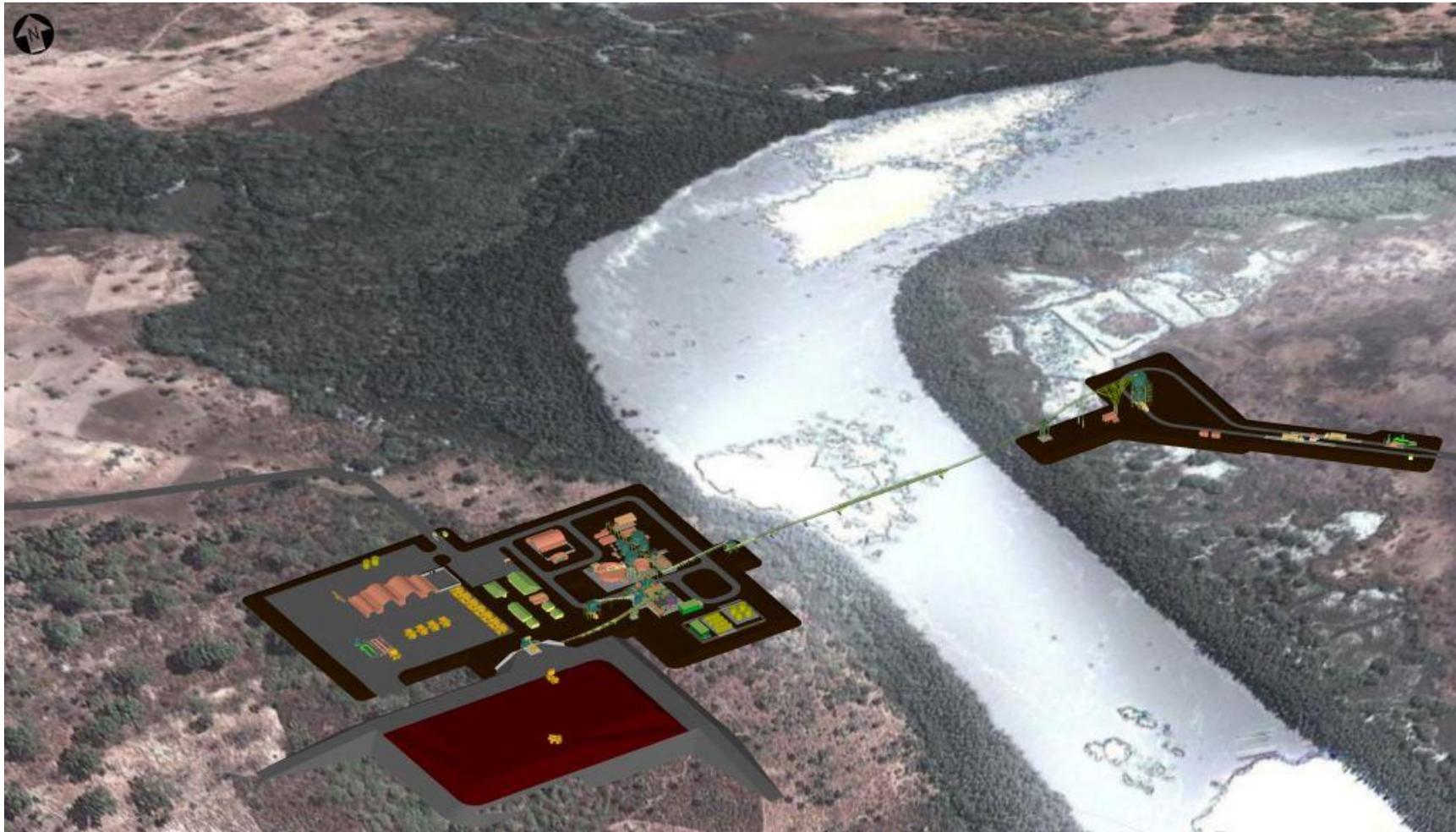
The process design criteria prepared by Lycopodium (2015a) is provided in Appendix 1B.4.

2.5.2 Feed Preparation, Stockpile and Reclaim

ROM ore will be delivered by 37-t capacity dump trucks from the open pit. ROM will either be dumped directly into the ROM bin or dumped onto the 175,000 t ROM stockpile, which is 1.2 months of feed for the plant. The ROM stockpile will have a five weeks storage capacity equivalent to 250,000 live tonnes.

Ore (P80 25 mm) will be dumped by haul trucks or loaded by front-end loaders directly into the ROM bin. The ROM bin will be equipped with a static grizzly to prevent oversized rocks from entering the bin. A belt feeder will extract ROM rock from the bin to be conveyed to the horizontal scrubber.

For metallurgical accounting and plant control purposes, weightometers will be installed on the scrubber feed conveyor.



NOTES:

1. SOURCE: LYCOPODIUM, 2015A.

Figure 2.9 Pictorial View of Process Plant Area

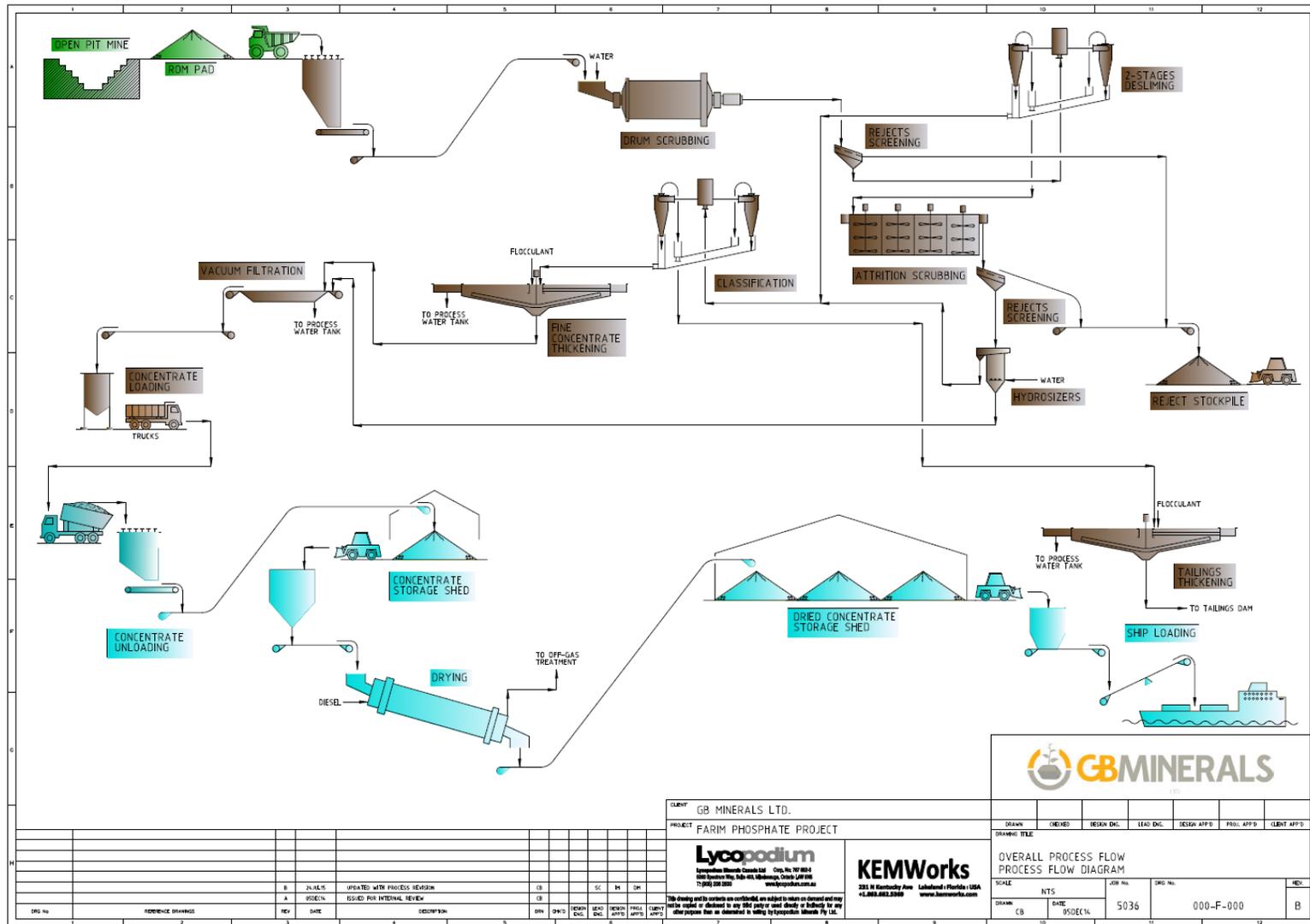


Figure 2.10 Process Flow Diagram

2.5.3 Scrubbing and Sizing

The scrubbing and sizing circuit will include a horizontal scrubber, an attrition scrubber, two reject screens, two-stage desliming cyclones, two hydrosizers, and a classification cyclone cluster and associated equipment. Reject material will be sent to the TSF, while concentrate will be sent to the Fine Concentrate Thickener.

2.5.4 Fine Concentrate Thickening

The fine concentrate thickening area will include a pump tank, a deep cone thickener and other associated equipment.

Classification cyclones underflow will be collected in the fine concentrate pump tank prior to being pumped to the fine concentrate thickener. Filter cloth wash return water and filter sump pump discharge will be periodically pumped to the fine concentrate pump tank to be re-processed. Underflow will be thickened to 55% solids and then will be pumped to the vacuum filter feed tank. Thickener overflow will flow by gravity back to the process water tank.

2.5.5 Concentrate Filtration and Storage

The concentrate filtration and stockpiling area will include a vacuum belt filter, a product pipe conveyor, a concentrate stockpile and other associated equipment.

Coarse concentrate and thickened fine concentrate from fine concentrate thickener will be combined in the 22 m³ live concentrate filter feed tank from which it will be gravity-fed to the 1.6 m wide x 18 m long concentrate belt filter. Phosphate concentrate will be filtered to achieve 8% moisture and the filter cake will discharge onto a concentrate filter discharge conveyor. Filtrate will be collected in a filtrate receiver and will be pumped back to the process water tank.

A cloth wash system for washing the vacuum filter belt is included for cleaning of the belt cloth. A sump pump is provided to pump any spillages back to the fine concentrate pump tank feeding the fine concentrate thickener.

The concentrate filter discharge conveyor will transport the filtercake into the concentrate pipe conveyor feed bin. A belt feeder under the feed bin will feed the concentrate filtercake onto the concentrate product pipe conveyor. The concentrate filter discharge conveyor will be equipped with a weightometer for accounting purposes. The pipe conveyor will discharge into a 2,000 m³ live concentrate bin. Concentrate dump trucks will drive under the concentrate bin to be loaded for transport to the port facility.

A truck wash station is provided near the entrance of the concentrate storage area to wash the concentrate dump trucks before entering the concentrate storage area. The under body and wheel wash will have a drive-through concept where the trucks will drive through the station at 5 km/h with no stopping required. Trucks will be weighed before and after concentrate loading for accounting purposes.

2.5.6 Tailings Handling

The tailings handling area will include a high rate thickener, the TSF and other associated equipment. The TSF is described in Section 2.8.

Tailings from the beneficiation plant will be collected in the coarse tailings tank before it will be pumped to the tailings thickener. Tailings will be thickened to 15% solids content and will be pumped to the tailings dam for storage. Tailings thickener overflow will flow by gravity back to the process water tank.

This final tailings stream, at approximately 50% solids, is stored at the tailings dam. Water reclaimed from the tailings pond is returned to the process water tank.

2.5.7 Process Plant Water Use

Process Water

The process water system will consist of a mostly closed circulating loop to minimize makeup water requirements. Process water will be used primarily in the scrubbing circuit as dilution water. A process water tank will provide live capacity and will be replenished by the thickener overflow, tailings dam reclaim and filter filtrate. Excess process water will be sent to the water treatment plant for treatment.

Make-up Water Requirements

A total of 3.0 m³/h of raw water sourced from groundwater will be required as make-up to the process plant: 1.7 m³/h will be treated and used in process, with the balance (1.3 m³/h) to a potable water treatment plant for the production of potable water.

The process plant will generate an excess of 31 m³/h of process water. Excess water which comprises of truck wash discharge water and process water tank overflow will be sent to an event pond for sedimentation. Event pond return water will be pumped to a water treatment plant for treatment before it will be recycled back to the filtered water tank for re-used in the process plant.

Raw/Fire Water

Raw water will be stored in a tank (317 m³) for use to feed process plant make up water requirements, and to provide a four-hour supply of fire water.

2.5.8 Reagents

The primary reagents to be used in the process plant are two flocculants: Flomin 923 and Magnafloc 1011, or equivalent products. Both substances are anionic polymers with negligible human or aquatic toxicity. Magnafloc 1011 is a very high molecular weight anionic polyacrylamide flocculant supplied as a free flowing granular powder Magnafloc 1011 exhibits a very low order of oral toxicity and does not present any abnormal problems in its handling or general use.

Dry flocculant will be delivered in 25 kg bags. The bags will be added to the feed hopper, mixed with an eductor (jet wet mixing system) using filtered water, and will be stored in a flocculant storage tank. The flocculant will be added to the thickener.

A reagent storage area will be provided to store all the dry bagged reagents. The reagent storage area is located to the north of the plant and close to the reagent mixing facilities for easy access.

2.6 TOPSOIL STOCKPILES

Topsoil will be salvaged and stored in clearly marked designated areas during operations for use in progressive reclamation and end of mine life reclamation activities as outlined in the ESCP. Care will be taken to ensure that topsoil is protected and handled in a manner that will preserve its quality. Stockpiles will be revegetated to maintain soil fertility and enhance physical stability until the soil can be utilized for reclamation.

2.7 WASTE OVERBURDEN DISPOSAL

The project mining plan indicates that 539 Mm³ (loose cubic metres) of waste overburden will be produced during the mining operations.

Based on the testing to date there is potential for elevated concentrations of environmentally significant metals and compounds in a portion of the waste overburden. The relative quantities of each lithology and their geochemical characteristics are being determined in more detail at present. In the meantime, the following design philosophy has been adopted:

- 78% (420 Mm³ of 539 Mm³) will be placed as in-pit overburden backfill (IOB)
- 7.5% (39.5 Mm³) will be deposited in ex-pit waste dumps (WD-1, WD-2, WD-3a and WD-3b)
 - WDs 1, 2 and 3a will stockpile inert waste only
 - WD-3b will contain potentially leachable waste in specially designed encapsulation cells contained within inert waste
- 0.5% (3 Mm³) of waste overburden (inert overburden only) will be used to construct the initial TSF embankments, sediment control dams and flood protection bund in the first two years of mining
- 14% (77 Mm³) of waste overburden (inert overburden only) will be placed in 3 surcharge waste dumps (WD-4, WD-5 and WD-6) located within the footprint of the backfilled open pits

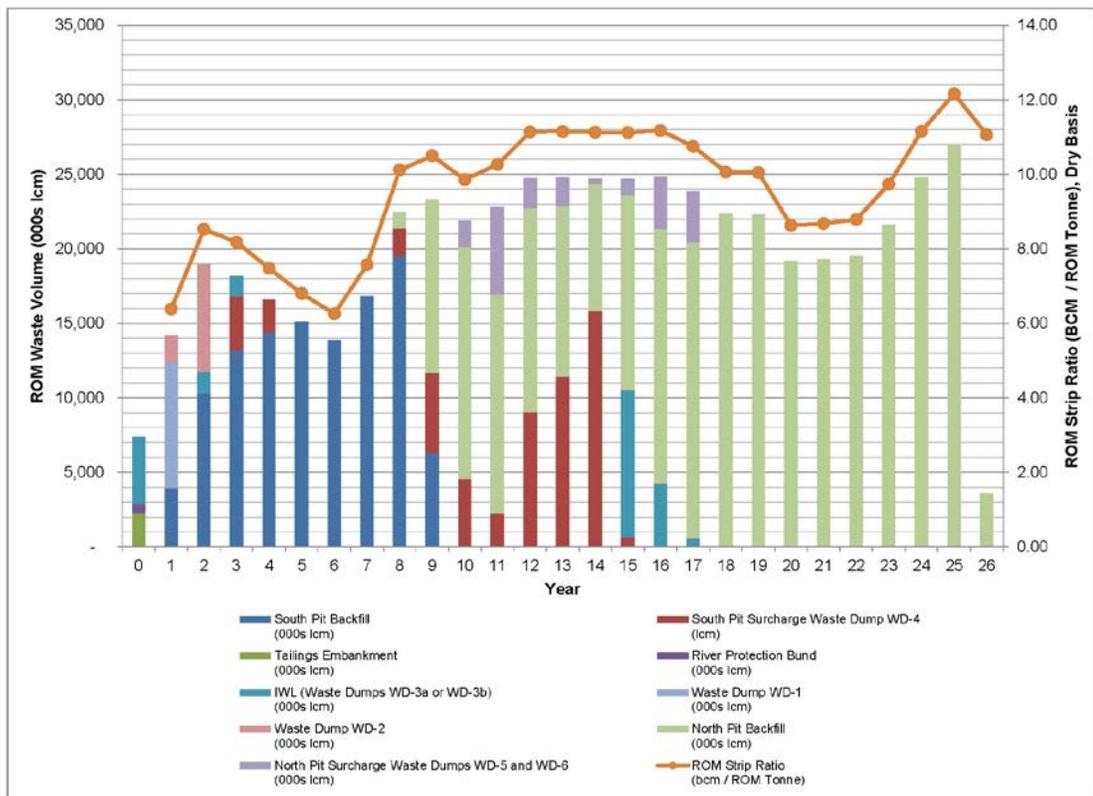
Table 2.4 summarizes the waste overburden disposal plan including the capacity and heights of the proposed waste dumps. Figure 2.11 presents the waste overburden disposal schedule.

