Report to:

East Africa Metals Inc.

National Instrument 43-101 Technical Report and Preliminary Economic Assessment for the Da Tambuk Project, Adyabo Property, Tigray National Regional State, Ethiopia

Project No. 704-ENG.VMIN03019-01

Report to:

# EAST AFRICA METALS INC.

# NATIONAL INSTRUMENT 43-101 TECHNICAL REPORT AND PRELIMINARY ECONOMIC ASSESSMENT FOR THE DA TAMBUK PROJECT, ADYABO PROPERTY, TIGRAY NATIONAL REGIONAL STATE, ETHIOPIA

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# GLOSSARY

## *UNITS OF MEASURE*

| | |
|---|---|
| annum (year) | a |
| arc minute | ' |
| arc second | " |
| centimetre | cm |
| coefficients of variation | CV |
| cubic feet per minute | cfm |
| cubic metre per second | $m^3/s$ |
| cubic metre | $m^3$ |
| day | d |
| decrees Celsius | °C |
| degrees | ° |
| delta | δ |
| dry metric tonnes per year | dmt/a |
| dry metric tonnes | dmt |
| gram per tonne | g/t |
| gram | g |
| grams per litre | L |
| hectares | ha |
| horse power | hp |
| hour | h |
| kilogram per tonne | kg/t |
| kilogram | kg |
| kilometre | km |
| kilotonne | kt |
| kilovolt | kV |
| kilowatt hour per tonne | kWh/t |
| kilowatt hour | kWh |
| kilowatt | kW |
| litre | L |
| metre | m |
| metres above mean sea level | mamsl |
| micron | µm |
| milligrams per litre | mg/L |
| milligrams | mg |
| millimetres per day | mm/d |
| millimetres per month | mm/mo |
| millimetres per year | mm/a |
| millimetres | mm |
| million pounds | Mlb |

| | |
|---|---|
| millions of years | Ma |
| minute | min |
| month | mo |
| parts per billion | ppb |
| parts per million | ppm |
| percentage | % |
| plus/minus | ± |
| pound | lb |
| second | s |
| square kilometre | $km^2$ |
| tonne | t |
| tonnes per annum | t/a |
| tonnes per cubic metre | $t/m^3$ |
| tonnes per day | t/d |
| tonnes per day | t/d |
| tonnes per hour | t/h |
| troy ounce | tr oz |
| US dollar | US$ |
| US Dollars per tonne | US$/t |
| volt | V |
| watt | W |

### *Abbreviations and Acronyms*

| | |
|---|---|
| Aberdeen International Inc. | Aberdeen |
| absolute relative difference | ARD |
| ACME Analytical Laboratories (Vancouver) Ltd. | ACME Vancouver |
| ACME Analytik Ankara | ACME Turkey |
| aqua regia and diisobutyl ketone | DIBK |
| Arabian Nubian Shield | ANS |
| Ashanti Gold Field | Ashanti |
| atomic absorption spectroscopy | AAS |
| atomic absorption | AA |
| Beles Engineering PLC | Beles |
| Blue Coast Research Ltd. | BCR |
| Canadian Institute of Mining, Metallurgy and Petroleum | CIM |
| carbon-in-leach | CIL |
| carboxymethyl cellulose | CMC |
| differential global positioning system | DGPS |
| dynamic unfolding | DU |
| East Africa Metals Inc. | EAM |
| east | E |
| engineering, procurement and construction management | EPCM |
| environmental and social impact assessment | ESIA |
| Environmental Impact Assessment | EIA |

Ethiopian Birr ........ ETB
Ethiopian Institute of Geological Surveys ........ EIGS
Exploratory data analysis ........ EDA
Ezana Mining Development PLC ........ EMD
falling object protective structure ........ FOPS
Federal Democratic Republic of Ethiopia ........ FDRE
free board marine ........ FOB
free carrier ........ FCA
general and administrative ........ G&A
geographic information system ........ GIS
Geological Survey of Ethiopia ........ GSE
global positioning system ........ GPS
inductively coupled plasma – emission spectroscopy ........ ICP-ES
inductively coupled plasma – mass spectrometry ........ ICP-MS
inductively coupled plasma ........ ICP
inductively coupled plasma-atomic emission spectroscopy ........ ICP-AES
internal rate of return ........ IRR
International Electrotechnical Commission ........ IEC
International Organization for Standardization ........ ISO
inverse distance weighted to the third power ........ $IDW^3$
Kluane Drilling Ltd. ........ Kluane
life-of-mine ........ LOM
Ministry of Mines, Petroleum and Natural Gas ........ MoMPNG
nearest neighbor ........ NN
net present value ........ NPV
net smelter royalty ........ NSR
north ........ N
portable x-ray fluorescence ........ pXRF
Preliminary Economic Assessment ........ PEA
project affected person ........ PAP
Qualified Person ........ QP
quality assurance ........ QA
quality control ........ QC
rock quality designation ........ RQD
rollover protective structure ........ ROPS
run-of-mine ........ ROM
silicon dioxide ........ $SiO_2$
sodium cyanide ........ NaCN
sodium meta bisulphite ........ SMBS
south ........ S
Standard Reference Materials ........ SRMs
Sweden Agency for Research Cooperation with Developing Countries ........ SAREC
tailings containment facility ........ TCF
Tetra Tech Canada Inc. ........ Tetra Tech
Tigray Resources Inc. ........ TRI

| | |
|---|---|
| volcanic-hosted massive sulphide | VHMS |
| volcanogenic massive sulphide | VMS |
| waste rock storage facility | WRSF |
| weak acid dissociable | WAD |
| west | W |
| work breakdown structure | WBS |
| x-ray diffraction | XRD |
| x-ray fluorescence | XRF |

# 1.0 SUMMARY

## 1.1 INTRODUCTION

East Africa Metals Inc. (EAM) through its wholly-owned subsidiary Tigray Resources Inc. (TRI) owns the Adyabo Project, which includes the Mato Bula and Da Tambuk deposits.

The Mato Bula and Da Tambuk deposits are high-sulphidation gold-rich volcanogenic massive sulphide (VMS) submarine porphyry related systems located in the southern part of the Arabian Nubian Shield (ANS) in the Tigray region of northern Ethiopia.

EAM commissioned Tetra Tech Canada Inc. (Tetra Tech) to complete a Preliminary Economic Assessment (PEA) on the Da Tambuk deposit, which follows the Mineral Resource estimate prepared by David G. Thomas, P.Geo. A PEA for the Mato Bula deposit has been prepared separately.

This PEA reports on underground mining of the Da Tambuk deposit using a centrifugal gravity concentrator to recover coarse and liberated gold followed by a carbon-in-leach (CIL) circuit.

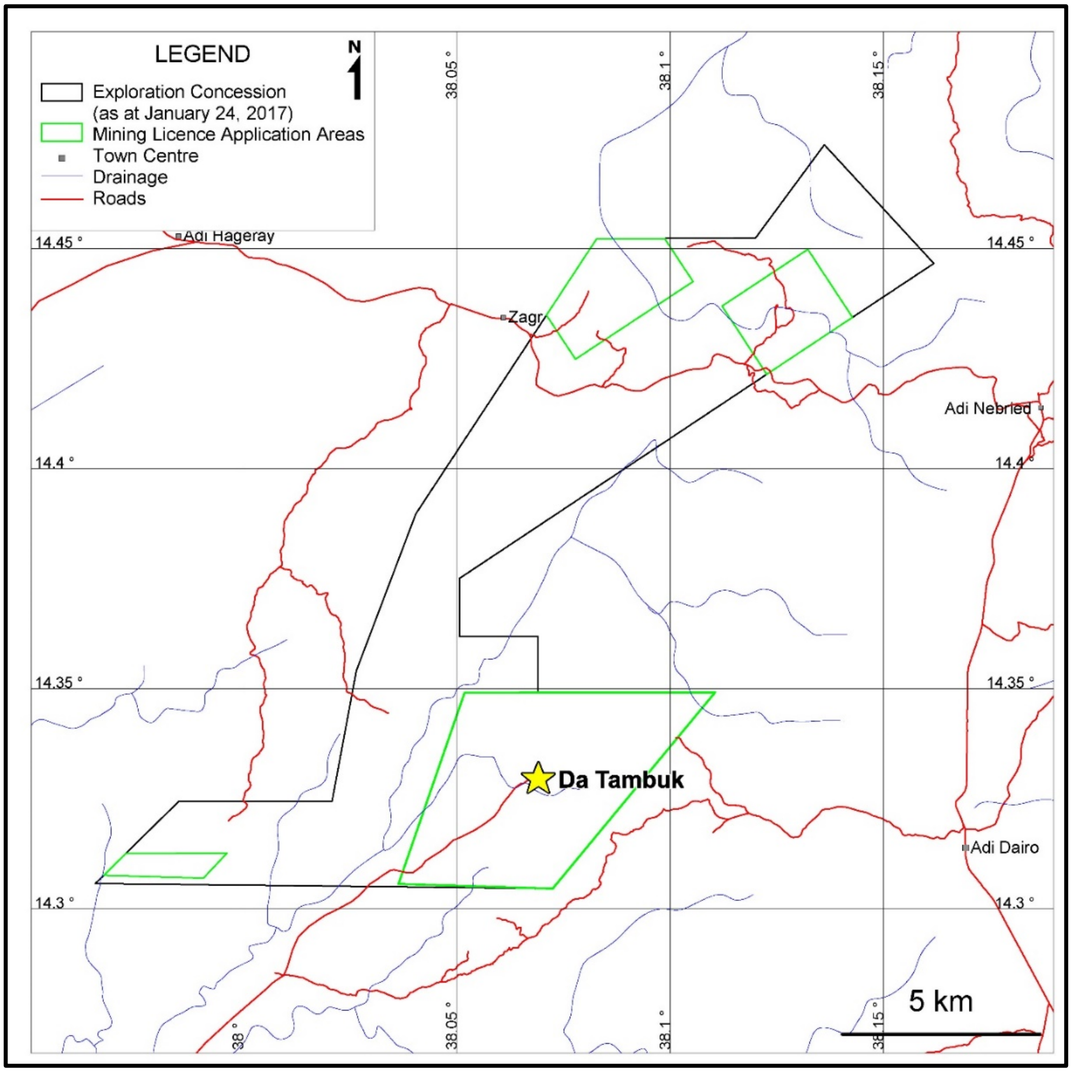
The effective date of both the PEA and the Mineral Resource estimate is April 30, 2018.