Water collected from the WD-1, WD-2 and WD-3a dumps will report to separate SCPs and will be discharged to the environment after reducing the sediment load to an appropriate level. Based on the current design philosophy, no seepage collection measures are proposed.

WD-3b will be designed to reduce contact water from entering the surface water and groundwater environments. A basal low permeability soil liner will be formed beneath the footprint of WD-3b and seepage/run-off flows at the base of WD-3b will report to ECP-1 by means of re-shaping the ground surface to promote drainage to the pond, or provision of a network of above-ground sand/gravel drains. Any contaminated water collected in ECP-1 will be returned to the process plant for re-use. Uncontaminated water will be returned to the plant for re-use, if required, or discharged to the environment.

Table 2.4 Waste Overburden Disposal Plan

Name	Location	Capacity (Mm ³)	Height (masl)	Comment
In-pit Backfill		420		Progressive backfill both pits during operation
Ex-pit Waste Dumps		39.5		Sum of WD-1, WD-2, WD-3a and WD-3b
WD-1	North of South Pit	9.0	30	Years 1-2
WD-2	North of South Pit	8.5	30	Year 1
WD-3a	Adjacent TSF	13.4	30	Years 0, 2, 3 and 15 to 17
WD-3b	Adjacent TSF	8.6	40	Years 0 to 26
Construction Material		3.0		To construct initial TSF, bund, etc.
Surcharge Waste Dumps		77.0		Sum of WD-4, WD-5 and WD-6
WD-4	Backfilled South Pit	57.0	25	Years 3, 4 and 8 to 15
WD-5	Backfilled North Pit	10.4	35	Years 10 to 15
WD-6	Backfilled North Pit	9.6	40	Years 15 to 17
Total		539		



NOTES:

1. ASSUMES ALL OVERBURDEN 7.5 M ABOVE THE ROOF OF THE FPA SEAM IS POTENTIALLY LEACHABLE.
2. WASTE DEPOSITED EX-PIT REFERS TO THE RIVER PROTECTION BERM, TAILINGS EMBANKMENT, OR TO AN EX-PIT WASTE DUMP.

Figure 2.11 Waste Overburden Disposal Schedule

2.8 TAILINGS STORAGE FACILITY

A paddock style TSF will store 6.4 Mt of tailings generated over the Project life.

The design incorporates a multi-zoned embankment, a compacted in situ soil-lined basin area, an underdrainage system covering the approximate extent of the supernatant pond, and an upstream toe drain. Due to the potential elevated levels of environmentally significant elements, a provisional allowance has been included to line the facility with an HDPE geomembrane, subject to further geochemical assessment of the tailings solids and supernatant liquor. The TSF is designed to fully contain the design tonnage as well as rainfall runoff arising from storm events up to and including a 1 in 100 year average return interval (ARI) storm event or wet sequence. The embankments will be constructed in stages over the life of the facility to suit the storage capacity requirements.

Tailings will be discharged into the facility by sub-aerial deposition methods via a number of single point discharge spigots located along the embankment crest. The active tailings beach will be rotated around the facility so as to maximise tailings density and maintain the supernatant pond around the central decant. The upstream toe drains and underdrainage system will drain by gravity to a collection sump located at the toe of the southern embankment. Supernatant water will be decanted from the facility via the decant tower located at the centre of the facility. Solution recovered from the toe drains, and underdrainage and decant systems will be pumped back to the plant for re-use in the process plant.

The TSF will be located immediately adjacent waste dumps WD-3a and WD-3b. This will allow for an efficient management of waste and final reclamation of a single integrated waste landform.

2.9 SURFACE WATER MANAGEMENT

The site presents a unique water management challenge due to the Mine Sites proximity to the tidally influenced River Cacheu and the presence of a distinct wet season receiving heavy rainfall. Three main types of water will need to be managed at site:

- **Non-contact (clean) Water** - Water that does not come in contact with mining areas or wastes. Non-contact water includes water originating from the tidally influenced River Cacheu and its tributaries, water generated from pit perimeter dewatering wells, and runoff from stabilized or undisturbed/reclaimed areas.
- **Sediment-laden Water** - Water that originates from disturbed areas, which includes runoff from disturbed areas such as the active waste dumps and construction sites. This water type will be managed to remove sediment to acceptable levels, but otherwise the quality of this water is considered to be acceptable for discharge to the environment.
- **Contact Water** - Contact water is mine effluent that may be of adverse water quality (mainly metals) without treatment. Sources of contact water at the site include pit water (groundwater seepage that bypasses the dewatering wells, as well as direct precipitation falling into the open pit), tailings supernatant, and runoff and seepage from the TSF and waste dump WD-3b.

2.9.1 Management of Non-Contact Water

To limit the amount of water that needs to be managed, measures will be implemented to minimize the movement of non-contact (clean) water into active mining areas and construction sites. Management measures include the use of clean water diversion channels and flood protection bunds:

- **Clean Water Diversion Channels** - Diversion channels will be constructed to direct non-contact (clean) water away from construction sites and active mining areas. Temporary diversion channels will be constructed as outlined in the ESCP. Permanent diversions will be constructed to divert clean water around the open pits.
- **Flood Protection Bunds** - Flood protection bunds will be used to divert non-contact water away from each of the pits, as follows:
 - **River Cacheu Flood Protection Bund** - The footprint of the south pit lies partially within the tidal flood plain of the River Cacheu, which has a tidal range at the site of approximately 1.5 m. A flood protection bund will be constructed along the entire perimeter of the south pit where it borders the River Cacheu. This will be constructed in stages using temporary bunds. The bund will have a crest elevation of 4 m ASL and a toe width of 20 m. An erosion protection layer will be placed on the river side of the bund.
 - **North Pit Flood Protection Bunds** - The north pit will require the construction of two flood protection bunds during the initial stages of pit development, to keep the ephemeral Rio de Cavaras Marinhos and Rio de Bunja from flowing into the pit.

2.9.2 Management of Sediment-Laden Water

Sediment-laden waters will be collected and managed within the SCPs. Erosion will be minimized to the greatest extent possible to reduce the levels of sediment in runoff by following the mitigation measures outlined in the ESCP. Three sediment control ponds have been situated within the mine site footprint to manage sediment laden waters coming from the waste dumps, open pits and construction sites, as follows:

- SCP-1 - Runoff from inert WD-1 and contact water from ECP-1 only if discharge criteria are met
- SCP-2 - Runoff from the TSF and WD-3a
- SCP-3 - Runoff from inert WD-2

SCPs will also be required to manage runoff from the surcharge waste dumps (WD-4, WD-5 and WD-6). Water management plans for the surcharge waste dumps will require development during the next phase of engineering. It has been assumed that each of the surcharge waste dumps will require at least one pond of similar size to SCP-3. The current location and configuration of the surcharge WDs may need to change slightly to accommodate the required water management features.

Water will be allowed to discharge directly from the SCPs to the environment once concentrations of suspended solids meet the specific discharge requirements identified in the WAMP. Contingency measures to remove sediment include the use of flocculants, and if water quality monitoring identifies exceedances of discharge criteria for other parameters (i.e., metals), the SCP water can be directed to the treatment plant prior to discharge. Small quantities of water from SCP-1 may be utilized as make-up water in the process plant.

2.9.3 Management of Contact Water

As discussed above, sources of contact water at the site includes water from the open pit sumps, tailings supernatant, and runoff and seepage from the TSF and waste dump WD-3b. Contact water will be managed within two facilities, the TSF and ECP-1. The first priority is to return contact water to the process plant, as the process plant operates at a water deficit.

The TSF will generate a surplus of water throughout the year. During the dry season, all available tailings supernatant will be decanted and sent back to the process plant, and additional make-up water for the process plant will be derived from ECP-1 (containing contact water) and SCP-1 (containing sediment-laden water), in that order. During the wet season, there is a surplus of tailings supernatant that will require management.

Contact water is expected to require treatment before it is discharged to the environment. ECP-1 will receive the following contact water streams:

- Water from the open pit sumps
- Surplus tailings supernatant from the TSF (any surplus not recirculated back to process)
- Runoff and seepage from WD-3b

The water treatment plant will treat all contact water exceeding discharge criteria. Contact water meeting discharge criteria, prior to or after treatment, will be discharged to the River Cacheu via an outfall equipped with a suitably sized diffuser.

2.10 MINE SITE SERVICES

Details of associated infrastructure will be refined during the detailed design of the project, but will include the following:

- **Water Supply** - Groundwater will be used to satisfy process and potable water demands. Process water use is discussed in Section 2.5.7.
- **Post-Process Water Treatment** - A water treatment plant will treat and filter water from process, tailings supernatant, and other industrial wastewater streams including truck wash water. An event pond will be used for temporary storage of wash/process water.
- **Potable Water Treatment Plant** - A potable water treatment plant will filter and sterilize groundwater for potable consumption.
- **Sewage Treatment** - Human sewage will be disposed of in a suitably sized septic system.
- **Landfill** - A landfill will be constructed to dispose of solid, non-hazardous waste generated by the mine. The landfill will be located between the two pits and waste dumps WD-1 and WD-2 and will have a design capacity of 10,000 m³. The area will be fenced and cover material will be regularly applied over the waste. A portion of the fenced area not used for landfilling will be designated for the temporary storage of hazardous wastes requiring off-site disposal at a licenced facility, in accordance with the WMP.

- **Administration Building** - A single-storey administration building will be located near the main site entrance gate. The building will have a reception area, offices, meeting rooms, a main conference room, medical clinic, kitchenette and washrooms. The offices are for managers, engineers, geologists, and clerks.
- **Laboratory** - A laboratory will be used to test metallurgical accounting samples from the process plant, mining and exploration operations.
- **Kitchen/Dining Hall** - A plant kitchen and dining hall will include a seating area for up to 80 people with overhead fans, kitchen, and food storage.
- **Change House/Ablutions** - Two plant change house and ablutions buildings will be constructed and they will include separate male and female showers, bathrooms, and change room with lockers.
- **Workshop/Warehouse** - The combined plant workshop/warehouse, used to store and maintain equipment and parts will house mechanical, electrical, instrumentation and general items. Internal offices will be supplied adjacent to the warehouse for warehouse and maintenance staff.
- **Truck Shop** - A truck shop will service the mining fleet and include the necessary maintenance service bays as well as an office for supervision and planning. Initially, 4 truck bays will be required, but will be progressively expanded to 6 bays as the fleet requirement increases. The building will be a steel structure with metal cladding and a concrete slab on grade. A tire yard will be located adjacent to the truck shop.
- **Fuel Supply** - Diesel fuel is required primarily for the mining fleet, rotary dryer, and the power generation plants. Diesel fuel will be shipped to the Port of Bissau, and then transported via trucks to diesel fuel storage tanks at the Mine. Two storage tanks will be designed in accordance with the American Petroleum Institute API 650 standard, and will be within a secondary containment berm. One tank (10 m³ capacity) will dispense fuel to light vehicles, and the other tank (50 m³ capacity) will dispense fuel to the mining fleet. Any diesel spillages around the diesel area will be collected and transported to an oil/water separator. Separated oil will be disposed and separated water will be sent to site drainage.
- **Power Supply** - Electricity for the Mine Site will be supplied from four onsite 1.5 MW prime rated 11 kV diesel generators (3 duty, 1 standby).
- **Communications Systems** - Integrated voice and data network infrastructure will be provided. Radio sets will be provided for operations personnel.

2.11 MINE SITE ROADS

The Mine Site roads will be constructed, or at minimum surfaced with crushed waste rock from an aggregate source in Saltinho, located approximately two hours east of Bissau (Figure 1.2). Three main types of roads will be constructed within the Mine Site:

- Overburden haul roads capable of supporting 97-t capacity end-dump truck (180 t fully loaded)
- Ore haul roads that support a 36 t capacity end-dump truck (approximately 72 t fully loaded)
- General use access roads used for all other non-mining traffic

Additionally, it will be necessary to construct a village road around the northern extent of the Project, to replace village roads through the Mine Site that will be inaccessible to local villages during the life of the mine.

Several overburden and ore haul roads will be constructed and used for the life of mine, but many more will be constructed over the course of the operation phase in accordance with the mine plan.

2.12 PRODUCT TRANSPORT ROUTE

The Product Transport Route component of the Project consists of the following (Figure 1.2):

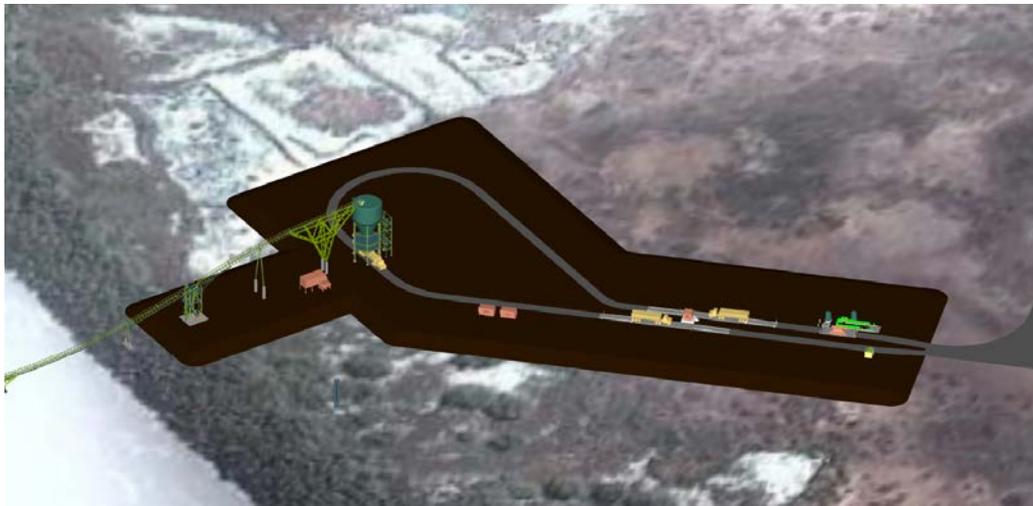
- A truck load-out facility located on the south side of the River Cacheu, consisting of an elevated bin to store and transfer product to trucks
- A 2-km gravel access road connecting the truck load-out facility to the existing paved highway
- A 68-km section of the existing paved road (highway) between Bissau and Dugal
- A 6-km gravel access road from the highway turnoff at Dugal to the Port Site

The load-out facility will consist of the following (Figure 2.12):

- 1,000 m³ live concentrate bin
- Truck wash station
- Weigh scales
- Fleet parking

A fleet of 47 - 31-t capacity end dump highway haul trucks will transport the concentrate to the Port Site via the proposed Product Transport Route. The trucks will operate 14 hours per day during daylight hours, from 6:00 a.m. to 8:00 p.m.

The maximum highway speed of 80 km/h slowing to 30 km/h within sensitive areas (village markets, roads close to residences, etc.) will be enforced, either by the local police force or by GB Minerals. The round trip time between the Mine Site and the Port Site for the highway haul trucks is 3.8 hours, including unloading, driving, unloading and break times. Each truck is expected to make 3 round trips per day. The truck fleet will transport a total of 4,331 t of product per day to the Port, for a total of 140 truck trips per day. The trailers will be covered to minimize dusting (Figure 2.13).



NOTES:

1. SOURCE: LYCOPODIUM, 2015a.

Figure 2.12 Truck Load-out Facility - Pictorial View

Drivers will be provided training according to “rules of the road” that will be developed by GB Minerals, to ensure driver compliance with corporate policies and procedures including adherence to speed limits, incident reporting, and emergency response.



Figure 2.13 Example Trailer for Road Transport of Product

In recent public consultation events held in villages along the product transport route, GB Minerals was requested to operate the product trucking operation during nighttime to minimize use of the road during the daytime when pedestrian and bicycle traffic dominates. While interactions with other road users would be reduced at night, additional risks are presented. GB Minerals remains open to considering this option, and intends to discuss the idea further with the relevant stakeholders.

2.13 PORT SITE COMPONENTS

The Port Site consists of product handling, processing and storage facilities, a wharf to facilitate ship loading, and ancillary buildings and infrastructure. Maintenance facilities to service the fleet of 47 end dump highway haul trucks will also be located at the Port Site. The Port Site area including the 6-km access road from the highway is shown on Figure 1.4. Figure 2.4 shows the plan view layout of the Port Site, and Figure 2.14 presents a pictorial view. The process design criteria specifying the material handling details at the Port Site are provided in Appendix 1B.4. Shiploading and shipping drawings are included in Appendix 1B.5.



NOTES:

1. SOURCE: LYCOPODIUM, 2015a.

Figure 2.14 Port Site - Pictorial View

The Port Site will be utilized exclusively for shipping product to the market and is not expected to be utilized for importing supplies and equipment required for the Project. Supplies and equipment will be handled at Bissau Port during all phases of the Project as discussed in Section 2.14.