## 1.2 PROPERTY DESCRIPTION AND OWNERSHIP

Located in the Tigray National Regional State of the Federal Democratic Republic of Ethiopia (FDRE), the Mato Bula Project is approximately 600 km (1,100 km ground distance) north-northeast of the capital city of Addis Ababa (population 3,385,000 in 2008), and 33 km northwest of the town of Shire (formerly Indaselassie). The FDRE comprises a total area of 1,104,300 km$^2$ and is located between longitudes 33°E to 48°E and latitudes 3°N to 15°N. The country is bounded by Eritrea to the north, Djibouti and Somalia to the east, Somalia and Kenya to the south, with Sudan and South Sudan to the west.

As of January 24, 2017, TRI's precious and base metals Adi Dairo exploration concession (MoM/056-319/99) area covers 108.98 km$^2$. In December 2017, EAm through TRI applied for a mining license covering the Da Tambuk deposit, as well as other satellite prospects, covering a total of 38.33 km$^2$ (Figure 1.1).

**Figure 1.1 Adi Dairo Exploration Concession and Mining Licence Application Area Map**




Source: TRI (2017)

## 1.3 HISTORY

The Adyabo Property was first identified in a regional scale geological mapping and mineral exploration performed by the Ethiopian Institute of Geological Surveys (EIGS) and Ezana Mining Development PLC (EMD) during the 1960s and 1970s; EMD is a private Ethiopian company. Later, EIGS and EMD completed the reconnaissance mapping and prospecting for precious and base metals from 1991 to 1993. The encouraging results from this survey led EMD to acquire the exploration licences in 1993. In 1996, EMD and Ashanti Gold Field (Ashanti) signed a joint-venture agreement for base- and precious-metals exploration in the Adyabo Project area. In 2011 TRI acquired an undivided 80% interest of the Adyabo Property, in February 2016 EAM obtained the remaining 20% interest. EAM through TRI now 100% of the Adyabo Property and has full ownership of the Mato Bula Project, located within the Adyabo Property.

## 1.4 GEOLOGY AND MINERALIZATION

Northern Ethiopia is located within the ANS, an area of Neoproterozoic continental crust covering a large portion of northeast Africa and the western Middle East. Formation of the ANS took place around 870 to 550 Ma during the collision of East and West Gondwana (Johnson & Woldehaimanot 2003). Situated in the northern half of the East African Orogen, it consists of Neoproterozoic juvenile arcs, later-formed sedimentary and volcanic basins, large granitoid and gabbroic intrusions, and enclaves of pre-Neoproterozoic crust (Johnson et al. 2011; Hamimi et al. 2014). Deformation, metamorphism, and uplift occurred due to the Gondwana collision, producing a range of predominantly greenschist facies metamorphic rocks in the Pan-African ANS (Archibald et al. 2015). A later intrusive event, comprising calc-alkaline plutons and subordinate alkaline intrusions (dated at 680 to 600 Ma and 610 to 580 Ma respectively in the northern ANS), emplaced the major granitoids within the ANS (Morag et al. 2011). These metamorphics and volcanics collectively represent granitoid-greenstone terranes; analogous to the Canadian terranes that host some of the world's largest gold-rich VMS deposits (e.g., Bousquet 2-Dumagami, LaRonde Penna; Trench & Groves, 2015).

The Adyabo Project is located in the suture zone of the Adi Nebrid and the Adi Hageray structural blocks. The rocks present in the concession area comprise predominantly metavolcanics (Tambien Group) and younger meta-sedimentary rocks of the Tsaliet Group. The centre of the licence area is dominated by a northeast-trending liner thrust belt of mafic and ultramafic rocks called the Zager Mafic and Ultramafic Belt (Tadesse 1996). The geology of the area is complicated by the development of a fold and thrust belt, which appears to contain thrusted and back-thrusted blocks.

The geology near the Da Tambuk deposit comprises a northeast trending assemblage, from west to east, that includes a thick sequence of black and grey shales (locally with rare graphitic beds), mafic tuff and bedded chert, chlorite sericite schist and variable chlorite sericite schist. Locally, the assemblage is intruded by feldspar phyric quartz eye porphyry, and leuco grabbroic units. In the area of mineralization, strong silicification is noted locally, along with quartz veining.

Exploration efforts on the Adyabo Property currently target two deposit types: gold-rich VHMS and orogenic lode-gold mineralization. A spatial relationship between these deposit types is noted on the property and may be related to reactivation of hydrothermal pathways or redistribution of deposited mineralization during orogenesis.

Upon initiation of trenching, artisanal activities commenced. Staged trenching and subsequent drilling determined that mineralization is associated with moderate to intense silica alteration and quartz veining, and disseminated to semi-massive pyrite, minor chalcopyrite, and sphalerite (drill and trench plan map Section 10.0). The host rock is a pyrite-rich (greater than 10%) sericite schist that attains a thickness of 50 m.

Drilling and trenching exploration programs have defined the mineralization as a 13 m wide (true thickness) high-grade gold shoot that is present over a strike length of 135 m. This shoot is drilled to 150 m depth and appears to remain open along strike, towards the northeast, and down plunge. The shoot is also sub-vertical, but might have a high-grade component that dips shallowly to the southeast, and plunges at approximately 45° to the northeast.

## 1.5 MINERAL RESOURCE ESTIMATE

Mineral Resources for the Project were classified under the 2014 Canadian Institute of Mining, Metallurgy and Petroleum (CIM) Definition Standards for Mineral Resources and Mineral Reserves by applying a cut-off grade that incorporated mining and metallurgical recovery parameters. Mineral Resources are constrained to blocks with enough value to cover the underground marginal cut-off grade. The Qualified Person (QP) for the Mineral Resource estimate is David G. Thomas, P. Geo. The Indicated Mineral Resources is shown subdivided by area in Table 1.1 and the Inferred Mineral Resource is shown subdivided in Table 1.2.

**Table 1.1 Da Tambuk Project Indicated Mineral Resource Estimate David Thomas, P. Geo. (Effective Date: April 30, 2018)**

| Area | Cut-off (US$/t) | Tonnes | Gold (g/t) | Copper (%) | Silver (g/t) | Gold Equivalent (g/t) | Gold Metal (tr oz) | Copper Metal (Mlb) | Silver Metal (tr oz) | Gold Equivalent Metal (tr oz) |
|---|---|---|---|---|---|---|---|---|---|---|
| Da Tambuk | 23.9 | 775,000 | 4.51 | 0.11 | 2.4 | 4.65 | 112,000 | 1.9 | 59,000 | 116,000 |

**Table 1.2 Da Tambuk Project Inferred Mineral Resource Estimate David Thomas, P. Geo. (Effective Date: April 30, 2018)**

| Area | Cut-off (US$/t) | Tonnes | Gold (g/t) | Copper (%) | Silver (g/t) | Gold Equivalent (g/t) | Gold Metal (tr oz) | Copper Metal (Mlb) | Silver Metal (tr oz) | Gold Equivalent Metal (tr oz) |
|---|---|---|---|---|---|---|---|---|---|---|
| Da Tambuk | 23.9 | 110,000 | 4.04 | 0.06 | 2.93 | 4.13 | 14,000 | 0.2 | 10,000 | 15,000 |

Notes: Fladgate reviewed EAM's quality assurance (QA)/quality control (QC) programs on the Mineral Resources data. Fladgate concludes that the collar, survey, assay, and lithology data are adequate to support Mineral Eesources estimation.
Domains were modelled in 3D to separate mineralised rock types from surrounding waste rock. The domains were modelled based on copper and gold grades.
Raw drillhole assays were composited to 2 m lengths broken at domain boundaries.
Capping of high grades was considered necessary and was completed for each domain on assays prior to compositing.
Block grades for gold and silver were estimated from the composites using an inverse distance weighted (power of three) interpolation method into 5 m (along strike) by 2 m (across strike) by 5 m (vertical) blocks coded by domain.
Dry bulk density varied by deposit area. The dry bulk densities are based on 259 specific gravity measurements at Da Tambuk, 1,665 specific gravity measurements at Mato Bula and 231 specific gravity measurements at Mato Bula North.
Blocks were classified as Indicated and Inferred in accordance with CIM Definition Standards 2014. Inferred resources are classified on the basis of blocks falling within the mineralised domain wireframes (i.e. reasonable assumption of grade/geological continuity) with a maximum distance of 100 m to the closest composite. Indicated Mineral Resources are classified based on distances to drillholes which approximate a 40 m by 40 m drillhole spacing.
The Mineral Resource estimate is constrained within a wireframe model using a US$63.90/t minimum block value. Isolated blocks were removed from the wireframe. Metal prices of US$1,400/tr oz, US$3.20/lb and US$20.0/tr oz were used for gold, copper and silver respectively. Metallurgical recoveries of 93% for gold, 72% for copper and 50% for silver were applied at Da Tambuk.
An underground US$ per tonne cut-off was estimated based on a total process and G&A operating cost of US$23.9/t of ore mined. An additional mining cost of US$40/t was assumed for reporting underground Mineral Resources.
The contained gold, copper and silver figures shown are in situ. No assurance can be given that the estimated quantities will be produced. All figures have been rounded to reflect accuracy and to comply with securities regulatory requirements. Summations within the tables may not agree due to rounding.
Mineral Resources which are not Mineral Reserves do not have demonstrated economic viability. The estimate of Mineral Resources may be materially affected by environmental, permitting, legal, title, taxation, socio-political, marketing, or other relevant issues.
The quantity and grade of reported inferred resources in this estimation are conceptual in nature and there has been insufficient exploration to define these Inferred resources as an Indicated or Measured Mineral Resource and it is uncertain if further exploration will result in upgrading them to an Indicated or Measured Mineral Resource category.