2.13.1 Product Handling, Processing and Storage

Product will be delivered by 31-t haul trucks from the Mine Site at 8% moisture content. The product will be end-dumped onto a product unloading bin. A belt feeder will extract material from the product unloading bin onto a conveyor that will transfer the material to a stockpile located inside the product dryer shed. The covered product stockpile will have a capacity equivalent to 500 t or 16 truckloads.

Dust collectors will be installed at all material handling transfer points to prevent fine concentrate dust from entering the working environment and to minimize product loss. A rotary valve will discharge the collected dust back onto the closest concentrate belt conveyor, and clean air will be discharged to the atmosphere.

The ore is passed through a rotary dryer with hot air at 600°C, exiting the dryer at 105°C and 3% moisture. Hot air is produced by a burner through the combustion of diesel and air. Dried product from the rotary dryer will discharge onto a sacrificial conveyor and then onto a dried product travelling conveyor. The travelling conveyor will transport the dried product into a second product storage shed in which the material will be stockpiled until it is time for shiploading. The dried product stockpile in the product storage shed will have a live capacity of two ship loads which is equivalent to 60,000 t.

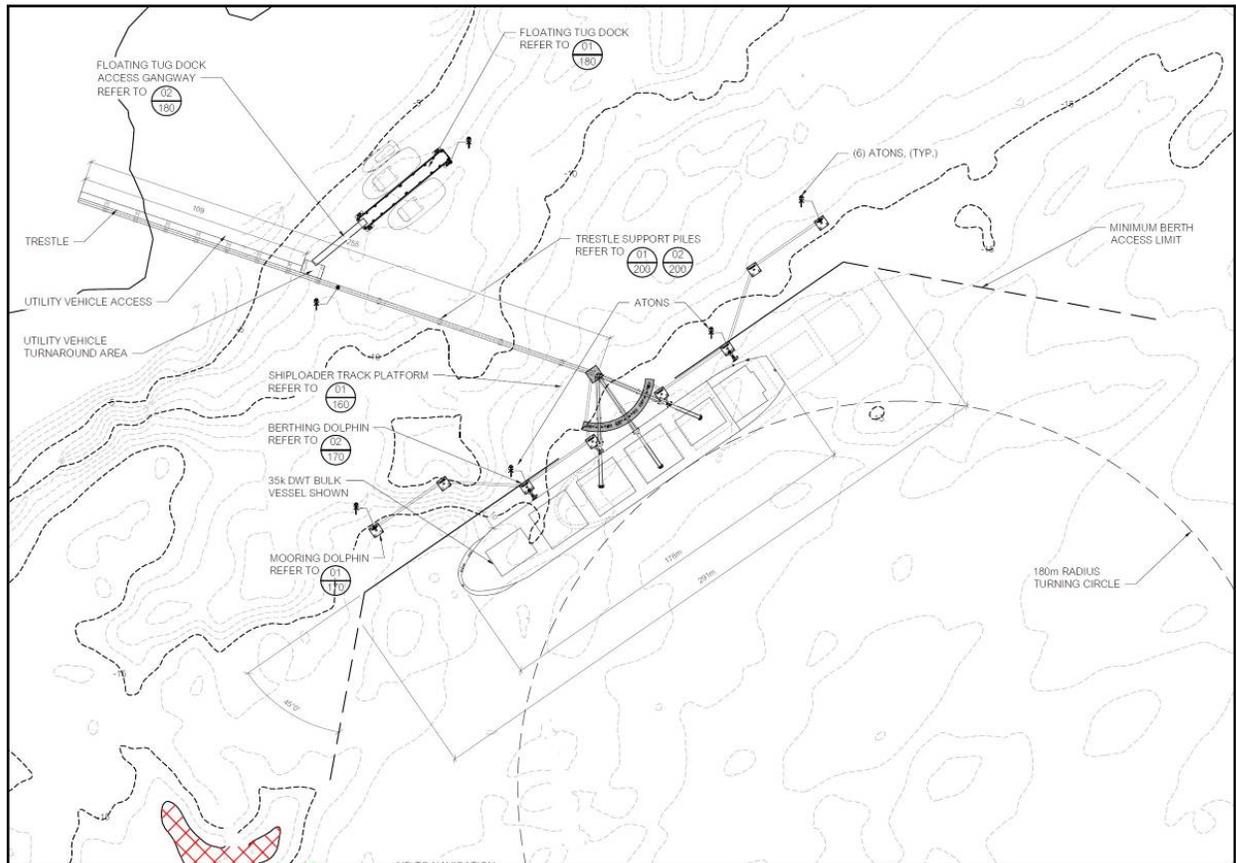
Hot rotary off-gas will be first treated in a dust collector to remove fine entrained product. A rotary valve at the bottom of the dust collector will return the fine product collected back to the product dryer feed periodically to reduce concentrate loss. Cleaned hot gas from the dust collector is fed into a scrubber where raw water is used to reduce off-gas temperature for condensing the moisture in the

off-gas. Condensate combined with the scrubber water will be collected in a scrubber seal tank and pumped to the port storm water settlement pond. Cooled scrubber off-gas will be discharged to the atmosphere.

A truck wash station is provided at the port near the entrance of the product storage area to wash the product dump trucks before entering the product storage area. The under body and wheel wash will have a drive-through concept where the trucks will drive through the station at 5 km/h with no stopping required. Water from the truck wash will pass through an oil water separator before it is directed to the storm water management system.

2.13.2 Wharf Details and Construction

The wharf was designed to extend approximately 200 m into the River Geba, reaching a sufficient depth of water to allow 30,000 to 35,000 deadweight tonne (DWT) capacity bulk carriers to berth at the Port. The wharf layout is shown on Figure 2.15.



NOTES:

1. SOURCE: BAIRD, IN LYCOPODIUM 2015a.

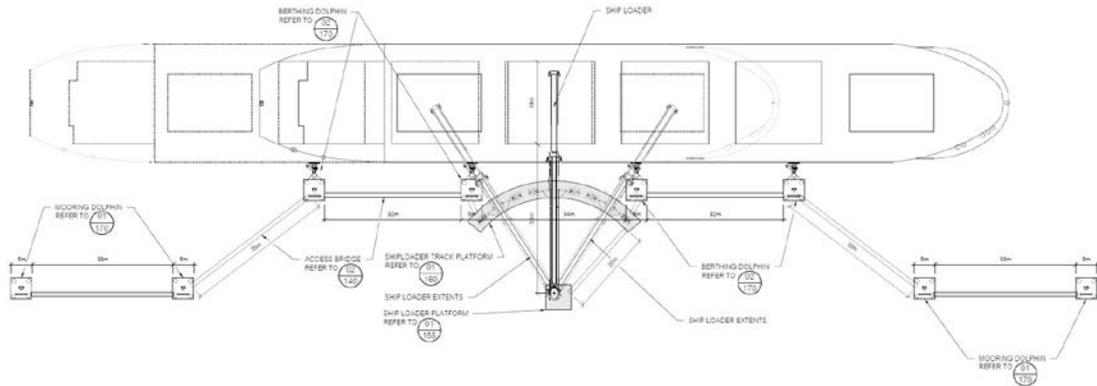
Figure 2.15 Wharf Layout

The wharf is shown in plan and cross section on Figures 2.16 and 2.17, respectively. The primary elements of infrastructure making up the direct load wharf follow (Baird, 2015):

- Steel pile bents to support the conveyor and truss system delivering phosphate to the wharf. Bents are constructed with two 600 x 16 mm pipe piles with opposing 1H:6V batters.
- Two steel pile supported platforms are used to support a single telescoping radial shiploader. The curved shiploader track platform is 4 m wide and approximately 47 m long on the outside arc. The platform is supported by nine bents of 600 x 16 mm pipe piles with opposing 1H:6V batters. Three HP360 x 152 beams are welded together to form the bent caps on which the superstructure is directly attached. The platform deck consists of five W360 x 122 steel beams evenly spaced and laterally restrained with heavy-duty steel grating.
- Four steel pile supported mooring dolphins. Each dolphin incorporates four 1,000 x 25 mm pile piles with 1H:6V vertical batters. The steel pile cap doubles as a driving template and is fabricated with 1,100 x 25 mm pile sleeves and 800 x 19 mm cross bracing. The central bollard mount consists of a 1,200 x 25 mm pipe fully grouted and sealed with 25 mm top and bottom plates. Steel grating is used as a permeable walking surface.
- Four steel pile berthing dolphins with steel decks. The berthing dolphins are identical to the mooring dolphins except for the addition of a braced 1,000 x 25 mm vertical pile. A parallel motion fender with two 800 mm Grade 3 rubber cones and a 2.5 x 5 m fender panel is affixed to each vertical pile through field-welded brackets.
- Steel gangways providing access to the mooring and berthing dolphins for stevedores.
- A floating wharf to moor tugs and the pilot boat. It is anticipated that all service vessels will be fuelled from the floating wharf.
- Guide piles and a graded access ramp for loading and unloading of a maintenance barge. Note this facility is recommended as there is no vehicular or heavy equipment access out to the wharf. As such, floating barge will need to be utilized in the event of breakdown. The maintenance barge will also be critical to maintain aids to navigation.
- Required aids to navigation at Ponte Chugue and along the anticipated navigation route.

The wharf was located east of the point at Ponte Chugue so that the facility could be both close to shore and vessels could still avoid the shoal. The facility is generally aligned with the -15 m contour.

The facility, and thus the vessel at berth, is generally aligned with the tidal currents, which reduces the tendency of the current to draw the vessel away from or onto the berth. In addition, it should minimize the amount of vessel motion during loading making for a safer warping operation. Warping is the practice of moving a vessel by hauling on a line fasted to or around anchors or piers.

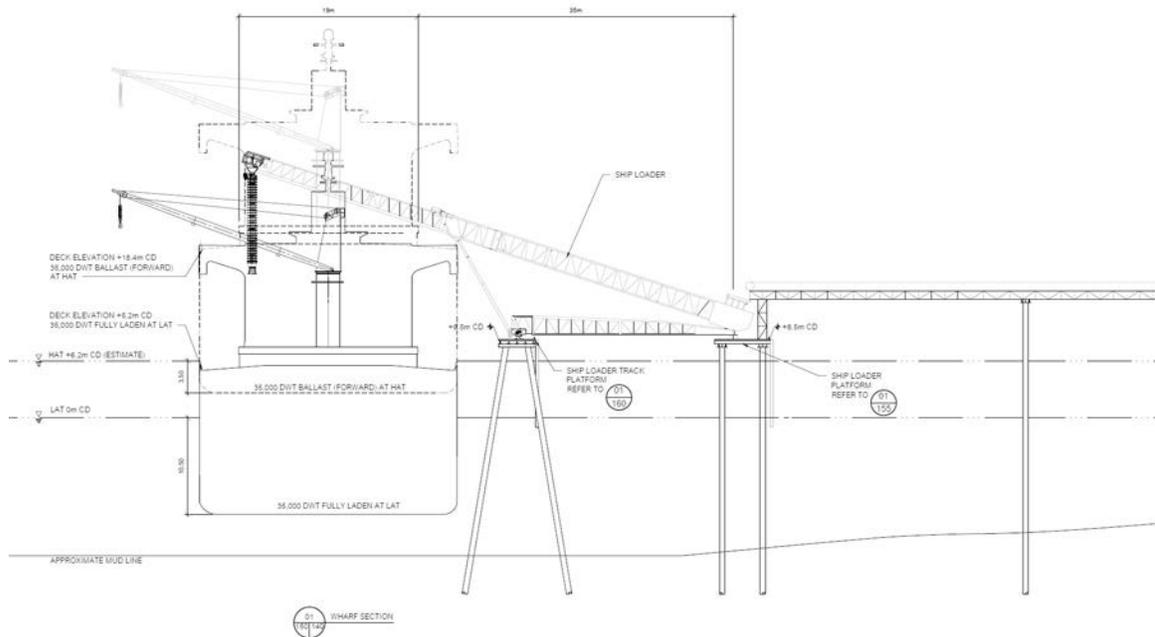


NOTES:

1. SOURCE: BAIRD, IN LYCOPODIUM 2015a.

Figure 2.16 Wharf in Plan View

Construction of the wharf will require extensive piling. Pile driving will be completed from barges and will be a challenge given the current and tide conditions at the site, and therefore specialized expertise will be required.



NOTES:

1. SOURCE: BAIRD, IN LYCOPODIUM 2015a.

Figure 2.17 Wharf in Cross Section

2.13.3 Shiploading Product

Bulk carrier vessels with a capacity of 30,000 to 35,000 DWT will arrive dockside with the assistance of one or two tugs, as well as a dedicated pilot.

When a ship is berthed, front-end loaders will transfer dried concentrate from the storage shed into three concentrate hoppers. Each concentrate hopper will be equipped with its own belt feeder for a regulated delivery of concentrate onto the port concentrate load-out conveyor. A belt weightometer will be installed on the load-out conveyor to accurately measure the tonnage of concentrate being loaded onto the ships. Reclaimed concentrate from the load-out conveyor will discharge onto the port concentrate shiploader. The port concentrate shiploader will be a traversing shiploader with luffing and shuttling boom which allows the ship to remain in one place during concentrate loading.

A centralized dust collector will be installed at all material handling transfer points to prevent fine concentrate dust from entering the working environment and to minimize product loss. A pneumatic conveying system will transfer the collected fines to a ribbon blender where the dust will be mixed with a wetting agent to increase the bulk density of the fine particles and hence preventing the fines from becoming airborne. Treated fines will be collected in a hopper and a belt feeder under the hopper will transport the material to the dried concentrate conveyor. Cleaned air from the dust collector will be discharged to the atmosphere.

The shiploading system will have a nominal capacity of 630 t/h and maximum capacity of 1,200 t/h. Each ship will have a 35,000 DWT concentrate capacity. To transport an annual concentrate tonnage of 1.32 Mt, a total of 38 shipments will be required each year. This equals roughly one ship every 8 days. Each ship will require 48 hours of loading time.

A similar wharf and direct load operation is shown on Figure 2.18.



NOTES:

1. SOURCE: BAIRD, IN LYCOPODIUM 2015a.

Figure 2.18 Example Shiploading Operation

2.13.4 Support Vessels

A fleet of support vessels will be required at Ponte Chugue to transport the pilot to and from bulk carrier, safely berth and de berth the vessel at the wharf, and to warp the vessel while at berth. Further description is provided below.

Tug Boats

Tugs will be required at Ponte Chugue to assist the bulk carrier into the berth and to warp the bulk carrier along the berth during loading. The tugs will be sized to handle the wind and potentially large current speeds at Ponte Chugue.

Pilot Boat

A Pilot boat will be required to transport the pilot from Ponte Chugue to the pilot pick up point, where the pilot will board the bulk carrier and return him to Ponte Chugue following outbound transit. Pilotage is standard practice at ports and river passages throughout the world. The use of a pilot significantly reduces the risk of vessel accident, as the pilot will gain considerable knowledge concerning the local environmental conditions of the river (waves, currents, winds, and hydrography) through repeated vessel navigation.

Local pilots for the Port of Bissau currently board vessels at Ponta de Caio (approximately 60 nautical miles (nm) from Ponte Chugue). It has been assumed that the dedicated Farim pilot will board at a similar location.

Maintenance Barge

A Maintenance Barge (crane barge) is needed to maintain the navigation aids and provide floating access to the direct load infrastructure in the event of damage or breakdown.

2.13.5 Port Operations

A general description of the port operation of the direct load terminal follows:

- Pilots will board the pilot boat at Ponte Chugue and sail to the pilot boarding location near Ciao. The ocean going vessel will then be piloted 60 nm to Ponte Chugue.
- Vessels ranging from 30-35,000 DWT will navigate the river, arrive at the facility, be berthed bow west, with tug assistance, and will undergo draft survey.
- Mooring lines will require nearly constant tending during loading to accommodate the changing tide.
- As the wharf utilizes one radial telescoping shiploader, the bulk carrier must be warped or shifted along the wharf throughout the loading process to access all the bulk carrier's holds. Warping requires careful preparation and a full mooring party available at the wharf and crew aboard the ship. If the ship moves off the wharf during warping, the bow or stern can swing in to the quay resulting in damage to the bulb, rudder, propeller, or to the wharf.
- Warping will be achieved with tug assistance.
- Warping will not be permitted after nightfall. In general, the vessel will be warped at dusk and can continue loading into the night until another movement is required.
- Vessel loading will be suspended during the rain to preserve the moisture content of the material.

- Following loading, the vessel will undergo another draft survey before deberthing under tug assist.
- Pilots will navigate the laden vessel 60 nm from Ponte Chugue to the pilot boarding location near Ciao. The pilot will then disembark and return to Ponte Chugue via the pilot boat.

Average bulk carrier turnaround-time (time the vessel is onsite) was estimated considering waiting berth, rain downtime, holidays, berthing, loading, draft survey and deberthing, and waiting until daylight to warp the vessel. The average turn-around time per vessel is approximately 3.5 days.

2.13.6 Ship Navigation

Bulk carriers calling on the Ponta Chugue Port Site requires navigation of the River Geba 60 nm to Ponte Chugue by bulk carrier. Establishing that a safe navigation route exists to access Ponte Chugue and the proposed transshipment locations is of critical importance for the feasibility of the export project. Previous study of the navigation route by Baird in 2012 (Baird, 2012) included:

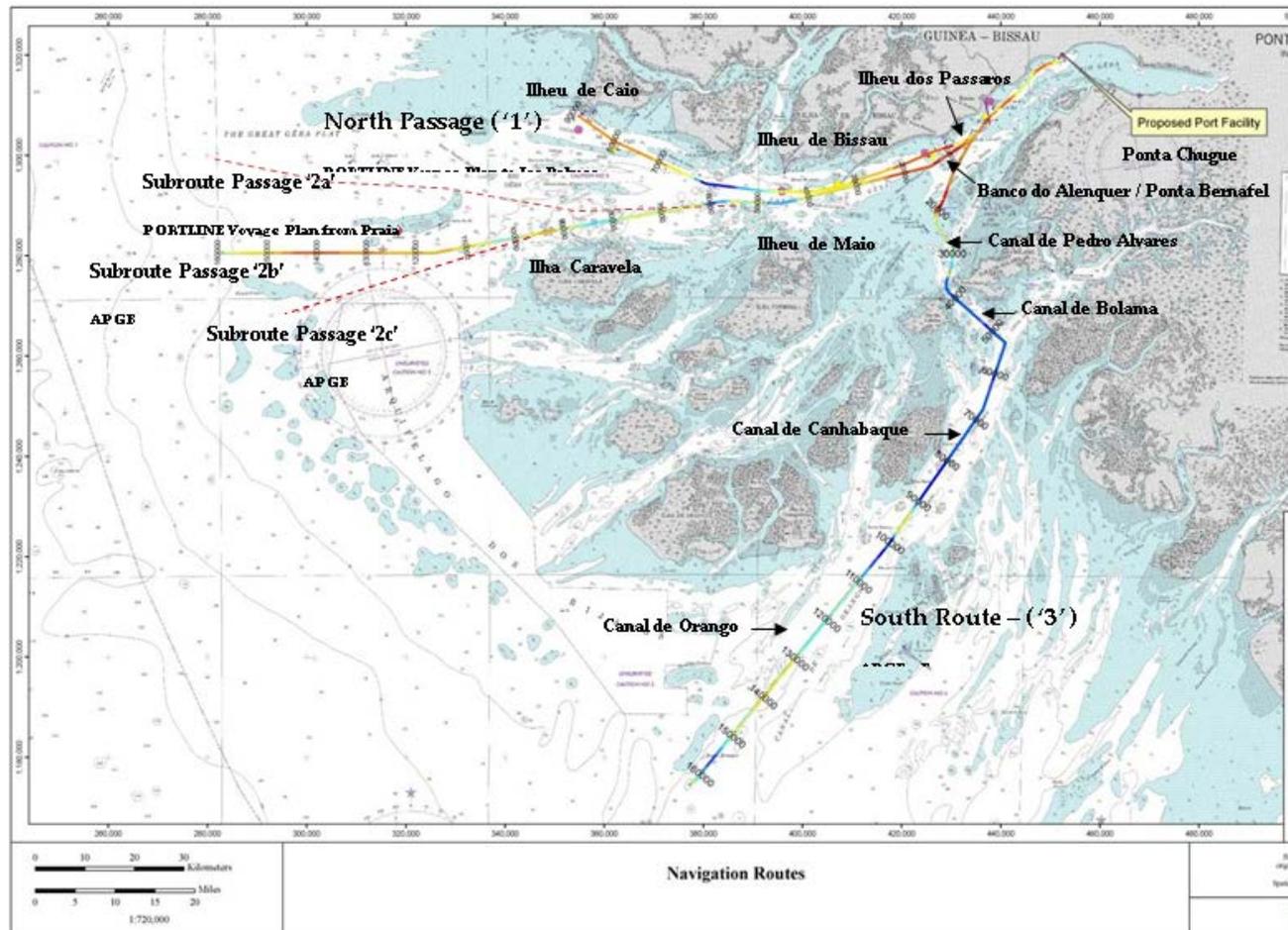
- A literature search pertaining to the existing navigation of the Geba estuary (Geba Channel).
- Interviews with local administrators and pilots from the Administration of Ports of Guinea-Bissau (APGB) and Portline Transportes Marítimos Internacionais, S.A. (Portline) based in Lisbon, Portugal, currently sailing to Bissau.
- A hydrographic survey by Coastal Consulting & Exploration (CCE), covering the project site at Ponte Chugue and a length of the River Geba from Ponta Chugue to Banco do Alenquer.

Several routes from the ocean to Ponta Chugue, identified as Routes 1, 2a, 2b, 2c and 3 on Figure 2.19, were evaluated based on available information. Navigation sub-routes 2a, 2b, 2c and 3 were discounted from further consideration due their shallow charted depths and general lack of information. The north route (Route 1 on Figure 2.19) to Bissau via the Canal de Caio was assumed as the main shipping route.

Beyond Bissau to the Ponta Chugue Port Site, hydrographic survey taken by CCE in 2012 consists of detailed coverage at Ponte Chugue and several lines from Ponta Chugue to Banco do Alenquer (Figure 2.20). Survey data were not gathered west of the approach to Bissau, hence a significant length of the navigation route does not have recent survey coverage. This represents a Project risk to be addressed through additional hydrographic surveys during the detailed engineering design phase of the Project.

The available depth along the north navigation route from the ocean to Ponte Chugue varies considerably, as does the tide, which ranges between 3 m at the most eastern end of the Canal de Caio and 6 m near Ponte Chugue.

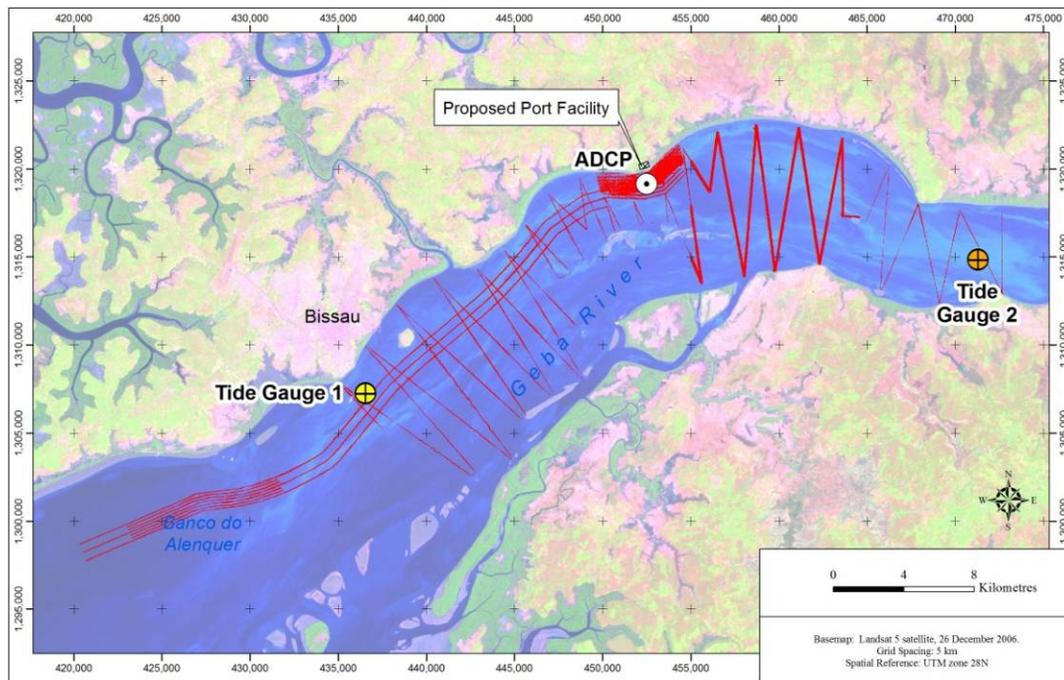
Baird (in Lycopodium, 2015a) used modelling to assess allowable vessel departure draft. The model established that vessels with laden drafts less than or equal to 10.1 m (generally vessels $\leq 35,000$ DWT) can depart from Ponte Chugue 100% of the time, meaning that they are not tidally constrained. A substantial number of 35,000 DWT ships worldwide have drafts less than 10 m which would not be tidally restricted to enter Ponta Chugue. A smaller number of 35,000 DWT ships worldwide have drafts of between 10 and 10.5 m, and these ships would be able to sail to the Port Site about 94% of the time without consideration of tides. As such, it is acceptable to consider these vessels part of the available fleet for the Project (Baird, in Lycopodium, 2015a).



NOTES:

1. FROM BAIRD, IN LYCOPODIUM, 2015a.

Figure 2.19 Potential Shipping Routes to Ponta Chugue Port Site



NOTES:

1. FROM BAIRD, IN LYCOPODIUM, 2015a.

Figure 2.20 2012 Hydrographic Survey at Ponta Chugue

2.13.7 Port Site Services

Details of associated infrastructure will be refined during the detailed design of the project and will include the following:

- **Water Supply** - Groundwater will be used to satisfy process and potable water demands. Truck washing is the main industrial water use at the Port. The total raw water requirement at the Port is 19 m³/h. A water treatment plant will filter raw water for all uses, and a subsequent potable water treatment plant will treat the water to potable standards.
- **Stormwater Ponds** - The effluent treatment system will consist of a storm water settlement pond, a storm water storage pond, and an effluent treatment plant. Effluent from the port area such as site drainage, dirty truck wash water, dryer scrubber water and water treatment plant effluent will be sent to the settlement pond. Overflow from the settlement pond will be sent to the storage pond. Clean water from the oil/water separator and effluent from the sewage water plant will also report to the storage pond. Water from the storage pond will be pumped to the effluent treatment plant. Sludge produced by the effluent treatment plant will be disposed. Treated effluent from the effluent treatment plant will be discharged to the shoreline to report to the River Geba.
- **Sewage Treatment** - Human sewage will be disposed of a suitably sized septic system.
- **Landfill** - Solid non-hazardous waste generated at the Port will be transported to a licenced disposal facility in Bissau, if such exists, or will be backhauled for disposal in the Mine Site landfill. An area within the fenced Port Site will be designated for the temporary storage of

hazardous wastes requiring off-site disposal at a licenced facility, in accordance with the Waste Management Plan (Volume 3).

- **Administration Building** - A single-storey administration building will be located near the Port Site entrance gate. The building will have a reception area, offices, meeting rooms, a main conference room, medical clinic, kitchenette and washrooms. The offices are for managers, engineers, and wharf personnel. A parking lot and transport and pick-up area is located adjacent to the administration building.
- **Wet Concentrate Shed** - A wet concentrate shed where the product will be unloaded and dried to 3% moisture will be situated at the Port Site.
- **Dry Concentrate Shed** - There will be a dry concentrate shed where final product will be stored for shiploading. On ship arrival, the product will be unloaded via front end loaders onto a conveyor feeding the shiploader.
- **Kitchen/Dining Hall** - A port kitchen and dining hall equipped with a seating for up to 20 people with overhead fans, kitchen, and food storage.
- **Change House/Ablutions** - Two plant change house and ablutions buildings will be constructed and they will include separate male and female showers, bathrooms, and change room with lockers.
- **Workshop/Warehouse** - The combined plant workshop/warehouse, used to store and maintain equipment and parts will house mechanical, electrical, instrumentation and general items. Internal offices will be supplied adjacent to the warehouse for warehouse and maintenance staff.
- **Shipping Control Room/Sample Building** - A combined shipping control room and sample building, to be used to check product moisture levels and store shipping records.
- **Power Supply** - At the Port Site, the power plant will consist of three onsite 0.5 MW diesel generators (2 duty, 1 standby).
- **Fuel Supply** - Diesel fuel is required primarily for the road haulage fleet, product dryer, the tugs and pilot vessel, and the power generation plant. Diesel fuel will be shipped to the Port of Bissau, and then transported via trucks to diesel fuel storage tanks at the Port Site. Two 600 m³ capacity storage tanks will be designed in accordance with the American Petroleum Institute API 650 standard, and will be within a secondary containment berm. A third 20 m³ capacity tank will dispense fuel to vehicles, and a fourth (36 m³ capacity) will be a day tank located at the rotary dryer. Fuel dispensing facilities will be located on the wharf at the tug dock. Appropriate spill response equipment will be positioned at the Port Site, and any diesel spillages around the diesel area will be collected and transported to an oil/water separator. Separated oil will be disposed and separated water will be sent to site drainage.
- **Communications Systems** - Integrated voice and data network infrastructure will be provided. Radio sets will be provided for operations personnel.
- **Roads** - Roads will be constructed of crushed waste rock from an aggregate source in Saltinho. The on-site roads are designed to connect the various port facilities. The off-site gravel road is approximately 6 km in length and connects the port facilities to the existing paved highway.

2.14 SITE ACCESS FOR RESUPPLY

Materials and equipment destined for either the Mine or the Port Sites will arrive to Guinea-Bissau mainly through the Port of Bissau. During construction, a portion of materials and equipment will likely also come from Senegal through the road arriving into Farim from the northwest through the village of Sara Ioba. A detailed estimate of the traffic expected during the life of the Project is provided in the Traffic Impact Assessment (Section 18).

Access to the Mine Site for resupply will be mainly using the highway from Bissau and using the ferry crossing at Farim. Oversized equipment delivered during construction and periodically during the operation and closure phases will be transported over an alternate route to the east that uses the bridge crossing of the River Cacheu at Sao Vicente. As a major user of the through road from Farim to the mine as well as the highway from Bissau, it will be necessary for GB Minerals to conduct road maintenance during the life of mine.

2.15 SECURITY

Site security requirements will be provided by a locally contracted private security company during the construction, commissioning, and operational phases of the Project. A perimeter fence will be installed at the Project fenceline as shown on Figure 1.3, once resettlement activities have been completed. Site security will monitor the fenceline for evidence of unauthorized entry, as a means of ensuring public safety. Safety berms will be included on all haul roads. These berms are designed to contain heavy vehicles and restrict access.

The lease area will be patrolled by security staff to prevent access of unauthorized personnel. Access control will be implemented and, where necessary, alternative access routes will be provided to members of the local community. A system to clear visitors will be initiated before construction and/or prior to the commencement of operations. Visitors will only be granted access with prior approval from the General Manager or any of his section managers.

Security management will be responsible for ensuring the safety and security of both the work force and the local communities. This will involve dialogue with local communities, community representatives and officials.

2.16 BORROW SOURCES

The aggregate for road upgrade and new construction will mostly be taken from an aggregate source in Saltinho, which is located approximately two hours east of Bissau. The Saltinho quarry is expected to have all the necessary permits for aggregate supply, and material will be tested if necessary to confirm that it will meet requirements.

2.17 CLOSURE PHASE OVERVIEW

2.17.1 Closure Planning Process

Closure planning is an integral component of the Project. Reclamation will be carried out at the end of the operation phase over a two year active closure period, in accordance with the MRCP. Mine closure would also be implemented should the mine close prematurely at any time during the life of the Project.

An approximate 5-year post-closure monitoring period will follow active closure, and will consist of environmental and social monitoring to ensure mine closure objectives have been met, including achieving physical and chemical stability across the Project sites. The MRCP gives due consideration to the re-establishment of sustainable livelihoods within the future mine and port footprints as the target endpoint.

The mine closure planning process occurs in stages:

- Stage 1 - Compilation of a preliminary MRCP as part of the ESIA.
- Stage 2 - Preparation of revised Interim MRCPs at regular intervals during the Project life.
- Stage 3 - Engineering design of stated closure measures, based on the latest Interim MRCP and following significant changes to the Project or information base.
- Stage 4 - Finalization of the MRCP, at least two years prior to the end of mine life, taking account of previous work and consultation with stakeholders.

2.17.2 Preliminary Closure Plan

The closure objectives adopted by the Project are as follows:

- Not compromise future public health and safety
- Ensure the after-use of the site is beneficial and sustainable to the affected communities in the long term
- Minimize adverse socioeconomic impacts and maximize the Project's socioeconomic benefits
- Establish the estimated cost to implement the MRCP and the identify the funding sources to implement the plan
- Commit to establishing the preferred beneficial future land use through a multi-stakeholder process, and reflecting this input in future revisions to the MCRP
- Maximize progressive reclamation opportunities to reduce environmental liabilities and financial assurance requirements throughout the mine life
- Meet national regulatory requirements and adopted international guidelines
- Conduct post-closure monitoring for a period of time appropriate to the risks; at a minimum for 5 years after closure

The first five objectives listed above are adopted from the IFC (2007a) and The World Bank (2009), and the final objective on post-closure monitoring is adopted from the ICMM (2008). These high-level objectives will become more specific as the Project proceeds and subsequent interim MRCPs are prepared, incorporating project and site conditions at that time, as well as input from stakeholders.

The MRCP contemplates the progressive rehabilitation of a number of facilities at the Mine Site including the WDs and the north and south open pits. The south pit and the majority of the north pit will be backfilled with waste overburden. A portion of the north pit will not be backfilled; the void in the north pit will be allowed to flood to form a small pit pond at closure. The TSF/WD-3a/WD-3b and the onsite landfill will be capped with a suitable engineered cover to prevent water ingress. Buildings, machinery and equipment will be decommissioned and removed from site for salvage or resale. Disturbed areas will be covered with stockpiled topsoil and revegetated. As much as practically possible, the land will be restored to provide stable landforms suitable for the agreed-upon future beneficial land uses.