## 1.6 MINERAL PROCESSING AND METALLURGICAL TESTING

In 2015, Blue Coast Research Ltd. (BCR) conducted a metallurgical test work program on a composite sample collected from the Da Tambuk deposit to evaluate metallurgical responses of the mineral sample to gravity concentration, agitated cyanide leaching and flotation technologies. The findings from this program are summarized below:

- The gravity concentration tests show that approximately 18.4% of the gold from the feed was recovered into a table concentrate containing 4,818 g/t gold.
- Whole material cyanidation of the Da Tambuk sample returned a gold extraction of 97.3%, indicating that the gold in the composite sample is not refractory and responds well to industry standard agitated cyanide leaching technology.
- Flotation was successful in producing reasonable copper-gold concentrate grades and recoveries from the Da Tambuk sample; however, the gold recovery to the flotation concentrate was lower than that achieved by agitated cyanide leaching.
- Intensive agitated cyanide leaching of a pyrite scavenger flotation concentrate achieved gold extraction of 96.6% indicating that the gold in this material is not refractory and can be recovered using industry standard technology.

The sample used in the test work has higher head grades, especially copper head grade, compared to the average feed grades that are planned to be fed to the proposed mill. Further test work should be conducted on better representative samples, including variability test samples, to confirm the metallurgical responses.

## 1.7 MINING METHODS

An evaluation of mining Mineral Resources for Da Tambuk resulted in a total of 650,000 t planned to be mined over a period of four years.

The tonnes planned for mining and processing include planned dilution of 25% resulting from mining shapes and an additional 10% dilution from unplanned sources.

The Da Tambuk mining operations are planned as a trackless underground operation using a ramp for access. For the PEA it was considered that a wide range of mining methods are possible, selected mining methods include both cut-and-fill and sublevel stoping methods. The cut-and-fill involves filling mined-out voids with combined waste rock and tailings.

Mining waste rock will be stored adjacent to the underground portal on surface, such that the rock can be re-handled for final underground storage.

Underground mining will require a staff of approximately 138 people including management and technical staff, production staff, and equipment maintenance personnel.

## Table 1.3 Da Tambuk Mining Schedule

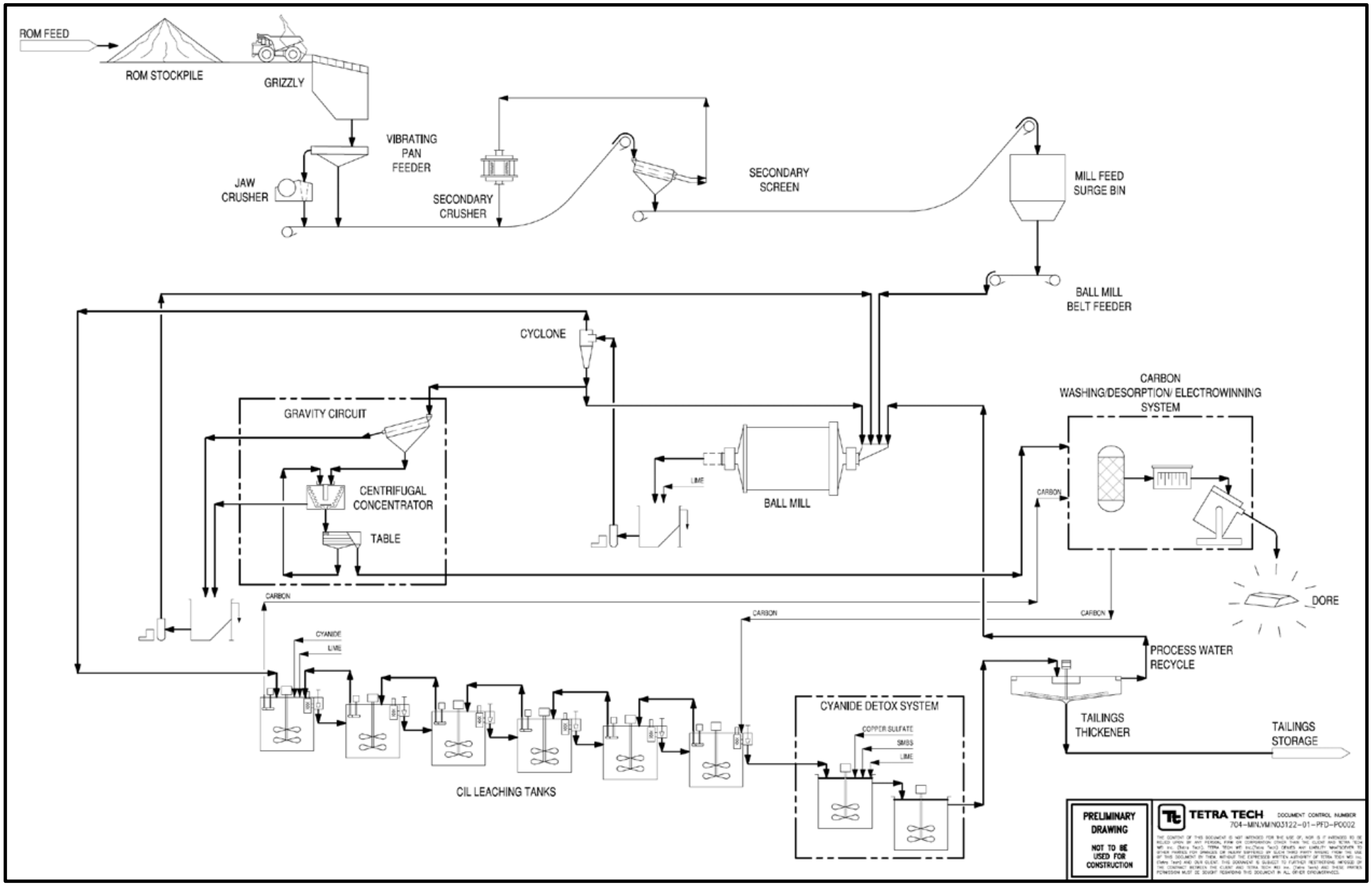
| Mining schedule | Unit | Total | Year | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | -1 | | 1 | | | | 2 | | | | 3 | | | | 4 | | |
| | | | Quarter | | | | | | | | | | | | | | | | |
| | | | -2 | -1 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| Ramp development | m | 2,467 | 72 | 114 | 123 | 140 | 156 | 152 | 170 | 157 | 153 | 143 | 145 | 159 | 588 | 196 | - | - | - |
| Raise development | m | 157 | - | - | - | - | 52 | - | - | 40 | - | - | - | 65 | - | - | - | - | - |
| Crosscut development | m | 210 | - | 30 | 30 | - | 30 | 30 | 30 | 30 | 30 | - | - | - | - | - | - | - | - |
| Other lateral development | m | 370 | 11 | 17 | 18 | 21 | 23 | 23 | 25 | 23 | 23 | 22 | 22 | 24 | 88 | 29 | - | - | - |
| Total lateral metres | m | 3,047 | 83 | 162 | 171 | 160 | 209 | 205 | 225 | 210 | 206 | 165 | 167 | 183 | 676 | 225 | - | - | - |
| Total vertical metres | m | 157 | - | - | - | - | 52 | - | - | 40 | - | - | - | 65 | - | - | - | - | - |
| Waste tonnes mined | t | 101,647 | 2,822 | 5,105 | 5,434 | 5,448 | 7,206 | 6,573 | 7,256 | 7,115 | 6,599 | 5,598 | 5,663 | 6,210 | 22,964 | 7,655 | - | - | - |
| **Stope tonnes mined** | **t** | **650,415** | **-** | **-** | **27,839** | **45,098** | **47,433** | **50,023** | **48,773** | **49,480** | **47,637** | **46,768** | **48,560** | **48,945** | **49,248** | **49,279** | **48,571** | **35,752** | **7,008** |
| Tonnes per day | t/d | 482 | | | 309 | 501 | 527 | 556 | 542 | 550 | 529 | 520 | 540 | 544 | 547 | 548 | 540 | 397 | 78 |
| Gold mined | kg | 3,173 | - | - | 190 | 288 | 280 | 267 | 248 | 233 | 198 | 190 | 203 | 231 | 244 | 238 | 210 | 126 | 28 |
| Silver mined | kg | 1,474 | - | - | 74 | 97 | 94 | 101 | 92 | 101 | 99 | 91 | 93 | 114 | 123 | 131 | 140 | 104 | 19 |
| **Gold grade** | **g/t** | **4.88** | | | **6.8** | **6.4** | **5.9** | **5.3** | **5.1** | **4.7** | **4.1** | **4.1** | **4.2** | **4.7** | **4.9** | **4.8** | **4.3** | **3.5** | **4.0** |
| Silver grade | g/t | 2.27 | | | 2.7 | 2.2 | 2.0 | 2.0 | 1.9 | 2.0 | 2.1 | 2.0 | 1.9 | 2.3 | 2.5 | 2.7 | 2.9 | 2.9 | 2.8 |

## 1.8 RECOVERY METHODS

The process flowsheet was developed based on the metallurgical test results. The proposed process will use both gravity concentration and cyanidation to recover gold from the mineralization. The proposed process plant has been designed to treat the gold bearing material at a processing rate of 550 t/d, equivalent to approximately 200,000 t/a. The designed mill availability is 90%. The overall gold recovery is anticipated to be 93%. The mill will include following processing circuits:

- Conventional crushing and ball mill grinding will be used for comminution with a cyclone to classify particle size of the ground mill feed. A centrifugal gravity concentrator in the grinding circuit will be used to recover coarse and liberated gold particles, and a shaking table will be used to upgrade the gravity concentrate before smelting.
- The ball mill cyclone overflow will be treated in a six-stage CIL circuit to extract gold from the feed material using sodium cyanide. The extracted gold is adsorbed from this solution onto activated carbon.
- The gold-loaded carbon will be removed from the CIL circuit and will initially be acid-washed to remove calcium and other impurities, followed by the elution, or stripping process to recover gold from the carbon into a gold-bearing pregnant solution. Then the gold will be recovered from the pregnant solution onto cathodes by electrowinning.
- The eluted carbon will be reactivated in a thermal kiln followed by attrition to remove carbon fines before being returned to the CIL circuit.
- The CIL tailings will be treated to destruct weak acid dissociable (WAD) cyanide by a sulphur dioxide/air procedure. After the chemical treatment, the WAD cyanide concentration is expected to be low enough to meet regulatory requirements.
- The detoxified tailings will be pumped to a thickener to recover the process water.
- Process water will be recycled from the overflows of the cyanide leach feed thickener and the tailings thickener, and this will be supplemented with process water recovered from the tailings containment facility. Fresh water will be used for reagent preparation and gold-loaded carbon elution circuit as well as for water make-up purposes, as required. The flowsheet is shown in Figure 1.2.

## Figure 1.2 Simplified Process Flow Sheet



## 1.9 PROJECT INFRASTRUCTURE

In addition to mining, process and tailings infrastructure, ancillary facilities will be required for operations. This includes road access, power, fresh and potable water supplies, offices, fuel storage, explosives storage, and reagent storage and administration facilities.

### 1.9.1 WASTE MANAGEMENT, TAILINGS CONTAINMENT, AND WATER MANAGEMENT

Over the life of the operations at Da Tambuk, waste rock removed from the underground to provide access will be hauled to the surface and placed in a storage area. This waste rock will eventually be hauled back into the underground mine and placed in the mined-out areas to provide working surfaces for mining activities and for permanent storage.

The tailings will be deposited behind an embankment that will be engineered to retain the tailings until closure of the operation.

The water management for Da Tambuk will consist of diverting run-off (non-contact water) away from the mine site and containing and managing contact water within the mining area. The water required for processing and for mining activities will be recycled through the process using thickeners, flocculation, detoxification, and filtration to maintain water quality for re-use in the operations. Since the operations are expected to have a negative water balance, make-up water will be needed for operations. Water captured from rainfall events within the mine site will be directed to water management ponds, which will be used as a water source during the dry season.

Dykes will be constructed where necessary to protect the processing area from natural flood events. Water used in underground mining will be collected underground in sumps, settled, and re-used for mining service water.

## 1.10 ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

In July 2017, EAM, through TRI, engaged an independent consulting firm Beles Engineering PLC (Beles) to undertake an environmental and social impact assessment (ESIA) for the Adyabo Project, which contains the Da Tambuk Project and the nearby Mato Bula Project. Beles completed the ESIA in November 2017 and has submitted the final report to TRI. The ESIA did not identify any significant issues that would prevent the development of the project, and that the impacts of development could be mitigated.

Mining licence applications were submitted to the Ethiopian Ministry of Mines, Petroleum and Natural Gas (MoMPNG) in December 2017.

## 1.11 CAPITAL AND OPERATING COST ESTIMATES

The estimated capital and operating costs for the Project are summarized in Table 1.4 and Table 1.5.

**Table 1.4 Capital Cost Summary**

| Description | Cost (US$ million) |
|---|---|
| Overall Site | 2.52 |
| Mining | 2.79 |
| Process | 10.04 |
| TCF | 1.27 |
| On-site Infrastructure | 1.39 |
| Project Indirect Costs | 6.55 |
| Owner's Costs | 3.00 |
| Contingencies | 6.46 |
| **Total Initial Capital Cost** | **34.03** |

Note: TCF – tailings containment facility

**Table 1.5 Operating Cost Summary**

| Description | Unit Cost (US$/t processed) |
|---|---|
| Mining | 31.02 |
| Process and TCF | 21.78 |
| G&A and Site Services | 9.05 |
| Total Operating Cost | 61.85 |

Note: G&A – general and administrative

All costs are reflected in Q1 2018/Q4 2017 US Dollars unless otherwise specified. The expected accuracy range of the cost estimates is –20% to +35%.

## 1.12 FINANCIAL ANALYSIS

Based on this PEA, TRI believes the Da Tambuk Project has positive financial potential and therefore warrants further development. The key financial results show a life-of-mine (LOM) of four years, recovering 94,877 tr oz of gold and 22,514 tr oz of silver.

Financial results are based on the following key assumptions:

- A gold price of US$1,325/tr oz
- A silver price of US$17.00/tr oz.

The key financial results are shown in Table 1.6.

**Table 1.6 Financial Modelling Results for Da Tambuk**

| | Value | Units |
|---|---|---|
| Diluted Tonnes of Material Processed | 650,415 | t |
| Metres of Underground Development | 2,467 | m |
| Mining Unit Costs | 31 | US$/t processed |
| Processing Unit Costs | 21.8 | US$/t processed |
| G&A Unit Costs | 9 | US$/t processed |
| Total Operating Cost per Tonne Processed | 62 | US$/t processed |
| Net Operating Income | 76 | US$ million |
| Capital Costs | 34 | US$ million |
| Sustaining Capital Costs | 8 | US$ million |
| Pre-tax Net Cash Flow | 30.1 | US$ million |
| Post-tax Discounted NPV (8%) | 13.0 | US$ million |
| Post-tax IRR | 28.6 | % |
| Post-tax Payback Period | 1.87 | years |
| Production Cash Cost | 642 | US$/tr oz |

Note: NPV – net present value; IRR – internal rate of return

# 1.13 RECOMMENDATIONS

## 1.13.1 GENERAL

Tetra Tech recommends that EAM advance the Da Tambuk Project through completion of a Feasibility Study prior to detailed engineering and construction.

Summary recommendations are outlined in the following sections; full recommendations and costs can be found in Section 26.0

## 1.13.2 GEOLOGY

The Da Tambuk deposit remains open to mineralization extension both southward and to depth. Additionally, the alteration trend extending southwards warrants additional investigation, and should be further profiled through a geophysical IP survey coordinated with the exploration conducted related to Mato Bula to the south. Additionally, nearby orogenic gold targets should undergo further drill assessment as warrant merits. The Sentraley area of colluvial artisanal workings presents as a greater than 1 km long trend of extensive artisanal workings that spatially warrant further examination.

It is recommended that the path forward for the Da Tambuk deposit area of the Adyabo Property should include the following main activities during the next two phases of the project.

- Phase 1 – Infill and extension drilling of the Da Tambuk mineralization are recommended to fully assess the Da Tambuk deposit and potential areas of extension

- Phase 2 – If positive results are achieved in Phase I, a second phase of work should be undertaken to further refine the mineral resources identified. This program will include:
  - conducting a Mineral Resource update at Da Tambuk, metallurgical investigations are required to bring any new mineralization into a resource context
  - test resource extensions, and new targets identified from trenching and IP survey work, as warranted.

### 1.13.3 MINING

A comprehensive geotechnical assessment including the drilling additional geotechnical holes for initial mining areas, geotechnical core logging, rock quality analysis and rock strength testing is recommended. This assessment will provide an enhanced understanding of the strength of the rock, the nature and orientation of jointing, and the interaction of the rock mass with mining.

This assessment will provide the information and parameters required for detailed mine design and will establish ground control practices to be implemented during mining.

### 1.13.4 METALLURGY AND PROCESS

Additional metallurgical test work on representative samples of the Da Tambuk deposit is recommended to fully characterize the deposit and provide the information required to establish design parameters for the engineering of the Da Tambuk process plant. The recommended test work is proposed below:

- Verify metallurgical responses of the samples collected from various rock zones, lithological zones, and spatial locations of the deposit.
- The test work should include coarse gold recovery by gravity concentration and gold recovery by cyanidation. The metallurgical response of the mineralization to flotation to recover copper minerals prior to the cyanidation leaching stage should be tested to determine if lower cyanidation consumption may be achieved in leaching.
- Comminution test work including the determination of abrasion indices, crushing indices and Bond Work Indices to establish comminution design-related parameters.
- Agitated kinetic leach tests at various grind size to determine the optimum particle size for leaching and confirm the leach time required.
- Settling test work is recommended on samples of agitated leach tailings to determination the settling rate of the tailings. This information will be required to establish design parameters for the thickeners
- Cyanide destruction testing to investigate optimum reagent dosages, reaction retention time, and other related parameters for the cyanide destruction circuit.

Further optimizations on plant design and plant arrangement are recommended. The costs associated with the optimizations will be part of the next phase of study.

Additional assessment of the potential water sources in the Da Tambuk Project area is recommended to confirm the optimum supply source (or sources), with regard to location, quantity and seasonal variation. This assessment should include assessment of groundwater sources in addition to surface sources.

# 2.0 INTRODUCTION

## 2.1 INTRODUCTION

EAM, through its wholly-owned subsidiary TRI, owns the Adyabo Project, which includes the Mato Bula and Da Tambuk deposits.

The Mato Bula and Da Tambuk deposits are high-sulphidation gold-rich VMS submarine porphyry related systems located in the southern part of the ANS in the Tigray region of northern Ethiopia.