At the Port Site, buildings, machinery and equipment will be decommissioned and removed from the site. Remediation will be undertaken, as required, so that the Port Site is compatible with future commercial or industrial land uses. The wharf structure will not be decommissioned, under the assumption that the Government or other private interests will wish to assume control of the site for future beneficial use.

Post-closure monitoring and maintenance will take place for a period of at least five year to verify that the site has been returned to a physically and chemically stable state that is compatible with and capable of sustaining the agreed upon final land uses. Furthermore, the MRCP commits to developing post-closure social management plans to address potential adverse socioeconomic impacts of closure as part of the company's future Community Development Plan.

2.18 WORKFORCE AND WORKER ACCOMMODATION

GB Minerals aims to employ citizens of Guinea-Bissau as much as possible, including those from the local area. This will benefit both the Republic of Guinea-Bissau, in terms of creating jobs and passing on skills, and the Project in terms of benefiting from a cost-effective and motivated workforce familiar with working in conditions such as those found at the proposed Mine Site.

2.18.1 Construction Phase Workforce

The Project's workforce requirements for the construction phase will include a variety of disciplines. A large proportion of the workforce will be comprised of general, unskilled labourers, with specialized skilled workforce (e.g., management, supervisors, electricians, mechanics, etc.) utilized for specific, short-term assignments as required throughout the construction phase. There will be an emphasis on local employment in as many skill levels as possible, but during the construction phase it will be necessary to rely more heavily on skilled expertise from elsewhere. The estimated construction phase workforce for each Project component is presented in Table 2.5.

During construction, a 150-person capacity temporary camp will be established within the Mine Site fenceline to house workers originating from outside of Guinea-Bissau. Local workers residing in Farim will be bused to the Mine Site. The camp will be serviced with treated potable water from a well and a septic system. The Mine Site landfill will be used for disposal of solid, non-hazardous waste.

2.18.2 Operation Phase Workforce

The operational phase workforce consists of Mine Site staff, Port Site staff, and office staff located in Bissau. The Mine Site workforce varies considerably over the operation phase, depending largely on the amount of waste overburden to be stripped in a given year in the mine plan. The minimum, maximum and average number of workers employed at each of the Project components and in total by the Project during the operation phase is summarized in Table 2.6.

Table 2.5 Construction Phase Workforce Estimate

Project Area	Skilled Expatriate Workers	Unskilled Local Labour	Peak Number of Workers
Mine Site	150	150	300
Port Site	65	60	125

Table 2.6 Operation Phase Workforce Estimate

Project Area	Min. No. of Workers	Max. No. of Workers	Average No. of Workers
Mine Site	180	528	370
Product Transport Route (drivers)	--	--	70
Port Site	--	--	58
Totals	556	818	660

A breakdown of the operations workforce by skill level for a typical operation year is provided in Table 2.7. Year 13 of operations is estimated to have 703 workers total and was selected as the basis of a typical year based on having a mid-range number of workers.

Table 2.7 Operation Phase Workforce Composition (Year 13)

Project Area	Skill Level 1 Professionals	Skill Level 2 Occupation-Specific Training	Skill Level 3 Operators and Labourers
Position Descriptions	University Education (i.e., Geologist); Managers; Trades	Supervisors, Clerical, Trades Assistants	Equipment Operators; General Labourers, Helpers
Administration	37	4	4
Mining	32	143	267
Process	17	30	28
Product Transport	-	-	70
Port Site	5	7	59
Totals	91	184	428

During operations, new national employees will be encouraged to relocate with their families to the town of Farim (or other, if identified by the Project) close to the Mine Site. Suitable transport arrangements will also be made available to those employees. A permanent accommodation village will also be established outside of Farim to house approximately 25 expatriate Mine Site employees. This village will provide accommodation and necessary services (e.g., food, ablutions, and laundry and recreation facilities) during all Project phases. Bus transportation will be provided between Farim and the Mine Site. Transportation will also be provided for rotational leave, based on the terms defined in employee contracts.

Workers employed at the Port Site during all Project phases will be expected to reside in Bissau, or a nearby village. Bus transportation will be provided between Bissau and the Port Site.

A small number of administrative employees will be based in Bissau in support roles (e.g., to carry out purchasing, logistical, and administrative functions). These personnel will generally live at home and will not work shifts.

2.18.3 Closure Phase Workforce

The closure phase workforce has not been estimated but can be expected to resemble the construction phase workforce. After 26 years of operation, it is reasonable to expect that nearly all positions will be filled by local mine personnel.

2.18.4 Training and Localization Plan

As the mining sector is a new area of business for the Republic of Guinea-Bissau, not all the skills required for the Project will be available. Where this is the case, the Project will initially employ expatriate employees. These will be selected partly on the basis of their ability to help train the Guinea-Bissau employees over time so they are able to take on more senior roles. GB Minerals will develop and implement a localization plan to transfer knowledge and utilize local talent, as part of a larger Human Resources Management Plan.

3 – LEGAL AND INSTITUTIONAL FRAMEWORK

3.1 APPLICABLE NATIONAL LEGISLATION

The Constitution of Guinea-Bissau establishes sovereign rights for the Republic of Guinea-Bissau for the preservation or exploitation of living and non-living natural resources. Further to the constitution, a number of laws related to environmental protection and management have been passed. The legislation most relevant to the Project is summarized below, and all national legislation identified as being relevant to the Project is summarized in Appendix 1F.

Mining and Minerals Law

Law 1/2000 (the Mining and Minerals Law) regulates all issues related to the exploration and commercial production of mining substances that exist in the soil or subsoil and in the territorial waters, with the exception of oil. All mining resources in Guinea-Bissau belong to the State and property rights and the issuing of licenses/permits is the sole responsibility of the government. The Mining and Minerals Law sets out the procedures which enable individuals and entities (national or foreign) to be issued with mining leases, licenses, and rights.

Basic Law on the Environment

Guinea-Bissau has developed a framework law on the environment that lays the foundation for environmental policy and environmental assessments. Law No 1/2011 of 2 March 2011 approves the Basic Legislation on the Environment. This law defines the basic concepts, norms, and principles related to the protection, preservation and conservation of the environment. It aims to improve quality of life through the management and rational use of natural resources, to achieve the sustainable use of such resources.

Environmental Assessment Law

Law 10/2010 (the Environmental Assessment Law) regulates environmental and social impact assessment in Guinea-Bissau. The Environmental Assessment Law sets out the types of projects for which an ESIA is required. The project categories are consistent with the World Bank Group's Equator Principle 1 and the IFC's practices. The Project is classified as a Category A project due to the potential for negative impacts. As such, a full ESIA needs to be completed for this project.

Law 10/2010 details the ESIA processes to be followed, requirements for public consultation and disclosure, the components of the studies to be undertaken and resulting reports, and the government agencies that will be involved in the assessment process. Articles 17 through 20 presented below are requirements specified in the draft TOR (GB Minerals AG, 2015; Appendix 1C):

Article 17 - Non-Technical Summary

- 1. The technical summary must contain at minimum key significant adverse effects of projects, alternatives, attenuation measures, and recommendations.*
- 2. The text must be written in plain language, must be signed by the licence holder/owner and the contracted experts executing the EIA.*

Article 18 - Contents of Report

1. ESIA must contain:

- a) *Concise description of the national environmental law and other regulations and guidelines governing in ecological terms and socio economic the basic factors and other development activities relevant that may affect the project*
- b) *Description of the objectives of the project*
- c) *Process and technology to be implemented*
- d) *Materials to be used in construction and during implementation of the project*
- e) *Products and bi-products of the project*
- f) *Localisation and the area of influence of the project*
- g) *Description of the conditions and potential of the environment being affected*
- h) *Environmental effects and socio-economic direct and indirect, including cumulative and irreversible, long, medium and short terms*
- i) *Alternative technology and possible processes, the reasons for preferred option chosen, alternatives to the location considered and reasons for the choice of the proposed location*
- j) *Preventative measures to prevent high risks and harm to human health and ensure safety in the work environment for employees and emergency management*
- k) *Identification of failures in knowledge and the uncertainties that were found in the compiled information*

2. The TOR will further detail the contents of the ESIA and the required plans.

Article 19 - Content of the environmental and social management plan

The Environmental and Social Management Plan of the Project needs to describe the measures to eliminate; minimize or attenuate; compensation and the various impacts including costs, timing and responsibility of each part in the implementation and should contain at least the following elements:

- a) *The attenuation/mitigation factors for the damages: should define the viable measures / feasible and economic and susceptible to replace the potential effects on the environment and human health and should prevent the compensatory measures when the attenuation measure are insufficient.*
- b) *Environmental monitoring: needs to ensure during and after the execution of the project to supply the crucial information of the environmental aspects, namely the effects on the environment, the effectiveness of the applied attenuation/mitigation measures should allow the project owner and interested parties to take corrective measures.*
- c) *Capacity building and training: to guarantee execution in a desired timeframe. The environmental component of the project and the attenuation measures of the plan are based on the estimate made by annexures in relation to the capacity of the environmental services censured.*

- d) *Execution Calendar of the measure to be undertaken and estimation of costs for the attenuation of the damage, environmental monitoring, and capacity reinforcements that adopt the plan:*
- i. *An execution calendar of the measures under the scope of the project. Indicating intervals and its execution plan of the project as a whole*
 - ii. *An estimate of the cost of investment and operation, indicating the sources of the necessary funds for their implementation*

Article 20.0 - Attachments

In the annexures all other information may be entered which in one way or another help the responsible authorities in clarifying the situation: This includes:

- a) *List of CV's of all involved in in elaborating the ESIA*
- b) *Meetings Minutes, consultations, opinions and files of the surveys*
- c) *Tables of relevant data, maps, photos that are not in the report*
- d) *Location of Plant, architecture of the activity and or building*
- e) *List of related reports*

Prior to the above legislation, Guinea-Bissau adopted the Decree-Law No. 5-A/1992 establishing the Water Code (Guinea-Bissau, 1992). The Water Code objectives include the following:

- Defining the legal regime of all activities relevant with water management
- Defining the institutional framework to implement national policy on water rights, guaranteeing the control and management of water resources
- Regulating water uses
- Guaranteeing the protection of the water quality in order to avoid freshwater pollution or its waste

The Water Code does not adopt end of pipe or receiving water quality objectives.

3.2 NATIONAL ENVIRONMENTAL ASSESSMENT PROCESS

The key national regulatory authorities involved in permitting and environmental management of extractive industries are as follows:

- Ministry of Energy and Natural Resources - Regulates the mineral industry in Guinea-Bissau, implements its mining policy and regulations, issues mining leases, and develops geological studies and maps.
- Secretary of State of Environment and Tourism - Responsible for implementing Guinea-Bissau's environmental policy.
- Célula de Avaliação de Impacte Ambiental (CAIA) - The lead authority responsible for coordinating review of the Project's ESIA. This department is responsible for ensuring, through collaboration with other relevant government departments, that all development projects are analysed for their potential impacts. It is also responsible to ensure that follow-up monitoring is completed and that projects are compliant with the environmental assessment process during operations.

The Secretary of State for the Environment will make a recommendation to the Ministry of Natural Resources and Energy regarding the implementation of the Project based on CAIA’s review of the ESIA. CAIA will then issue an environmental licence that is either a compliance declaration that gives the project proponent one year to implement initial management measures or a compliance certificate that gives the proponent a licence to operate for one to five years. The law further establishes the government’s authority to conduct environmental audits (at the expense of the proponent) to check compliance with the conditions of the environmental licence.

It is acknowledged that further national and regional regulatory agencies may be active in monitoring the Mine’s performance with respect to their requirements (such as, wildlife and forestry, workplace health and safety, work permits).

This ESIA has been completed in accordance with draft Terms of Reference (TOR) prepared by GB Minerals AG, which will be issued in final by CAIA. The draft TOR is included in Appendix 1C, and a table of concordance to the draft TOR is provided in Appendix 1D.

3.3 CURRENT REGULATORY STATUS

Land is State property in Guinea-Bissau but is administered at the local level by customary (traditional) authorities.

A Mining Agreement was negotiated and signed between the Ministry of Energy and Natural Resources and GB Minerals AG on May 1, 2009. GB Minerals AG is a Switzerland-based entity 100% owned by GB Minerals Ltd. The Mining Agreement allowed for the subsequent issuance of the following mining leases to GB Minerals AG on May 28, 2009:

- Mining Lease No. 001/2009, issued on May 28, 2009, grants the company a Mining Production Licence
- Mining Lease No. 004/2009, issued on May 28, 2009, provides GB Minerals AG with a Mining Licence

GB Minerals is in good standing on both mining leases. The Mining Lease details are summarized in Table 3.1 and the boundaries are shown on Figure 1.2.

Table 3.1 Mining Lease Details

Lease No.	Corner Post Identification	Co-ordinates (Bissau UTM, Zone 28N)		Area (ha)
		Northing	Easting	
004/2009	#14 Binta	1,387,500	460,000	30,625
	#15 Farim	1,376,500	477,500	
	#1 Guidaje	1,370,000	477,500	
	#2 Jumbembem	1370,000	460,000	

The Mining Agreement is considered the global agreement aggregating and coordinating the above licences and any other agreements or conditions relative to the Project. The Mining Agreement in its entirety includes:

- An Environmental Plan (submitted July 1, 2015)
- Mining Lease (granted)
- Mining License (granted)
- An Annex on Incentives (pending)
- Mining Operations Plan (submitted July 1, 2015)

The Mining Agreement provides GB Minerals with the right to construct and develop a mine to exploit the Farim phosphate deposit, and to construct and operate a port facility and any bridges, roads, transportation pipeline infrastructure required to connect the mine to the Port Site. The Government commits within the agreement to make immediately available the lands required for port infrastructure at the Ponta Chugue area.

In turn, the Mining Agreement requires GB Minerals to:

- Exploit the resource as per good international industry practices and in accordance with a Mining Operation Programme.
- Comply with environmental protection rules outlined in an Environmental Plan and the legislation and regulations applicable in Guinea-Bissau at the time of signing the Mining Agreement.
- Comply with the Social Program concerning employees who are national citizens and to train and to grant medical assistance to any person or employee used or working on the Project.

The key environmental provisions of the Mining Agreement are as follows:

- The licensee will take appropriate reasonable measures to ensure that its operations will not lead to any unnecessary adverse impacts to the environment, as per an approved Environmental Plan and any amendments.
- The licensee will compensate for damages caused by mining by rebuilding partially affected physical locations, where and when appropriate.
- The licensee shall have no responsibility for any environmental damage, except where gross negligence or wilful intent is demonstrated.
- The licensee shall not be held liable for environmental damages that may result from port infrastructure and roadways the licensee has undertaken to build as compensation for the Mining Rights granted under the Mining Agreement, except for in the instance of gross negligence or fault behaviour.
- Provisions regarding the timely issuance of permits/approvals to allow the mining project to proceed.

Mining is to be undertaken according to a Mining Operations Plan.

3.4 INTERNATIONAL AGREEMENTS AND TREATIES

Guinea-Bissau is a member of the African Union, Economic Community of West African States, Organisation of Islamic Cooperation, the Latin Union, Community of Portuguese Language Countries, La Francophonie and the South Atlantic Peace and Cooperation Zone.

The relevant international environmental and social development agreements to which Guinea-Bissau is a party are identified in Appendix 1F. Guinea-Bissau is signatory to numerous international human rights conventions. In some cases, however, these conventions have not yet been ratified or acceded to.

Being a signatory to such international agreements imposes obligations to address the topics raised in those documents. In many cases, those obligations are directly transposed into national laws. In other cases, implementation may be more complex and require more detailed analysis, prioritization, capacity building, and/or resource planning. These cases are normally addressed through the establishment of national strategies and action plans.

3.5 INTERNATIONAL STANDARDS AND GUIDELINES

For projects in developing countries, leading industry practice suggests the use of international standards and guidelines. Their use can be required in order to gain project funding from international lenders, but can also be implemented in cases where national legislation is not well defined. International standards and guidelines originated within financial institutions which were seeking to identify and manage environmental and social risks associated with projects they were funding. These standards have since been widely adopted and can be used by project proponents to give confidence (to regulators and shareholders) that the project conforms to leading international practice.

The following sections outline the guidance available from a variety of international organisations including the International Finance Corporation, the Equator Principles, and the International Council of Mining and Metals.

3.5.1 Equator Principles

The Equator Principles III is an environmental and social risk framework developed by The Equator Principles Association (2013) applied to identify, assess, and manage environmental and social risks in project finance transactions, based on the International Finance Corporation (IFC) Sustainability Framework.

The Equator Principles were initially developed in June 2003 by the World Bank Group, to provide an approach to determine, assess, and manage environmental and social risk in project financing. As of April 2015, 80 financial institutions were signatories to the Equator Principles (thus referred to as Equator Principle Financial Institutions, EPFIs) to ensure that the projects that were financed were developed in a manner that is socially responsible and reflect sound environmental management practices.

The ten (10) Equator Principles are:

- **Principle 1 - Review and Categorisation:** Obliges the categorization of projects based on the magnitude of potential impacts and risks in accordance with the social and environmental screening criteria of the IFC.
- **Principle 2 - Social and Environmental Assessment:** Requires the evaluation of social and environmental impacts and risks and the identification of mitigation and management measures that are needed to reduce impacts to acceptable levels.