EAM commissioned Tetra Tech to complete a PEA on the Da Tambuk deposit, which follows the Mineral Resource estimate prepared by David G. Thomas, P.Geo. A PEA for the Mato Bula deposit has been prepared separately.

This PEA reports on underground mining of the Da Tambuk deposit using a centrifugal gravity concentrator to recover coarse and liberated gold followed by a CIL circuit.

The effective date of the PEA and the Mineral Resource estimate is April 30, 2018.

## 2.2 QUALIFIED PERSONS

A summary of the QPs responsible for this report is provided in Table 2.1. The following QPs conducted site visits of the Property:

- David G. Thomas P.Geo., visited the Da Tambuk site from March 22 to 25, 2015.
- Mark Horan, P.Eng., visited the Da Tambuk site on April 6, 2017.

**Table 2.1 Summary of QPs**

| Report Section | | Company | QP |
|---|---|---|---|
| 1.0 | Summary | All | Sign-off by Section |
| 2.0 | Introduction | Tetra Tech | Mark Horan, P.Eng. |
| 3.0 | Reliance on Other Experts | Tetra Tech | Mark Horan, P.Eng.<br>Hassan Ghaffari, P.Eng. |
| 4.0 | Property Description and Location | Tetra Tech | Mark Horan, P.Eng. |
| 5.0 | Accessibility, Climate, Local Resources, Infrastructure and Physiography | Tetra Tech | Mark Horan, P.Eng. |
| 6.0 | History | Tetra Tech | Mark Horan, P.Eng. |

*table continues...*

| Report Section | | Company | QP |
|---|---|---|---|
| 7.0 | Geological Setting and Mineralization | DKT | David G. Thomas, P.Geo. |
| 8.0 | Deposit Types | DKT | David G. Thomas, P.Geo. |
| 9.0 | Exploration | DKT | David G. Thomas, P.Geo. |
| 10.0 | Drilling | DKT | David G. Thomas, P.Geo. |
| 11.0 | Sample Preparation, Analyses and Security | DKT | David G. Thomas, P.Geo. |
| 12.0 | Data Verification | DKT | David G. Thomas, P.Geo. |
| 13.0 | Mineral Processing and Metallurgical Testing | Tetra Tech | Jianhui (John) Huang, Ph.D., P.Eng. |
| 14.0 | Mineral Resource Estimates | DKT | David G. Thomas, P.Geo. |
| 15.0 | Mineral Reserve Estimates | Tetra Tech | Mark Horan, P.Eng. |
| 16.0 | Mining Methods | Tetra Tech | Mark Horan, P.Eng. |
| 17.0 | Recovery Methods | Tetra Tech | Jianhui (John) Huang, Ph.D., P.Eng. |
| 18.0 | Infrastructure | Tetra Tech | Mark Horan, P.Eng. |
| 19.0 | Market Studies and Contracts | Tetra Tech | Mark Horan, P.Eng. |
| 20.0 | Environmental Studies, Permitting and Social or Community Impact | Tetra Tech | Hassan Ghaffari, P.Eng. |
| 21.0 | Capital and Operating Costs | Tetra Tech | Mark Horan, P.Eng.<br>Hassan Ghaffari, P.Eng.<br>Jianhui (John) Huang, Ph.D., P.Eng. |
| 22.0 | Economic Analysis | Tetra Tech | Mark Horan, P.Eng. |
| 23.0 | Adjacent Properties | Tetra Tech | Mark Horan, P.Eng. |
| 24.0 | Other Relevant Data and Information | Tetra Tech | Mark Horan, P.Eng. |
| 25.0 | Interpretation and Conclusions | All | Sign-off by Section |
| 26.0 | Recommendations | All | Sign-off by Section |
| 27.0 | References | All | Sign-off by Section |

Note: DKT Geosolutions Inc.

## 2.3 SOURCES OF INFORMATION

All sources of information are shown in Section 27.0

## 2.4 UNITS OF MEASUREMENT AND CURRENCY

All measurements are reported in metric units, unless otherwise noted. All gold and silver weights are in troy ounces, unless otherwise notes.

All currency is reported in US dollars, unless otherwise noted.

# 3.0 RELIANCE ON OTHER EXPERTS

Tetra Tech followed standard professional procedures in preparing the contents of this report. Data used in this report has been verified where possible and Tetra Tech has no reason to believe that the data was not collected in a professional manner.

Technical data provided by EAM for use by Tetra Tech in this PEA is the result of work conducted, supervised, and/or verified by EAM consultants.

Tetra Tech has not independently verified the legal status or title of the claims or exploration permits, and has not investigated the legality of any of the underlying agreement(s) that may exist concerning the Property.

Mark Horan, P.Eng. relied on the legal audit and opinion with regard to the title, mining concessions, and registration issues provided by Worku Fantahun Shumiye, Legal Affairs Consultant and Attorney at Law (Addis Ababa, Ethiopia) in a letter dated October 7, 2013. This information pertains to Section 4.0.

Mr. Horan also relied on Peter Granata, C.P.A., C.A., Chief Financial Officer, of EAM, concerning tax matters relevant to this report. The tax, royalty and government participation rates applied to the economic analysis in this PEA were taken from the current Ethiopian federal government tax proclamation for mining. This information pertains to Section 22.0

Hassan Ghaffari, P.Eng. relied on Beles Engineering PLC concerning environmental matters relevant to this report. Beles is one of the very few firms in Ethiopia which provides a wide spectrum of services in water, land and environment including consultancy, training, and construction. They provide services pertaining to consultations, investigations of natural resources, feasibility studies, design and design review, environmental and social impact assessment studies, and baseline surveys. This reliance is based on report titled *Environmental and Social Impact Assessment of the Proposed Da Tambuk Gold Mining Project, Northwestern Tigray, Ethiopia* and dated April 2016. This information pertains to Section 20.0.

# 4.0 PROPERTY DESCRIPTION AND LOCATION

## 4.1 PROJECT LOCATION

Located in the Tigray National Regional State of the FDRE, the Da Tambuk Project is approximately 600 km (1,100 km ground distance) north-northeast of the capital city of Addis Ababa (population 3,385,000 in 2008), and 33 km northwest of the town of Shire (formerly Indaselassie) as shown in Figure 4.1. The Federal Democratic Republic of Ethiopia comprises a total area of 1,104,300 km$^2$ and is located between longitudes 33°E to 48°E and latitudes 3°N to 15°N. The country is bounded by Eritrea to the north, Djibouti and Somalia to the east, Somalia and Kenya to the south, with Sudan and South Sudan to the west.

**Figure 4.1 Property Location Map**

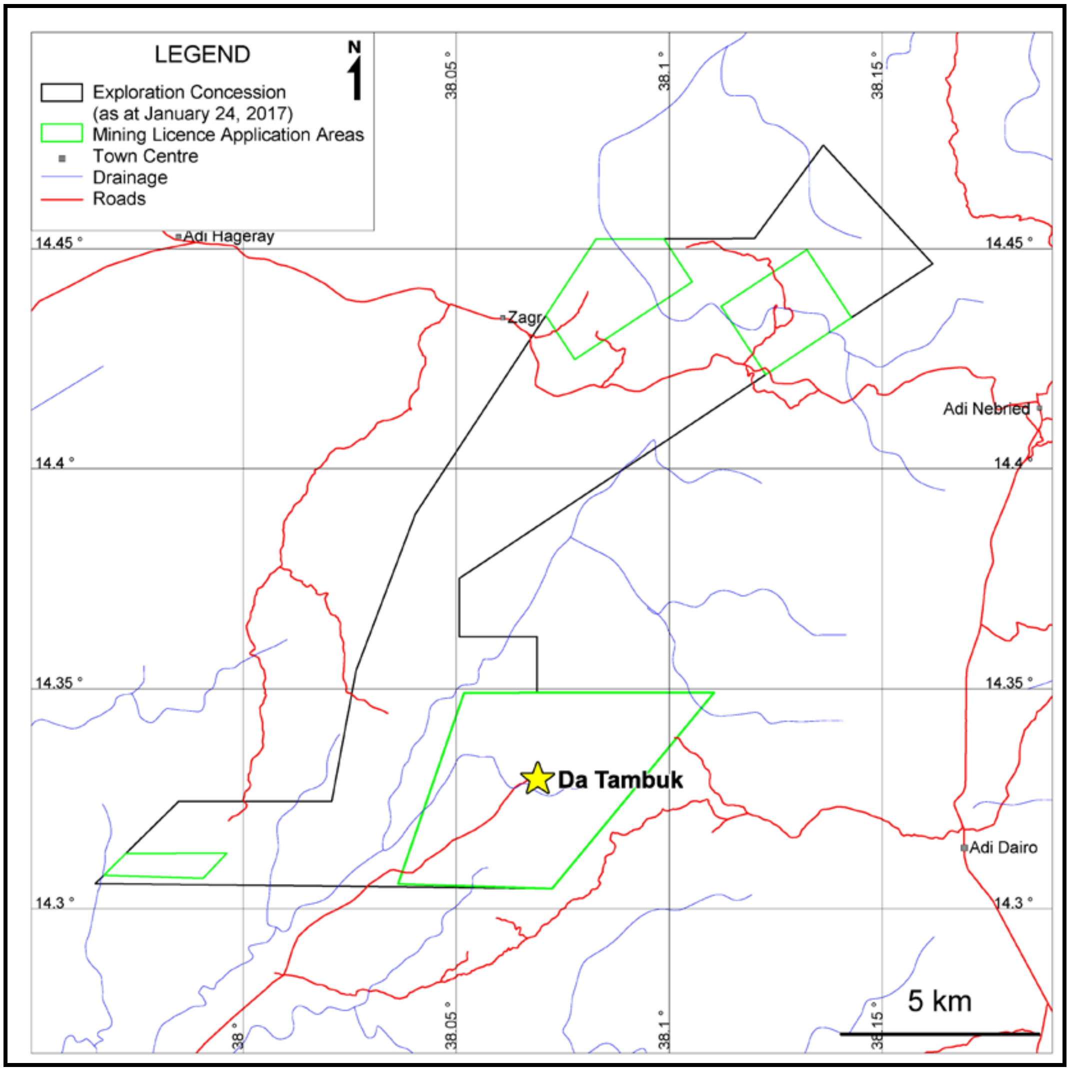

Source: Archibald et al. (2015)

## 4.2 MINERAL TENURE

EAM's wholly-owned subsidiary TRI precious and base metals Adi Dairo exploration concession (MoM/056-319/99) area covers 108.98 km$^2$ as of January 24, 2017. In December 2017, TRI submitted a mining licence application to the MoMPNG covering the Da Tambuk deposit, as well as other satellite prospects, located on the Adi Dairo concession (Figure 4.2). The concession and mining licence application corners were established by geographic information system (GIS) coordinate points, and have not been surveyed or marked on the ground (Table 4.1 and Table 4.2).