- **Principle 3** - Applicable Social and Environmental Standards: Establishes the IFC Performance Standards and Environmental, Health and Safety (EHS) Guidelines to complement the host country legislation as the basis for social and environmental performance.
- **Principle 4** - Action Plan and Management System: Requires the development of a plan for implementing the mitigation measures, corrective actions and monitoring measures necessary to manage the impacts and risks identified by the Assessment.
- **Principle 5** - Consultation and Disclosure: Obliges free, prior and informed consultation and the facilitation of informed participation for projects that may have significant adverse impacts to local communities and the public disclosure of the Assessment and Action Plan in a culturally appropriate manner.
- **Principle 6** - Grievance Mechanism: Requires that an appropriate grievance process be included as part of the management system and that affected communities are informed of the process.
- **Principle 7** - Independent Review: Calls for an independent social or environmental expert to review the Assessment, Action Plan, and consultation process to assess compliance with the Principles.
- **Principle 8** - Covenants: Incorporates into the lending covenants compliance with host country requirements, Action Plan implementation commitments, periodic reporting of social and environmental performance, and facility decommissioning and closure where appropriate.
- **Principle 9** - Independent Monitoring and Reporting: Calls for an independent social and/or environmental expert to verify monitoring and reporting information.
- **Principle 10** - EPFI Reporting: Commits the EPFI to publicly report its Equator Principles implementation process and experience on an annual basis.

Categorization of projects is based on the magnitude of its potential impacts and risks in accordance with the environmental and social screening criteria of the IFC. According to IFC classifications, projects fall into one of three categories, depending on the type, location, sensitivity, and scale of the project and the nature and magnitude of its potential environmental impacts.

3.5.2 IFC Performance Standards

The IFC Performance Standards on Social and Environmental Sustainability (IFC, 2012) are used as comprehensive standards by international finance institutions working with the private sector. These are used in conjunction with the Equator Principles to assess the environmental and social impacts associated with projects in countries which do not have well established environmental legislation. The Performance Standards define a project's role and responsibilities for managing health, safety, environmental, and community issues.

The IFC (2012) Performance Standards are supported by Guidance Notes which give additional information on the requirements of the Performance Standards and on good practice to enable improved project performance.

The Performance Standards are summarized below, followed by more detailed content definitions:

- **Performance Standard 1** - Assessment and Management of Environmental and Socials Risks and Impacts: This standard seeks to identify and assess the social and environmental impacts of the Project, including cumulative and/or sectoral impacts and technically and financially feasible alternatives, and to avoid, minimize, and manage any unavoidable adverse impacts to people,

their communities, and their environment. It requires the development of a formal environmental and social policy reflecting the principles of the performance standards. It clarifies levels of stakeholder engagement under different circumstances and required engagement beyond affected communities. It promotes improved environmental and social performance through effective management systems and periodic performance review by senior management. Finally it refers to private sector responsibility to respect human rights.

- **Performance Standard 2 - Labour and Working Conditions:** This standard seeks to establish, maintain, and improve the working relationship between workers and management. It mandates equal opportunity and fair treatment of workers and protects against child and/or forced labour practices. It demands that the workplace offer safe and healthy working conditions that promote the health and welfare of the employees. It establishes requirements for comparable terms and conditions for migrant workers, compared to non-migrant workers. The mandate also introduces the quality requirements for workers' accommodation. Additionally it requires ongoing monitoring of primary supply chain and introduces "safety" triggers.
- **Performance Standard 3 - Resource Efficiency and Pollution:** This standard is intended to minimize adverse impacts on human health and the environment by minimizing pollution and reducing emissions that contribute to climate change. It introduces a resource efficiency concept for energy, water (including unacceptable water stress), and core materials inputs. Requirements on energy efficiency and greenhouse gas measurement are important, similarly on the concept of "duty of care" for hazardous waste disposal.
- **Performance Standard 4 - Community Health, Safety, and Security:** This standard limits risks and impacts to the local communities associated with all phases of the Project, including unusual conditions. It requires that the health and safety risks be evaluated during all phases of the Project and that preventative measures be implemented to a level that is commensurate with the risk. It considers risks to communities associated with use, and/or alteration of natural resources and climate change through an ecosystem approach. It also gives consideration for the risks posed by security arrangements. Security arrangements must be guided by the principles of proportionality, good international practices in terms of hiring, rules of conduct, training, equipping and monitoring of such personnel, and applicable law. The use of force is typically not sanctioned and a grievance process must be established to allow affected communities to express concerns about the security arrangements and acts of security personnel.
- **Performance Standard 5 - Land Acquisition and Involuntary Resettlement:** This standard seeks to avoid and minimize involuntary resettlement and to mitigate unavoidable adverse impacts through compensation for loss of economic assets and economic and standard of living restoration measures. Land use issues are key to sustainability and requirements regarding consultation are essential. Resettlement measures are intended to aim at improving economic and livelihood conditions.
- **Performance Standard 6 - Biodiversity Conservation and Sustainable Management of Living Natural Resources:** This standard calls for the balancing of conservation of biodiversity and the promotion of sustainable management of natural resources. It explains in detail the definitions of and requirements for various types of habitat and introduces clear requirements for biodiversity offsets.
- **Performance Standard 7 - Indigenous Peoples:** This standard ensures that Project development respects the dignity, human rights, and cultures of indigenous peoples and avoids adverse impacts to their traditions and values. It seeks to establish and maintain ongoing

relationships and to foster good faith and informed participation of indigenous peoples when projects are located on traditional or customary lands and to respect and preserve those cultures and practices. It introduces the concept of Free, Prior, and informed Consent (FPIC) under certain circumstance.

- **Performance Standard 8 - Cultural Heritage:** This standard protects cultural heritage sites from Project-related impacts and promotes the equitable sharing of benefits from the use of cultural heritage in business activities. It requires clients to allow access to cultural sites.

3.5.3 IFC EHS Guidelines

The IFC EHS Guidelines were designed with the broad aim of defining ‘good international industry practice’ and setting specific minimum design and operating standards with regard to the environment, occupational health and safety, community health and safety, and life cycle impacts including during construction, operation, and closure.

The detail in these standards is generally derived from globally recognised sources, such as the World Health Organization (WHO), and are intended to apply where a government’s legislation is either not available or is potentially deficient in regards to good international practice. There is some flexibility in their application to existing facilities and less stringent measures can be adopted if there is a detailed justification.

The General EHS Guidelines (IFC, 2007a) are designed to apply to all projects and all sectors, but can be supplemented by sector-specific guidelines, where factors such as facility size, technology and associated impacts merit specific attention. Sector-specific EHS Guidelines which may also need to be considered include the EHS Guidelines for Mining (IFC, 2007b).

3.5.4 IFC Stakeholder Engagement Good Practice Handbook

The IFC Good Practice Handbook (IFC, 2007c) identifies the following key principles with respect to consultation:

- Provide meaningful information that is tailored to the needs of the stakeholders
- Provide information in advance of consultation and decision making activities
- Ensure that information is easy for stakeholder to access
- Ensure inclusivity in representation of views, including women, minorities and vulnerable people
- Promote two-way dialogues
- Ensure that the process is free of intimidation and coercion
- Incorporate feedback into project design

GB Minerals has considered the above guidance in the development and execution of its Stakeholder Engagement Plan.

3.6 INDUSTRY GOOD PRACTICE

3.6.1 ICMM Community Development Toolkit

The International Council on Mining and Metals (ICMM) was established in 2001 to improve sustainable development performance in the mining and metals industry. The ICMM Sustainable Development (SD) framework that all ICMM members are required to implement is centred on

integrating the following set of ten principles and seven supporting position statements into corporate policy, as well as setting up transparent and accountable reporting practices (ICMM, 2015). The ICMM Sustainable Development Framework aims to achieve the following:

- Implement and maintain ethical business practices and sound systems of corporate governance
- Integrate sustainable development considerations within the corporate decision-making process
- Uphold fundamental human rights and respect cultures, customs and values in dealings with employees and others who are affected by Project activities
- Implement risk management strategies based on valid data and sound science
- Seek continual improvement of Project health and safety performance
- Seek continual improvement of Project environmental performance
- Contribute to conservation of biodiversity and integrated approaches to land use planning
- Facilitate and encourage responsible product design, use, re-use, recycling and disposal of products
- Contribute to the social, economic and institutional development of the communities in which the Project operates
- Implement effective and transparent engagement, communication and independently verified reporting arrangements with Project stakeholders

Under SD Principle 9, ICCM published a community development toolkit, which includes 17 tools to assist in planning, management, evaluation phases of community development and stakeholder relationships to be implemented throughout the mining cycle (ICMM, 2012).

Principally, SP 9 commits members to:

- Contribute to the social, economic and institutional development of the communities in which the Project operates
- Engage at the earliest practical stage with likely affected parties to discuss and respond to issues and conflicts concerning the management of social impacts
- Ensure that appropriate systems are in place for ongoing interaction with affected parties, making sure that minorities and other marginalised groups have equitable and culturally appropriate means of engagement
- Contribute to community development from project development through closure in collaboration with host communities and their representatives
- Encourage partnerships with governments and non-governmental organisations to ensure that programs (such as community health, education, local business development) are well designed and effectively delivered
- Enhance social and economic development by seeking opportunities to address poverty

The tools have six specific objectives:

- To improve understanding of local community development processes
- To support lasting improvement in the quality of life enjoyed by mining communities
- To facilitate community empowerment through participatory development processes
- To build local capacities and development resources
- To foster constructive working relationships among communities, companies, and governments
- To reduce conflict in mining communities and regions

While not currently an ICMM member, GB Minerals intends to apply the ICMM Community Development Toolkit in the development of a future Community Development Plan.

4 – ANALYSIS OF ALTERNATIVES

The analysis of alternatives is integral to the evaluation of the environmental, engineering, and economic feasibility of the Farim Project. The purpose of the alternatives analysis is to improve decisions on project design, construction, and operation based on alternative options to the proposed project description. This Section examines the various alternatives considered as part of the Project.

Examination of the site and technology selection has focused on designing rigorous solutions that reduce the potential for health and safety hazards, and short and long term environmental and social impacts. The alternatives assessment process results in an economically feasible mine design that is robust from an engineering perspective.

The following IFC Performance Standards and Guidance Notes have been considered when assessing Project alternatives (IFC, 2012a, b).

- Guidance Notice to IFC Performance Standard 1 stipulates for greenfield developments, that: *the ESIA [should include] an examination of technically and financially feasible alternatives to the source of ... impacts, and documentation of the rationale for selecting the particular course of action proposed.* The alternatives analysis facilitates: *the consideration of environmental and social criteria at the early stages of development and decision-making.*
- IFC Performance Standard 3 requires that environmental aspects of the Project be incorporated into the site alternatives assessment, including use and efficiency of resources, and the equipment selection process should take resource efficiency into account.
- IFC Performance Standard 5 encourages companies to avoid acquisition of land that results in the physical or economic displacement of people, and requires a meaningful analysis of possible alternatives by the client which incorporates the social and project costs associated with displacement.
- IFC Performance Standard 6 requires that the client does not significantly convert or degrade natural habitats unless: no viable alternatives exist; communities are consulted with respect to the changes, and any conversion or degradation is mitigated. The Guidance Notes suggest: *alternatives may include variations in the layout of the project facilities, alternative engineering and manufacturing processes and construction practices, the selection of different sites or routing of linear facilities, and selection of alternative suppliers through screening to identify those with appropriate environmental/social risk management systems.*
- IFC Performance Standard 7 provides guidance on alternatives with respect to Indigenous Peoples, but is not applicable to this project as Indigenous Peoples are not present.
- IFC Performance Standard 8 provides guidance on removal of Non-replicable Cultural Heritage and stipulates that it should be preserved in place unless there are no technically or financially feasible alternatives and the overall benefits of the project conclusively outweigh the cultural heritage loss.

Other than IFC Performance Standards, the criteria considered in the assessment of alternatives that have influenced the design of the Project, include:

- The health and safety of workers and residents in surrounding communities
- The significance of potential social, health and environmental impacts and the ability to mitigate adverse impacts through evaluation of alternatives
- The economic production of phosphate product to meet market specifications
- Minimising the number of residents that would be displaced or disadvantaged economically and physically
- The availability of infrastructure and labour including the integration of local skills base
- Compliance with all applicable laws and regulations in Guinea-Bissau and International Best Practice
- Cost-benefit analyses to enhance Project benefits to surrounding communities, workers, investors, and the Guinea Bissau government (through tax revenue and social investment)

4.1 ALTERNATIVES CONSIDERED

Project alternatives that have been considered during the Project design are grouped as follows:

- No development of the Project - the Zero Option
- Mining Methods
- Locations of Waste Management Facilities
- Phosphate Beneficiation
- Product Transport to Port
- Product Export
- Closure Alternatives
- Employee Accommodation

4.2 ZERO OPTION

The zero option involves not developing the Project. This option would:

- Maintain the status quo of the socio-economic environment - therefore with no change to the current economic conditions and livelihoods
- Avoid the potential risk of any disturbance to the communities, current patterns of activity, or long term changes to the landscape
- Would not incur the potential (real or perceived) environmental and social impacts, risks or threats (subject to the detailed analysis in this ESIA)
- Avoid long term legacy issues associated with land use, aftercare management and maintenance of land that has been used for extraction of phosphate

The zero option would however also result in the loss of:

- Economic opportunity to exploit a nationally important mineral resource with potential economic benefits to the region and national economy for the duration of the Project.
- Local employment opportunity and associated economic benefits that derive from employment generation for the duration of the Project.

- Associated development and subsequent long term improvements to local infrastructure including roads, energy, waste and water management.
- The opportunity to upgrade and develop skills, with the associated direct economic benefits on local communities as a consequence of services and contracts delivered to maintain and support the mining operations. The Project's capacity-building and skills development is easily transferrable to other mining projects or other industries, and supports other economic development activities, during and after the mine.

It is expected that, with mitigation of the more significant adverse socioeconomic effects and enhancement of the beneficial socioeconomic effects, that the socioeconomic environment affected by the Projects is better off with the Project than with the zero option.

4.3 MINING METHODS

The site is underlain by a high-grade sedimentary, flat-lying phosphate deposit located within a single phosphate matrix bed known as the FPA ore zone. The deposit is well suited for open pit mining. It is not suitable for underground mining given that the material overlying the deposit is unconsolidated overburden that lacks the strength to remain in place, and that the ore is relatively thin and close to surface. Due to the geological and topographic characteristics of the deposit, three conventional surface (open pit) mining methods were analyzed:

- Dredging (overburden and ore)
- Dragline with ore slurry transport via pipeline and barge
- Excavator/truck with ore truck transport

A brief summary of the findings for each of the mining methods analyzed follows.

4.3.1 Dredge Mining

Dredge mining uses cutter-suction dredges which float above the digging operation within contained water impoundments. Phosphate ore is pumped to large storage tanks at the process plant.

GB Minerals rejected this possible mining method for the following reasons:

- Poor mining control of the ore body (difficulty extracting only the ore and not waste), resulting in lower grade of product

Technical challenges and costs associated with the handling and management of dredge spoils, which will be water-saturated do to the high clay content. Such materials will not stockpile easily, tend to slump, require large areas to stockpile, and considerable time to dewater. Settling of suspended solids in the runoff from such stockpiles would be challenging. As a result, dredging was discounted in favour of a dry mining method, which will provide better spoil containment control, mining grade control and product quality.

4.3.2 Dragline Mining

Dragline mining is successfully used elsewhere, and involves the use of electric walking draglines to remove the overburden directly above the phosphate. Ore slurry transport via pipeline and barge was considered as part of the dragline mining method. Overburden material is cast directly into a previous mined-out location within the operating radius of the dragline. The dragline is then used to

carefully extract the phosphate ore and places it in large piles onto operating benches. Given the operational reach of the dragline, the face is typically placed at a distance from the ore.

Ore piles are then slurried using multiple high pressure water jets. The slurry is piped to an ore well and pumped to large storage tanks at the process plant.

The dragline moves down the face over the width of the mine. Once the pit reaches the end of the pit limit, the entire operation is relocated toward the ore and water return pipelines for a new 40 m pit. Pipelines are typically located approximately 200 m to 250 m from the start of an operation, so multiple dragline / slurry setups can be achieved without relocation of the main pipelines.

The pre-strip operation (shovel/truck stripping above the working bench) typically advances 500 m or more ahead of the dragline mining face.

Pre-strip overburden (overburden above the dragline working bench) would be handled by shovels/excavators and haul trucks. Overburden is initially hauled from the pit to an external waste dump until a large enough mined out area can be established. Once sufficient mined out area is developed, pre-strip overburden is backhauled into the mined out area for placement and final storage.

The advantages of the dragline mining method include:

- Lower waste removal costs (i.e., for removal of waste located below the dragline working bench)
- No trafficability or operating/travel surface requirements for equipment below the dragline working bench
- Minimal support equipment (additional bench equipment) required
- Lower number of required trucks, haul road maintenance, etc.

Disadvantages of this mining method include:

- Higher up-front capital investment for draglines
- Limited grade control and blending capability of the ore due to the fixed linear progression of the pit
- Reliance on ability to stack spoil material in mined-out areas
- Higher standards required for bench preparation (such as levelling, dewatering, etc.)
- Power requirements to run draglines, pit cars, pumps and boosters

As such, this mining method was discounted based on the costs and increased power demands, as well as limited grade control. In addition, this mining method does not complement the proposed mine plan.