The Adi Dairo concession was originally granted to Aberdeen International Inc. (Aberdeen) on January 25, 2007. In December 2011 the licence was acquired by TRI through an option agreement with Aberdeen to acquire up to an 80% interest in the Adyabo Property (the Adyabo Property being comprised of both the Adi Dairo concession and a second concession, West Shire), in two phases over a three-year period. On May 7, 2014, EAM acquired ownership and control of TRI and took over responsibility for the Adyabo Project. On February 1, 2016, the 20% holder of the Adyabo Property converted ownership to a 2% net smelter royalty (NSR), granting 100% ownership to EAM.

**Figure 4.2 Adi Dairo Concession Map**




Source: TRI (2017)

### Table 4.1 Adi Dairo Exploration Concession Coordinates

| No. MOM/0138-0182/2000 | | |
|---|---|---|
| Corner No. | Northing Coordinate | Easting Coordinate |
| 1 | 14°18'20.52" | 37°57'55.22" |
| 2 | 14°19'27.84" | 37°59'5.64" |
| 3 | 14°19'27.84" | 38°1'14.88" |
| 4 | 14°21'14.76" | 38°1'35.40" |
| 5 | 14°23'22.92" | 38°2'25.44" |
| 6 | 14°27'7.92" | 38°4'58.08" |
| 7 | 14°27'8.28" | 38°7'12.00" |
| 8 | 14°28'24.60" | 38°8'9.96" |
| 9 | 14°26'47.61" | 38°9'42.35" |
| 10 | 14°22'30.20" | 38°3'2.50" |
| 11 | 14°21'42.50" | 38°3'2.50" |
| 12 | 14°21'42.50" | 38°4'8.40" |
| 13 | 14°20'56.80" | 38°4'8.40" |
| 14 | 14°20'56.80" | 38°6'37.80" |
| 15 | 14°18'16.49" | 38°4'21.00" |

Note: All coordinates in latitude/longitude (Adindan) projection

### Table 4.2 Da Tambuk Mining Licence Application Area Coordinates

| Corner Point | Latitude (Adindan) | Longitude (Adindan) | Area ($km^2$) |
|---|---|---|---|
| ADML1 | 14.3056 | 38.0363 | 25.14 |
| ADML2 | 14.3490 | 38.0518 | |
| ADML3 | 14.3491 | 38.1105 | |
| ADML4 | 14.3046 | 38.0725 | |
| ADML5 | 14.4248 | 38.0778 | 6.34 |
| ADML6 | 14.4348 | 38.0710 | |
| ADML7 | 14.4522 | 38.0828 | |
| ADML8 | 14.4522 | 38.0987 | |
| ADML9 | 14.4425 | 38.1054 | |
| ADML10 | 14.4214 | 38.1226 | 5.34 |
| ADML11 | 14.4369 | 38.1122 | |
| ADML12 | 14.4498 | 38.1323 | |
| ADML13 | 14.4343 | 38.1427 | |
| ADML14 | 14.3076 | 37.9673 | 1.51 |
| ADML15 | 14.3125 | 37.9725 | |
| ADML16 | 14.3126 | 37.9962 | |
| ADML17 | 14.3069 | 37.9907 | |
| Total | | | 38.33 |

# 5.0 ACCESSIBILITY, CLIMATE, LOCAL RESOURCES, INFRASTRUCTURE AND PHYSIOGRAPHY

## 5.1 ACCESSIBILITY

The Adyabo Property can be accessed directly by scheduled flights from Addis Ababa to Shire (population 43,967) and Axum (population 47,320) year-round. Alternatively, the property can be reached from Addis Ababa via a paved highway.

The TRI head office is maintained in Addis Ababa and Adyabo Project office in Shire Indaselassie. The Adyabo Project area can be accessed from this base via a paved highway that passes along the eastern side of the concession area, followed by dirt road, partially constructed and maintained by the company.

## 5.2 CLIMATE

The Adyabo Project region is characterized by a temperate to hot climate and has both dry and wet seasons. The rainy season extends from mid-June to mid-September with average rainfall of 800 to 1,000 mm/a. Mean daily temperatures range from a high of 32.5°C in March to a minimum of 13°C in January. Most of the region is devoid of natural vegetation, with minor areas of shrub brush and trees most commonly located along tributaries and main drainages. Farming is the main land use and the growing season coincides with the rainy season. During this time, crops such as teff and maize are grown for harvest in November (Archibald at al. 2014).

The climate graph for Shire below (Table 5.1) typifies weather in Tigray. Extreme heat is tempered by the elevated plateau present throughout much of Ethiopia.

Exploration activity can be conducted year-round, although extra caution must be exercised on the roads and while crossing streams in the wet season (June to September).

**Table 5.1 Climate Chart for Shire, Tigray Region (1,900 m)**

| | | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average High | °C | 28.0 | 29.8 | 30.3 | 31.8 | 31.1 | 29.5 | 23.6 | 23.4 | 26.7 | 28.3 | 28.7 | 27.5 | 28.2 |
| Daily Mean | °C | 19.2 | 20.7 | 21.5 | 23.3 | 23.1 | 21.9 | 18.1 | 18.2 | 19.7 | 20.1 | 19.4 | 18.6 | 20.3 |
| Average Low | °C | 10.5 | 11.6 | 12.7 | 14.9 | 15.1 | 14.4 | 12.7 | 13.0 | 12.8 | 11.9 | 10.2 | 9.7 | 12.5 |
| **Precipitation** | | | | | | | | | | | | | | |
| Average Monthly | mm/mo | 2.0 | 1.0 | 3.0 | 22.0 | 48.0 | 119.0 | 297.0 | 274.0 | 110.0 | 15.0 | 14.0 | - | 905.0 |
| Average Daily | mm/d | 0.1 | 0.0 | 0.1 | 0.7 | 1.5 | 4.0 | 9.6 | 8.8 | 3.7 | 0.5 | 0.5 | 0.0 | 29.5 |
| Max Daily | mm/d | 15.0 | 4.0 | 34.0 | 29.0 | 55.0 | 57.0 | 94.0 | 82.0 | 102.0 | 60.0 | 40.0 | 10.0 | - |

## 5.3 PHYSIOGRAPHY

The Tigray region is an upland landlocked area in northern Ethiopia. The landscape consists of steep hilly terrain with deeply incised river valleys and lowland plain areas (Figure 5.2). Rivers over the concession area follow the regional stratigraphy, and drain from northeast to southwest where they meet and flow west to join the Tekezze River.

The largest river on the concession is the Mai Hanse River, which flows from just south of the Adi Nebrid and Zagr. This river is associated with flat plains and the majority of agriculture activities. The highest point on the concession is on the northeast corner at 1,865 m and the lowest is 1,085 m.

Vegetation consists of open grassland and arable fields on the river valleys and small shrubs typically covering steep hills and ridges. Soil cover is typically less than 1 m.

## 5.4 LOCAL RESOURCES AND INFRASTRUCTURE

Ethiopia is a landlocked country. Addis Ababa, the capital city has international air service to major cities in Africa and other global centres. There is good paved highway access from Addis Ababa to the port of Djibouti, a distance of 560 km by air. The highway is suitable for the movement of containerized and heavy lift cargo, and it is the main import and export route of the country. In addition, the Government of Ethiopia has undertaken a major transportation infrastructure program for the country, including significant new railway routes. A new railway route from Addis Ababa to Djibouti was completed in 2016. Although numerous rivers drain Ethiopia’s diverse topography, the only navigable waterway is the Baro River (a tributary of the Nile), located on the country’s western border with Sudan. Historically, Gambela in the southern part of the country has served as a port along the Baro River.

There is a paved highway from Addis Ababa to Axum and to Shire in northern Ethiopia, and this highway will be used to transport equipment and goods to the Da Tambuk Project. Approximately 50 civil airports exist in the country, including five in the Tigray Region (Axum, Dansha, Humera, Makale, and Shire), along with two major military airports. In June of 2009, the Ethiopian government announced plans to construct 5,000 km of new railway for the country, primarily to facilitate the transportation of goods.

Shire is a university town with a population of 47,284 (2007 census). Many districts of the town have modern amenities such as running water, sewerage, and a hospital. A scheduled air service is operated year-round and a variety of commercial premises are located in the town. However, a subsistence lifestyle is evident in the villages in proximity to the Da Tambuk Project, and only limited power and water is available for the inhabitants. Livestock and agriculture are emphasized.

High-voltage power lines are located along the Shire to Adi Dairo and Adi Nebried to Shiraro Roads (Figure 5.2), the voltage of the line is 33 kV.

Other significant infrastructure includes a heliport 1 km south of Adi Dairo, and an airport at Shire. The cellular network and internet are reliable over the majority of the concession area.

**Figure 5.1 Paved Road, Telephone Lines, and High-tension Power Lines near the Eastern Boundary of the Da Tambuk Project**

Source: Archibald et al. (2014)

# 6.0 HISTORY

## 6.1 PROJECT OWNERSHIP

The Adyabo Property was first identified in a regional scale geological mapping and mineral exploration performed by the EIGS and EMD during the 1960s and 1970s; EMD is a private Ethiopian company. Later, EIGS and EMD completed the reconnaissance mapping and prospecting for precious and base metals from 1991 to 1993. The encouraging results from this survey led EMD to acquire the exploration licences in 1993. In 1996, EMD and Ashanti Gold Field (Ashanti) signed a joint-venture agreement for base- and precious- metals exploration in the Adyabo Project area. In 2011 TRI acquired an undivided 80% interest of the Adyabo Property, in February 2016 EAM obtained the remaining 20% interest. EAM through TRI now 100% of the Adyabo Property and has full ownership of the Mato Bula Project, located within the Adyabo Property.

## 6.2 PREVIOUS EXPLORATION

Historic exploration on the Adyabo Property is summarized as follows:

- Regional scale mineral exploration and mapping projects were conducted by the EIGS and EMD during the 1960s and 1970s.
- Hunting Geology and Geophysics Ltd conducted a regional air borne geophysical survey in 1971 over a large portion of the Tigray Greenstone Belt. There were some encouraging results; however, at the time, lack of geological knowledge for most of the area prohibited follow-up work.
- In 1985, a regional gravity survey, funded by the Sweden Agency for Research Cooperation with Developing Countries (SAREC), was conducted along drivable roads at 5 km stations. The results were inconclusive due to sparse data density caused by a limited regional infrastructure, and no follow-up was conducted.
- Reconnaissance mapping and prospecting for precious and base metals was conducted by the EIGS from 1991 to 1993. Encouraging results led EMD to acquire exploration licences in 1993.
- In 1996, EMD and Ashanti signed a joint-venture agreement for exploration of base and precious metals. The most detailed exploration of the belt occurred under this licence which lasted until 1998.
- In 1997, the EIGS produced a 1:250,000 scale geology map covering 9,600 km$^2$ of the area between Axum and Shiraro.
- Aberdeen obtained the Adi Dairo and West Shire licences in 2007, and during the 2007–2010 period, they conducted airborne electromagnetic (EM) totalling

2200 line-km, 1707 line-km of airborne magnetics and radiometric survey, 858 rock chip samples generally on a grid of 150 m line spacing with some targeted rock chip sampling, 1,139 –80 mesh stream sediment samples, and reconnaissance mapping.

- During 2011, exploration activities were conducted across the concession, including remote sensing across the concession, 33.43 km$^2$ of geological mapping, 175 stream sediment samples, 5046 soil samples, 1674 rock chip samples and 261 m of trenching, with 600 samples sent for laboratory analysis.
- In 2012, the Adi Dairo exploration licence was officially transferred to TRI. Exploration activities included 70 stream sediment samples, 770 rock chip samples, 96 channel samples, 10,812 soil samples, 133 km$^2$ geological mapping, alongside GIS and remote sensing.
- In 2013, high ranking precious and base metal targets were advanced within the concession area including completing first pass drilling at Adi Gozomo and Da Tambuk, completing the regional soil program, and compiling a regional geology map.
- During 2014, exploration activities included 4,246 portable x-ray fluorescence (pXRF) soil samples, 573 gold-silver soil samples, 11 rock chip samples for gold-silver and/or multi-element geochemical analysis, 38 rock chip pXRF analysis, 191 trench samples, and 1434.29 m of diamond drilling (including 717 core samples for assay). This work helped target the gold-rich VMS shoot at Da Tambuk. These initial holes were submitted for a Mineral Resource estimate.
- During 2015, exploration activities included 16,593 pXRF soil samples, 6 trenches (359 m, with 186 samples collected), 1,722.13 m of diamond drilling (with 609 drill core samples collected), A differential global positioning system (DGPS) sub-centimetre survey was completed at Da Tambuk drill sites and trenches, compilation of an Inferred Mineral Resource model for Da Tambuk, completion of metallurgical test work at Da Tambuk, and declaration of the Da Tambuk gold-rich VMS deposit Mineral Resource update.
- During 2016, exploration activities included 515.11 m of diamond drilling in 4 drillholes (with 196 drill core samples collected), 1 trench (26 m, with 13 samples collected), assay results from 318 diamond drill core samples previously collected, 513 m of drill core analyzed with a pXRF, and 46 samples collected from 5 drillholes for metallurgical work.

# 7.0 GEOLOGICAL SETTING AND MINERALIZATION

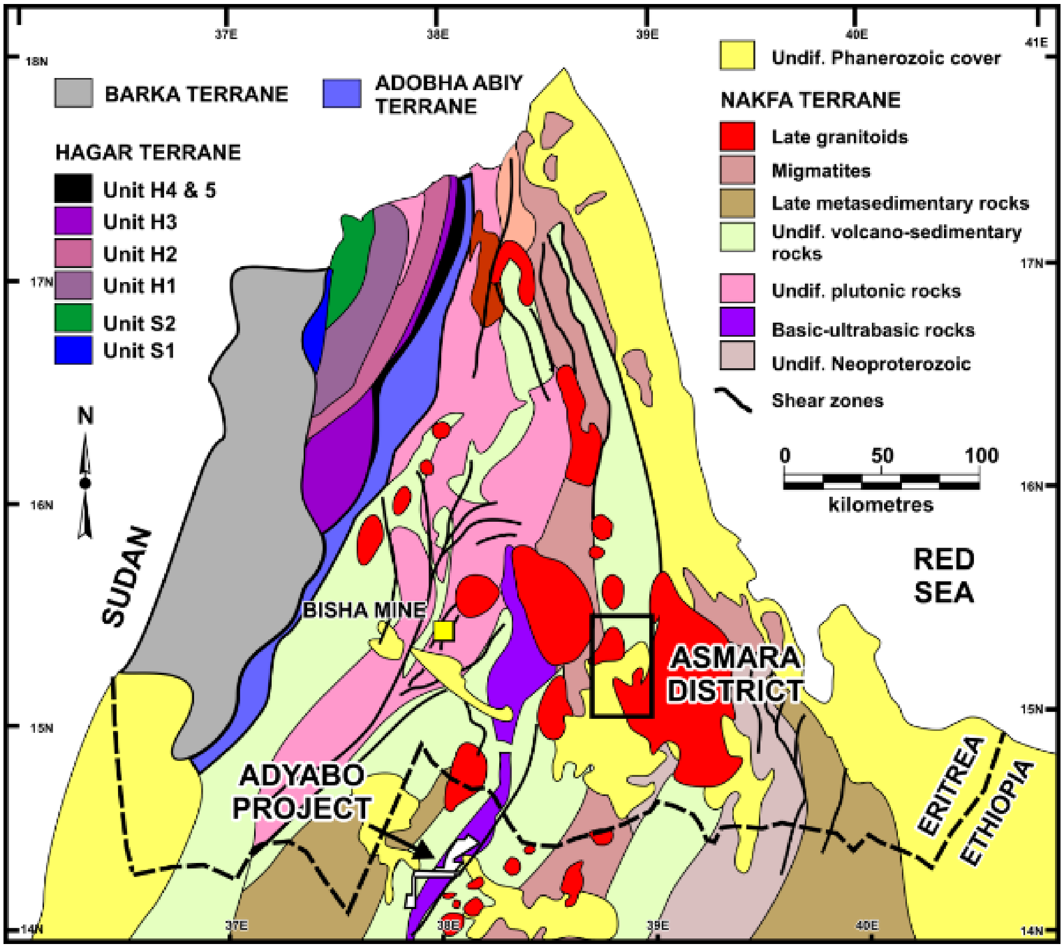
## 7.1 GEOLOGICAL SETTING

### 7.1.1 REGIONAL GEOLOGY

Northern Ethiopia is located within the ANS, an area of Neoproterozoic continental crust covering a large portion of northeast Africa and the western Middle East (Figure 7.1; Stern, 2002; Drury and De Souza-Filho 1998). Formation of the ANS took place around 870 to 550 Ma during the collision of East and West Gondwana (Johnson & Woldehaimanot 2003). Situated in the northern half of the East African Orogen, it consists of Neoproterozoic juvenile arcs, later-formed sedimentary and volcanic basins, large granitoid and gabbroic intrusions, and enclaves of pre-Neoproterozoic crust (Johnson et al. 2011; Hamimi et al. 2014). Deformation, metamorphism, and uplift occurred due to the Gondwana collision, producing a range of predominantly greenschist facies metamorphic rocks in the Pan-African ANS (Archibald et al. 2015). A later intrusive event, comprising calc-alkaline plutons and subordinate alkaline intrusions (dated at 680 to 600 Ma and 610 to 580 Ma respectively in the northern ANS), emplaced the major granitoids within the ANS (Morag et al. 2011). These metamorphics and volcanics collectively represent granitoid-greenstone terranes; analogous to the Canadian terranes that host some of the world's largest gold-rich VMS deposits (e.g., Bousquet 2-Dumagami, LaRonde Penna; Trench & Groves, 2015). This is probably significant to the Au-rich VMS and orogenic gold prospectivity of the Pan-African ANS, as recently discovered systems (mostly within the last 3 to 4 years) symbolize an emerging gold province, with regional Mineral Resource estimates in excess of 28 million tr oz gold (Trench & Groves 2015).