4.3.3 Excavator/Truck Mining Method

This method uses excavators and trucks to mine the overburden and ore using a multiple bench open pit. As the initial pit is developed, overburden is stored outside the pit. Once a sufficient volume of the pit has been excavated, the mine waste and overburden is back-hauled into the mined out area. Based on the mine plan, it is estimated that some in-pit backfilling will become feasible in the second year of mining. Overburden not stored in the open pit (i.e., as IOB) will be sent to the WDs. The benching and excavation depths will depend on the actual overburden depth and will be altered to accommodate thicker overburden.

For the planned open pits, overburden will be stripped and removed with front end loaders matched with mine haul trucks. Overburden excavation will advance ahead of the ore extraction, with multiple benches. The ore will be mined with smaller backhoes matched with smaller mine haul trucks to minimize mining dilution and maximize ore recovery. The ore will be hauled to a ROM stockpile adjacent to the plant, and fed into a process plant. The plant feed hopper will be installed so that ore haul trucks can directly feed ore to the plant if possible.

The advantages of the excavator/truck mining method include:

- Lower up-front capital investment and investment risk
- Better control of stackability of spoil material in the mined-out areas
- More operational flexibility and consistency of operation
- Improved grade control

Disadvantages of this mining method include:

- Typically higher operating costs
- Higher equipment trafficability requirements on operating/travel surfaces due to reliance on truck haulage, including access to the bottom (FPA ore zone) of the pit
- More operational and support equipment required

This method was selected based on lower initial capital, lower investment risk, improved grade control, limited power supply, and operational flexibility.

4.4 WASTE MANAGEMENT FACILITIES

Taking into account the previous waste management site selection studies completed by Golder (2014b), further work was undertaken by the Knight Piésold Pty. Ltd. (Lycopodium, 2015a). Additional studies were conducted to evaluate waste disposal options further as part of mining, waste and water management planning. The assessments applied the existing criteria and also these additional strategies:

- Segregation of “clean” waste overburden (material not expected to meaningfully leach metals) from “dirty” overburden that may potentially leach metals
- Disposal of dirty overburden adjacent the TSF with common water management systems, which will allow for final reclamation of a single integrated waste landform
- The use of smaller available areas between both pits for ex-pit overburden storage
- The use of surcharge waste dumps positioned within the backfilled portions of the open pits

An outcome of the updated WMF options review was to adopt the previously preferred O1a waste dump location (Figure 4.1) as the location of the TSF/WD-3a/WD-3b. Two small waste dumps have been identified using the available space between the open pits for the disposal of waste early in the mine life when in-pit backfilling or surcharge waste dumps are not an option. The second overburden storage facility / waste dump O2 will no longer be required. The preferred WMF locations are shown on Figure 4.2. They consist of two small ex-pit waste dumps between the two pits (WD-1 and WD-2), WD-3a and WD-3b, WD-3b will contain dirty overburden which will be contained within the TSF/WD-3a/WD-3b, WD-4 which is a surcharge waste dump located on the backfilled south pit, and two additional surcharge waste dumps (WD-5 and WD-6) located on the backfilled portion of the north pit. As noted on Figure 4.2, the TSF is located within the TSF/WD-3a/WD-3b at the Golder O1a

waste dump location. The final WMF configuration presents added benefits of containing all dirty overburden not placed in-pit in one single facility with special water management measures, and reducing the overall footprint of the Mine Site.

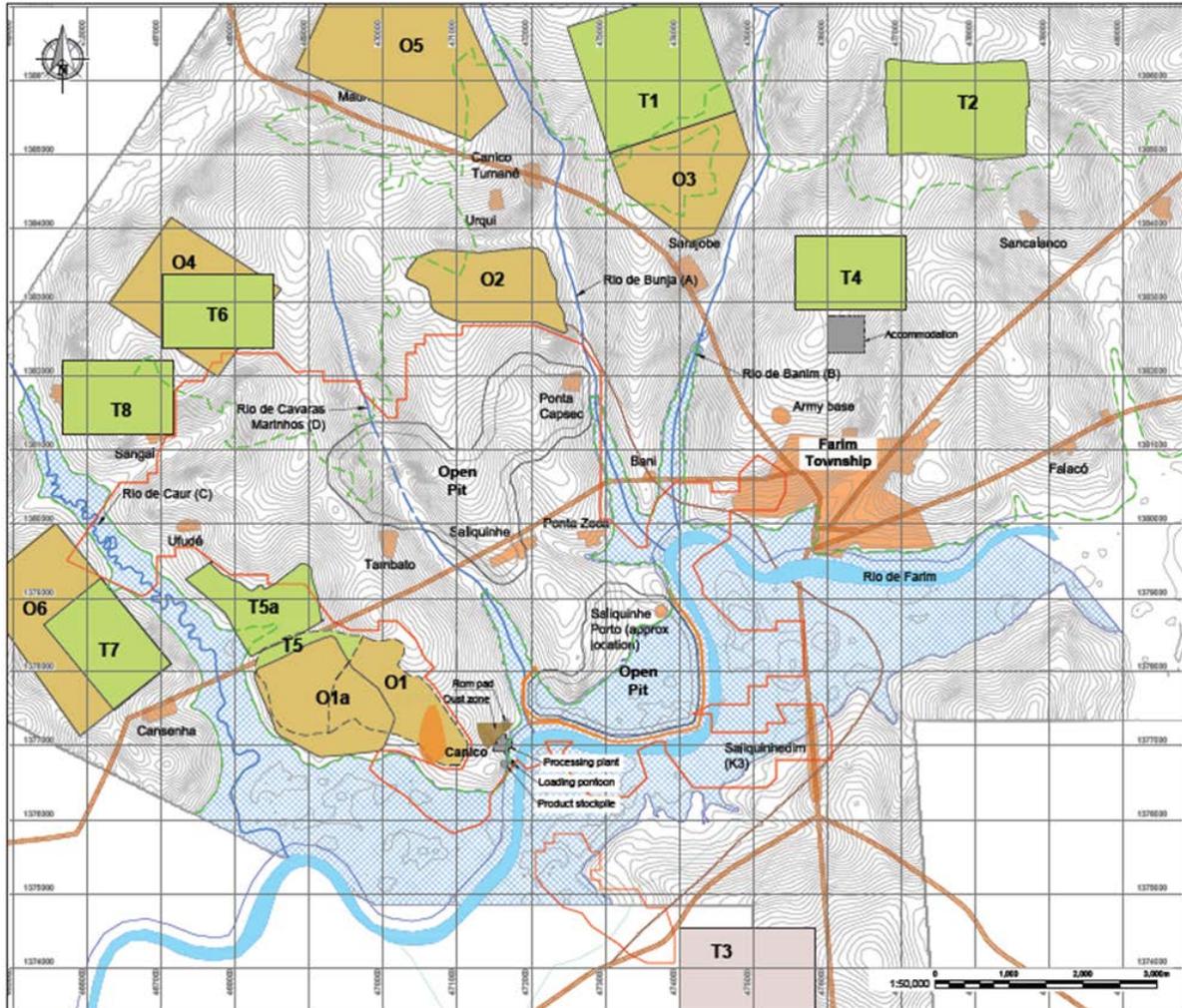


Figure 4.1 Golder Reviewed WMF Site Location Options

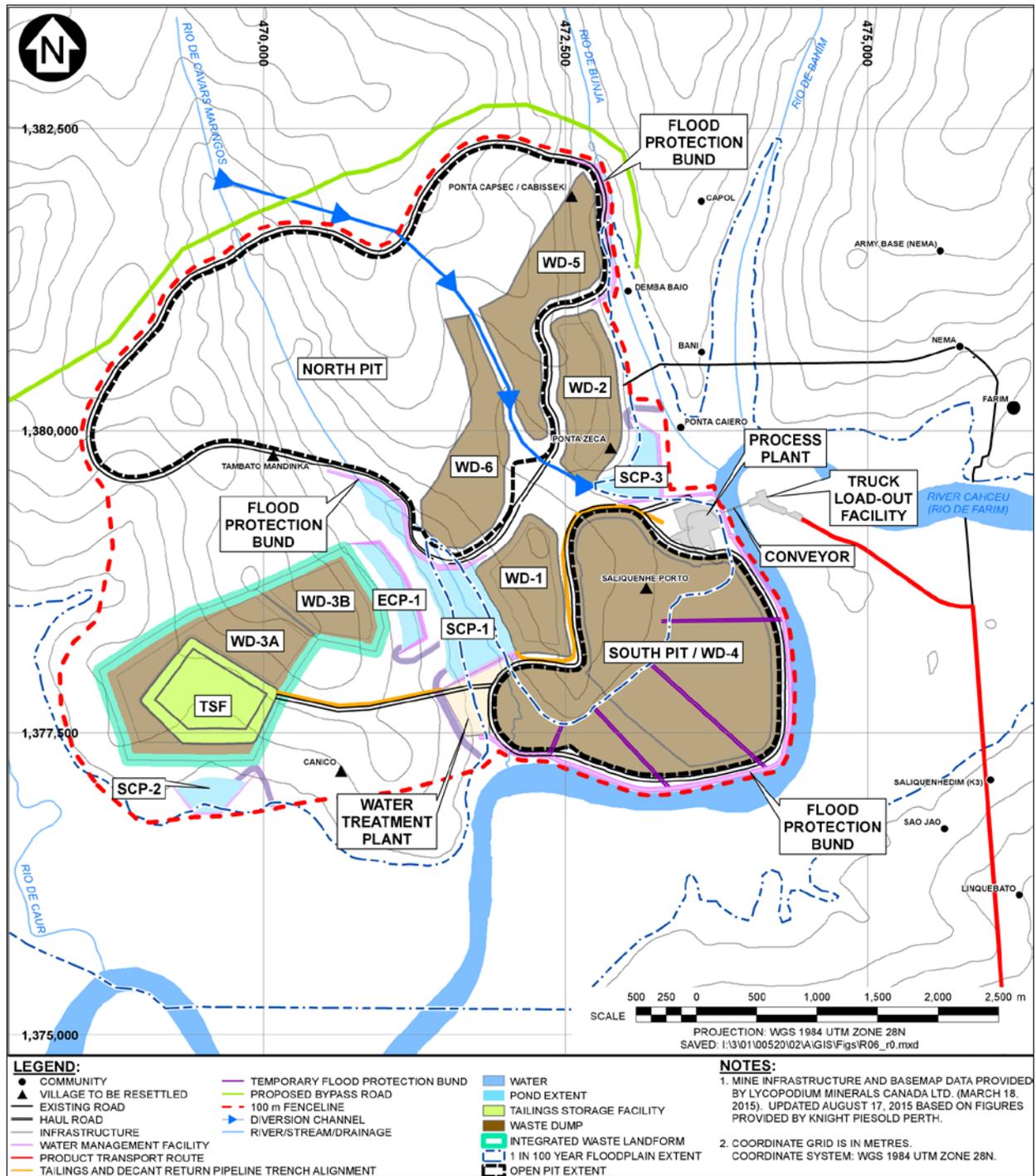


Figure 4.2 Selected Waste Management Facility Locations

4.5 PHOSPHATE TREATMENT OPTIONS

Alternative treatment options for the phosphate ore were assessed as part of the Feasibility Study. The only alternative to treating the ore is to ship off site for treatment. This is considered as the

Direct Shipping Option (DSO). No beneficiation plant or tailings storage facility would be located on-site.

The DSO option was also proposed as a start-up option for the first 10 years of mine life. This would allow production to commence rapidly and enable the construction of a beneficiation plant during operations.

Due to the moisture content of the phosphate ore, some dewatering is required prior to transport. Additionally, the current process plant is scaled back from what was previously proposed, with scrubbing only and no floatation circuit. The DSO option would increase the amount of material transported and also decrease the market value of the product. As such, the DSO options have been discounted. The chosen option is for a process plant to be constructed on the site, and the phosphate product to be produced through this plant (see Section 2).

4.6 PRODUCT TRANSPORT TO MARKET OPTIONS

Markets for the phosphate product are located overseas, as such three transport options to deliver the product were considered. These options include the following and are discussed below:

- River Cacheu Barge and trans-shipment at the River Cacheu mouth
- Slurry Pipeline to a new port facility at Ponta Chugue
- Truck Transport to a new port facility at Ponta Chugue

The option to transport the product to ship from the Port of Bissau was not considered as the option would require trucks or slurry pipelines to run through an urban area, which would present unacceptable community safety issues or physical displacement of existing people and infrastructure. Additionally, the Port of Bissau does not have enough storage area, and has a limited draft. The Ponta Chugue port site location is ideal in that it is removed from densely populated areas and is a location that can handle a draft of approximately 13 m and can navigate to be directly loaded at the Port Site without tidal assist for ships of 35,000 DWT or smaller. Further, the Ponta Chugue port site was identified by the GoGB for the Project.

4.6.1 River Cacheu Barge - Trans-shipment Option

This option included loading barges on the River Cacheu near the mine site that would transport the product approximately 165 km downstream to the river mouth for transfer to trans-ocean shipping vessels. This option was under active study at one point, but was rejected since it would create an unacceptable increase in the amount of shipping traffic at the river mouth as well as a substantial increase in traffic along the River Cacheu, potentially impacting the local communities and land uses.

4.6.2 Slurry Pipeline to Ponta Chugue Option

This option included the construction of a slurry pipeline along the existing road infrastructure alignment (where available) from the mine site to Ponta Chugue port site. The slurry pipeline option was investigated in 2011 but was rejected as it was the most expensive and technically complex option. Additionally, construction of the pipeline through communities would be very intrusive and present community safety issues, and would require a high level of maintenance and security during the life of mine.

4.6.3 Truck Transport for Ponta Chugue Option

The truck transport option included two sub-options: (1) Truck transport from mine site to port site; and (2) Product conveyor over the River Cacheu to truck loading facility. These options are discussed below.

4.6.3.1 Truck-only Transport Option

Transporting product using trucks travelling from the mine site to Ponta Chugue would require a dedicated ferry vessel to cross the River Cacheu, which would compete for space and present safety issues to current ferry users. Increased truck traffic through Farim would also pose community safety issues. Consequently, the truck-only transport option was rejected.

4.6.3.2 Conveyor and Truck Transport Option

The preferred option includes product transport from the mine to a truck loading facility via an enclosed conveyor system over the River Cacheu. The loaded trucks would transport the product to Ponta Chugue, alleviating the use of ferry crossing and avoiding additional heavy truck traffic through Farim.

4.7 SHIPLOADING ALTERNATIVES

Two port-based shipping scenarios were investigated: direct loading onto bulk carriers and transshipment from barges to bulk carriers. Both options were developed with the intent of minimizing initial Project capital expenditures (CAPEX), as opposed to optimizing operations, safety, and maintainability.

Under the transshipping scenario, barges would be loaded at Ponte Chugue via a nearshore loading wharf. Laden barges are then stored at a barge marshalling area prior to being transported by tugs to a deep water transshipping location. At the transshipping areas, bulk carriers will be moored at a dedicated single point mooring (SPM), which allows them to swing freely with the prevailing current and wind conditions. Barges will be berthed alongside the bulk carriers and unloaded with the ship's gear (cranes aboard the ship).

This option was under study until it was confirmed that direct loading of vessels was possible by constructing a 200 m long trestle dock to provide sufficient draft for the vessels without dredging. The direct load option is considerably lower cost as GB Minerals will not need to purchase barges. Additionally, the environmental footprint of the direct load option is smaller.

4.8 CLOSURE ALTERNATIVES

There are a range of alternatives available for closure of the Mine Site and the preferred options have been integrated into the design.

4.8.1 Pit Management

An alternative to closure of the open pits would be to leave the pits open and allow them to fill with water. This allows for the pits to be easily re-opened in the future, in the event that technology or phosphate prices suggest that it becomes economical. It also provides a water source for the area. However, the major downsides to leaving the pit open include creating potentially stagnant deep

water that is a human health and safety risk; and increased land would be taken up for ex-pit disposal of waste overburden.

The alternative of not backfilling the pits during the course of mining and leaving large pit lakes at closure was discounted as it is both economically punitive and displaces considerably more land at closure. At closure a small lake or pond will form at the west end of the north pit within the area of the final two years of mining.

4.8.2 Waste Management Facilities

Alternatives for the closure of the TSF/WD-3a/WD-3b and other waste dumps were considered. The preferred option is to maximize disposal within the pit footprints (IOB and surcharge waste dumps) and to revegetate the waste dumps as practically possible. The TSF/WD-3a/WD-3b will be capped with a suitable cover to encapsulate the tailings and overburden and limit seepage from the facility.

5 – PUBLIC CONSULTATION

5.1 INTRODUCTION

Public consultation is an important component of any project, in that it provides an opportunity for local stakeholders to engage with Project proponents. Through public consultation communities receive information about the Project and help to inform the Company on the key issues most relevant to stakeholders. Public consultation should be conducted through a proactive approach, meaning that effort should be focussed on the key concerns and managing the expectations of all stakeholders early in the life cycle of the Project. Engagement provides a valuable opportunity for the following:

- Ensure information provided by the Project is accurate
- Manage stakeholder expectations
- Provide the Company and ESIA team any local knowledge and comments/questions about the Project, in order to consider these in the impact assessment and when developing mitigation

The Farim Phosphate deposit has been known for some time, with exploration and bulk sampling having occurred in the mid-1980s. No public consultation records are available for the 1980s period of exploration, but GB Minerals has documented several consultation campaigns conducted over the period of 2011 through 2015. Additionally, a number of Farim residents have been employed by GB Minerals since 2011 until present.

Given the Project's exploration and stakeholder engagement history, the Project is well known to residents in the Farim area and Oio Region. The overall message from stakeholders is one of support for the Project. In fact, along with this support has been an impatience expressed by local residents, who are keen to realize benefits that are expected from the Project.

The objective of GB Minerals' recent public consultation is to actively obtain feedback on the Project from stakeholders at national, regional, and local levels with particular emphasis on local communities. The basic principles of the consultation and disclosure were to:

- Manage communication between the Project proponent and stakeholders by creating an atmosphere of mutual understanding, respect, trust, and collaboration in meetings.
- Provide adequate, clear, timely and consistent information about the Project and ESIA process with information on how stakeholders can participate (including outside of meetings and after the consultation team has left the area).
- Build capacity among stakeholders so they can understand the information and contribute to the process with issues of concern and suggestions for enhanced benefits.
- Provide stakeholders with timely feedback on whether and how their contributions were incorporated into project designs and decisions regarding alternatives, mitigation measures, and strategies for enhancing benefits.
- Identify, record, and respond to questions and comments raised by local communities during the course of the ESIA and throughout the life of the mine.

This section summarizes the public consultation process and the outcomes. Public consultation reports for the periods of 2011 to 2013 and 2015 (Tropica Environmental Consultants, 2012a; Golder, 2014c; Eco Progresso, 2015) are included in Appendix 1G. GB Minerals' Stakeholder Engagement Plan (SEP) is included in Volume 3.

5.2 REGULATORY REQUIREMENTS

5.2.1 Corporate Policy

GB Minerals has developed a corporate Environmental, Social, Health and Safety Policy that includes GB Minerals' commitment to consultation with relevant stakeholder and sets out the goals that form the basis for all engagement activities conducted by GB Minerals. The Policy is presented in the ESMP (Volume 3).

5.2.2 National Regulations

The Environmental Assessment Law (Law 10/2010) identifies the requirement for Project proponents to carry out public consultation activities with potentially affected stakeholders (Republic of Guinea-Bissau, 2010). This includes government agencies and representatives, local leaders, community members and non-governmental organizations (NGOs).

The draft Terms of Reference (TOR) for the Project notes that the participation of people and the main institutions involved in the Project is a key element of the ESIA (GB Minerals AG, 2015). The TOR directs GB Minerals' ESIA consultant to demonstrate the extent of consultations undertaken for the ESIA.

5.2.3 International Standards

Applicable international standards include the Equator Principles III (The Equator Principles Association, 2013) and the IFC Performance Standards on Social and Environmental Sustainability (IFC, 2012a).

Equator Principles 5 and 6 pertain to public consultation, as follows:

- **Principle 5** - Consultation and Disclosure: Obliges free, prior and informed consultation and the facilitation of informed participation for projects that may have significant adverse impacts to local communities and the public disclosure of the Assessment and Action Plan in a culturally appropriate manner.
- **Principle 6** - Grievance Mechanism: Requires that an appropriate grievance process be included as part of the management system and that affected communities are informed of the process.

The applicable IFC Performance Standards are:

- **Performance Standard 1** - Stakeholder engagement is the basis for building strong, constructive, and responsive relationships that are essential for successful management of a Project's environmental and social impacts. Stakeholder engagement is an on-going process that may involve the following elements:
 - Stakeholder analysis and planning
 - Disclosure and dissemination of information
 - Consultation and participation
 - Grievance mechanism
 - Ongoing reporting to Affected Communities

- **Performance Standard 5** - Stakeholder engagement in the context of land acquisition and involuntary resettlement.
- **Performance Standard 8** - Stakeholder engagement in the context of potential impacts to cultural heritage.

The IFC Good Practice Handbook (IFC, 2007c) identifies the following key principles with respect to consultation:

- Provide meaningful information that is tailored to the needs of the stakeholders
- Provide information in advance of consultation and decision making activities
- Ensure that information is easy for stakeholder to access
- Ensure inclusivity in representation of views, including women, minorities and vulnerable people
- Promote two-way dialogues
- Ensure that the process is free of intimidation and coercion
- Incorporate feedback into project design

These standards are explained in greater detail in the SEP.

5.3 PROJECT STAKEHOLDERS

GB Minerals has identified potential stakeholders that will be either directly or indirectly influenced by the Project or have an interest in the Project or the ability to influence the Project. Table 5.1 identifies the relevant stakeholder groups.

Table 5.1 Stakeholder Groups

Stakeholder Groups	Description of Stakeholder Group
Potentially Affected Population	PROJECT AFFECTED PERSONS (PAPs) <ul style="list-style-type: none"> • Residents potentially affected by physical displacement (loss of housing) • Land owners/users directly affected by land acquisition • Any other person/business/entity economically displaced
	DIFFERENTIALLY AFFECTED POPULATION <ul style="list-style-type: none"> • Local disadvantaged groups such as women, children or the poor
	POTENTIALLY AFFECTED COMMUNITIES <ul style="list-style-type: none"> • See Table 5.2
Government Authorities	LOCAL GOVERNMENTS <ul style="list-style-type: none"> • Farim Municipality • Local Village Administrators and/or Committees • District Administrators in Bissora, Farm, Mansaba, Nhacra and Mansoa
	NATIONAL and REGIONAL GOVERNMENT <ul style="list-style-type: none"> • Ministry of Geology and Mining • Ministry of Environment • Ministry of Public Works • CAIA • Other relevant National Ministries and Departments • Oio Region Administration

Table 5.1 Stakeholder Groups

Stakeholder Groups	Description of Stakeholder Group
Other Organizations Investors, Financial Institutions Media	GENERAL PUBLIC <ul style="list-style-type: none"> Population of Guinea-Bissau
	BUSINESSES <ul style="list-style-type: none"> Businesses within the regional area and Guinea Bissau
	NON-GOVERNMENT and QUASI-GOVERNMENT ORGANIZATIONS <ul style="list-style-type: none"> Non-commercial, non-governmental and public organizations at all levels, including community-based organizations or interest groups (i.e., labour, youth, businesses, environmental, etc.)
	INVESTORS and FINANCIAL INSTITUTIONS <ul style="list-style-type: none"> Current and potential investors, financial institutions
	MEDIA <ul style="list-style-type: none"> Interested media organizations

GB Minerals with the participation of their consultant team (Eco Progresso and Knight Piésold) conducted an updated stakeholder identification and analysis process for the Mine Site, Product Transport Route and the Port Site in May 2015. The potentially affected communities identified during this exercise are listed in Table 5.2.

Table 5.2 Potentially Affected Communities

Mine Site	Transport Route	Port Site
<ul style="list-style-type: none"> Cancenha Caurndin Canico Lique Coroto Tambandito Tambato Mandinka Ufude Sandjal Saliquenhe Porto Ponta Caiero Demba Baio Urqui Canico Tumanna Bani Nema Farim Capol Saliquenhe Sara Ioba 	<ul style="list-style-type: none"> Saliquenhedim (K3) Sao Jao Capatrice Colimessin-Cunda Djalicunda Linguebato Bironqui Calingue Fula Calingue Mandinga Mansaba Mansaba Sutu Manbonco Manbonco Dar Ponta Fernando Ndjassone Some Tano Cutia Cureyni Cussac Sansaunto Mansoa Rossum Dugal 	<ul style="list-style-type: none"> N'Raga Cunteda Chugue Aroté Ancone

5.4 PUBLIC CONSULTATION FROM 2011 TO 2013

GB Minerals began the Public Consultation process in 2011 with an initial scoping visit. Meetings were held with CAIA (a department of the Office of the Prime Minister) the lead authority responsible for evaluating ESIA's, and other key government departments. One meeting was also held with village Chiefs in Farim, which determined that the communities were supportive of the Project.

Follow up meetings were held in March 2012. These meetings were held in the communities near Farim, using posters to present the Project. A similar format was used for further consultation meetings held in December 2013. Meetings started with general introductions, followed by a presentation of Project information in the form of posters. Attendees were then provided an opportunity to raise questions and concerns. Details of these meetings and presentations are provided in Appendices 1G.1 and 1G.2.

5.5 PUBLIC CONSULTATION IN 2015

GB Minerals, through its consultant Eco Progresso, held additional public consultation meetings in May and June of 2015. The consultation activities conducted in 2015 focused on informing local stakeholders on the Project, its current status and to answer questions and address concerns of stakeholders.

Meetings were conducted with regional government representatives including the Governor of Oio Region, Regional Secretary of Oio, leaders of the five sectors of Oio, traditional leaders and village leaders, local communities around the mine site, port site and along the transport route, and NGOs. PowerPoint® slides were presented at each of the meetings, and hard copies of the presentation were made available to interested participants. Question and answer sessions followed the presentations. The 2015 meetings are summarized below:

- May 27 - Public meeting in Farim with the Farim Governor and other local leaders invited.
- May 30 - Public meeting in Saliquenhe, which also included Region Oio government officials from Bissora, Nhacra, Mansoa, Mansaba and Farim.
- July 10 - Public meeting in villages near the Port Site (Encone; Cunteda; Aroté; Abana).
- June 11 - Public meeting in Caurundin (included Cancenha); Saliquenhe Ba, and Saliquenhe Porto (included Ponta Caiero; Demba Baio).
- June 12 - Meeting at NADEL NGO offices in Farim, with representative NGOs, associations, churches and community radio stations (NGO Nadel, ECO, AFAS, AFA-K, AMIC, RAFAF and Ajub-AMA, LSEE, the Association FAMM APROSAL and representatives of Djalicunda radios, Bombolom-FM, Sol Mansi and national radio).
- June 13 - Meetings held in Mansaba and Mansoa and a radio show in Djalicunda, as follows:
 - Meeting in Mansaba with Régulo of Mansaba, Administrator Secretary, and the Mansaba sector administrator, and village chiefs from the following villages located along the Product Transport Route: Mansaba Calinque Mandinga, and Bironqui.
 - Radio Djalicunda - a debate was held in Creole.
 - Meeting in Mansôa, attended by village representatives from Cureini, Dugal, Rossum Cutia, SOMEK Committee, Fanhe and Cussac.

In addition to public meetings GB Minerals, through its consultant Eco Progresso, participated in a radio show in Bissau.

Details of these meetings and presentations are provided in Appendix 1G.3.

5.6 SUMMARY OF ISSUES AND CONCERNS

A summary of the key issues raised during the public consultation activities is presented separately below for the period of 2011 to 2013 and 2015.

5.6.1 Key Issues and Concerns - 2011 to 2013

A number of key issues were identified during the relatively continuous public consultation activities from 2012 and 2013 (from Golder, 2014d):

- People said they were happy that consultation meetings took place as it provided them an insight into the Project and opportunity to be involved. It was commented that there is currently no mechanism for people to complain or provide feedback on the Project. For example, communities complained that Project vehicles do not provide lifts, even if going in same direction.
- There was an apparent mistrust of the Project in the communities. People claimed that in the past promises have been made regarding resettlement and compensation for exploration and mining activities which have not been honoured. It should be noted that no information was provided to the consultation team on who made these promises and what specifically they were.
- People questioned why the government was never represented at the public consultation meetings. There was also suspicion that the Project and government were colluding to develop the Project without supporting the local communities. Communities requested better collaboration with all partners of the Project, including both government and the Project.
- There is concern that fertility of the land will be affected, based on the belief “that phosphate is a fertiliser; mining it means removing the fertiliser from the land”. People are concerned that their main livelihood, agriculture, would be lost.
- The company compensation policy was not clear and compensation rates were not known. According to the communities, some farms had been damaged without any compensation being offered. On the few occasions where compensation was offered (due to damage of cashew trees) payment was given only for mature trees that were damaged. Nothing was received for young trees, and recipients were never advised of compensation rates and requirements.
- Opportunities for training and skill development were requested. This is in anticipation of the start of the Project so that local people are prepared and ready to apply for jobs advertised.
- People asked if local people would be employed in the Project. People did not want foreigners brought in to take up jobs in the Project that could be undertaken by local people, as was claimed for the exploration work.
- People said they were worried that they were going to be resettled. Relocation is a concern because residents fear they will not have lands to continue farming activities. People said they will oppose relocation because there would be loss of livelihoods. It was suggested that the Project should undertake community development register/opportunities to identify potential community development opportunities in the Project area. The Project will not be committed to anything by this study. It will rather help the Project at a later stage if it wants to undertake some community development programs. People requested services be provided by the Project (e.g. roads, schools, hospitals, churches, transportation, etc.) and that GB Minerals provide irrigation schemes to support continuous farming throughout the year. The communities

appear to regard the Project as a surrogate government in terms for providing means for development. It was claimed that the government had failed to provide the communities with any substantial infrastructure development. In general, it appears that the communities mistrust the Government.

- People said they were worried that cultural sites like shrines, cemeteries and grooves (sacred places that people have cultural attachment to, mostly in the forests) would be destroyed by the Project.

The full list of comments and questions is presented in the Appendices 1G.1 and 1G.2.

5.6.2 Key Issues and Concerns - 2015

Below is a summary of the key issues and concerns raised by participants during consultation events hosted in 2015:

- Stakeholders expressed concern and a desire to know more about the potential loss of land, houses and potential resettlement. Stakeholders are particularly interested in understanding how it will affect them personally and how it will affect their livelihoods.
- Participants expressed the desire to be continually informed about the Project process and any Project updates. Participants noted the need to educate the local public on the Project given the inexperience with mining projects and the low literacy rates in the area. Dissemination to the village level was identified as important.
- The possibility of regional development as a result of the Project was raised. Stakeholders expressed a desire for the Project to contribute to community development in the area through the establishment of schools and hospitals.
- The creation of employment opportunities for residents of the region. Meeting participants were hopeful that the Project will allow the young population in region to find employment. It was clarified that preference will be given to residents of the region (those living near the mine site, along the Product Transport Route, and near the port) when apply for jobs given they meet the qualification criteria.
- Concerns over the Project were also raised, particularly the potential impacts as a result of Project traffic was discussed. Potential risks to safety of pedestrians were raised, as well as the increased noise from truck traffic. Members in the meeting suggested operating the ore transport trucks during the night-time from 9:00 pm to 6:00 am to reduce the safety risks.

The full list of comments and questions is presented in the Appendix 1G.3.

5.7 DISCUSSION

The major concerns raised during the public consultation meetings are grouped by key themes and are discussed below.

Employment: Many participants were interested in the potential employment opportunities resulting from the Project. Participants indicated their desire for the Project to give priority to local residents. GB Minerals intends to hire as many employees, including men and women, from the Oio Region. Priority will be given to qualified applicants from communities affected by the Project. Local residents will make up the majority of the workforce curing construction, and even more so during the operation phase.

Community Development: The need for community development and specifically the development of social infrastructure was raised. Participants stated that the Project can benefit local communities through creation of roads, electric power supply, schools, and hospitals. The communities would like the proponent to develop a register to record potential community development opportunities. The communities proposed that it will help the Project at a later stage if they consider initiating community development program; no commitments will be made by undertaking this exercise now. Through its Community Development Plan, GB Minerals will explore the opportunities for community development that will be sustainable and will continue to flourish beyond the life of the Project.

Health and Safety: Comments made on potential impacts focused on problems associated with dust and contamination of water and the safety of local residents living around the mine and along the Product Transport Route. GB Minerals has developed a Community Health, Safety and Security (CHSS) Plan to ensure the safety of all community residents. In addition to the CHSS Plan, GB Minerals will be required to meet internationally accepted thresholds relating to air and water quality.

Displacement, Resettlement and Compensation: The launching of the Project will imply expropriation of agricultural land and displacement of villages. Several questions were asked on how and when the populations will be displaced and where they will be resettled. Resettlement will be addressed by GB Minerals following internationally approved standards to ensure proper and fair resettlement and compensation to the affected households. A Resettlement Policy Framework has been developed for the Project. Compensation was a recurrent issue during consultation. Participants wanted to know how they may be compensated for potentially adverse impacts resulting from the Project and how economic benefits from the Project will be made available to them.

Community Engagement: Consultation came up as a leading concern for the stakeholders who attended the public consultation meetings. There appeared to be a general feeling that communities have been neglected in the past by both the government and the Project. In many cases the communities do not trust that the Project or the Government are willing to provide support to local communities. Based on consultation activities undertaken in 2015, the perception toward the Project has changed, with people expressing good will towards the Project.

It is important that the Project continues to provide adequate, clear, timely and consistent information about the Project and ESIA process, as well as information on how stakeholders can participate meaningfully to the Project. Sufficient opportunity should be given to stakeholders to raise issues, make suggestions and voice concerns and expectations of the Project. GB Minerals has developed a SEP to guide them in conducting meaningful engagement with relevant stakeholders throughout the life of the Project.

The ESIA Public Consultation process provides a mechanism for disseminating accurate information and supporting the stakeholder engagement process. Both processes enable clear and consistent messages to reach stakeholders.