The northern Ethiopian basement is primarily a granitoid-greenstone terrane (Figure 7.2). The Late Proterozoic Tambien Group and Tsaliet Group are two of the major sequences, which host the Mato Bula–Da Tambuk system. The Tsaliet Group is the older of the two, composed of metavolcanic and metavolcaniclastic sequences, with mineral assemblages that indicate peak regional metamorphism of pumpellyite-actinolite to lower greenschist facies (approximately 245–375°C; Alene et al. 2006). Conversely, the Tambien Group is a younger, metasedimentary slate and carbonate succession, with metamorphic temperatures inferred (by chlorite thermometry) to have been at the lower end of those experienced by the Tsaliet Group (approximately 250°C; Alene et al. 2006). The contact between the two Groups is inferred to be either unconformable or gradational (Beyth 1971; Alene et al. 1998).

**Figure 7.1 Geological Setting Map with Relation to Asmara Properties and Bisha Mine**




Source: Redrawn after Drury and De Souza-Filho (1998)

## Figure 7.2 Geology of the Region Surrounding the Mato Bula-Da Tambuk System in Northern Ethiopia

### SYMBOLS

Geological contact : observed,inferred.

Faults : observed,inferred.

Fault barb on downthrown side.

Synform

Mato Bula - Da Tambuk Au-rich VMS System

#### EARLY - LATE JURASSIC

**Ja** Adigrat Formation : Triassic-Middle Jurassic sandstone.

#### LATE PALEOZOIC - TRIASSIC

**Pzt** Enticho Sandstone, Edaga Arbi Glacials,Gura and Gilo Formations: Sandstone, shale, conglomerate and tillite.

#### LATE PROTEROZOIC

**PR2s** Shiraro Formation : Sandstone and conglomerate.

**PR2d** Didikama Formation : Slate and dolomite.

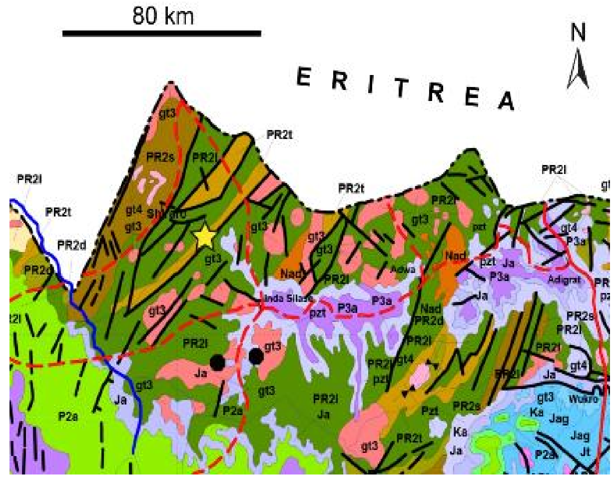
**PR2t** Tembien Group : Chlorite, sericite and graphite phyllites, limestone, slate and dolomite.

**PR2l** Tsaliet Group : Metaandesite, metadacite,metarhyolite.chlorite, sericite and graphite phyllites,green schist,limestone and quartzite.

#### PRECAMBRIAN AND PHANEROZOIC INTRUSIVE ROCKS

**gt4** Post - tectonic granite and syenite.

**gt3** Late to post - tectonic granite.




#### MIDDLE - LATE OLIGOCENE

**P3a** Aiba Basalts:Flood basalts with rare basic tuff.

#### EOCENE

**P2a** Ashangi Formation: Deeply weathered alkaline and trasitional basalt flows with rare intercalations of tuff,often tilted (includes Akobo Basalts of SW Ethiopia).

#### CRETACEOUS

**Ka** Amba Aradom Formation:Sandstone, conglomerate and shale.

#### LATE JURASSIC

**Jag** Agula Formation :Kimmeridgian shale,marl and limestone.

**Ju / Jt** a) Urandab Formation (Ju) : Oxfordian-Kmmerdgian marl and shaly limestone
b) Antalo Formation (Jt) : Limestone.

Source: Adapted from Tefera et al. (1996)

### 7.1.2 STRUCTURAL SETTING

Numerous accreted terranes and microcontinents reflect episodic terrane collision and closure of the Mozambique Ocean from about 800 to 550 Ma as part of the East African Orogeny. Inner terranes collided against and deformed older Archaean to Mesoproterozoic crust of eastern Africa, as mainly high metamorphic grade. The final 100 Ma of the orogeny was dominated by strike-slip movement along suture zones between the obliquely colliding terranes. The ANS is characterized by an extremely broad group of such strike slip faults.

The overall structural trend of the Tigray region is northeast directed with multiple phases of folding and faulting observed across the belt including isoclinal folding, recumbent folding, and thrust and shear faults. Deformational structures within both the Tambien and Tsaliet Groups can be linked to two major phases of folding: D1; a N-S regional compression, and D2; an approximate east-west regional compression (Alene & Sacchi 2000). The D1 compression produced mm-dm wavelength upright and tight folds within bedding, formed between approximately 700 to 650 Ma, along with elongation lineations and regional foliations that exhibit a transposed fabric. The later D2 compression, likely associated with the final collisional phases between East and West Gondwana, produced more regional scale structures (e.g., stretching lineations) in addition to large, mostly upright, open folds with a lack of pervasive cleavage (Abdelsalam & Stern 1996; Alene & Sacchi 2000; Alene et al. 2006). Textural features and mineral assemblages indicate that the metamorphism affecting the Tsaliet Group occurred during D1, while either D2-synchronous metamorphism or pre-D2 local contact metamorphism (from granitoid intrusives) is responsible for the production of the Tambien Group metamorphics (Alene & Sacchi, 2000).

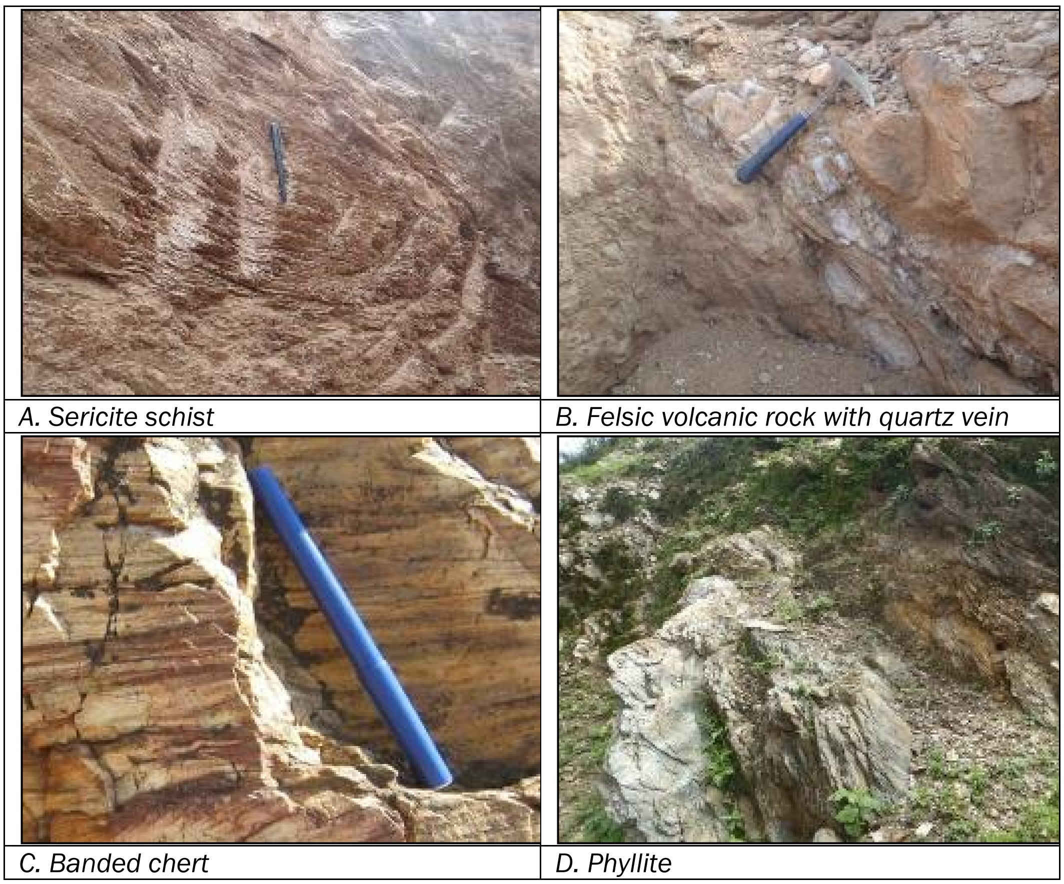
### 7.1.3 LOCAL GEOLOGY

The Adyabo Project is located in the suture zone of the Adi Nebrid and the Adi Hageray structural blocks (Figure 7.2). The rocks present in the concession area comprise predominantly metavolcanics (Tambien Group) and younger meta-sedimentary rocks of the Tsaliet Group. The centre of the licence area is dominated by a northeast-trending liner thrust belt of mafic and ultramafic rocks called the Zager Mafic and Ultramafic Belt (Tadesse 1996). The geology of the area is complicated by the development of a fold and thrust belt, which appears to contain thrusted and back-thrusted blocks.

Regionally, from west to east, the project geology includes slate with marble lenses (Leso Formation), metaconglomerates, greywackes, and sandstone (Tsaliet Group) and a sequence of older Adi Hageray Block intermediate metavolcanic and volcaniclastic rocks (intruded by mafic intrusions) that have been thrust over the Tsaliet Group. The central part of the Adi Dairo concession is underlain by metamorphosed mafic and ultramafic rocks (talc-schist, tremolite-chlorite schist and altered pyroxenite-bearing metavolcanic rocks) comprising the Zager Mafic and Ultramafic Belt; the east part of the project area is underlain by phyllic and graphitic schist, meta-chert, and intermediate metavolcaniclastic rocks of the Adi Nebrid Block (Gardoll et al. 2015). Photographs of some of the lithologies present in the project area are illustrated in Figure 7.3. Syn- and post-tectonic granite and granodiorites are present in the project area, and numerous porphyritic dykes and stocks have also been documented. On the western and northern edge of the project area two large (greater than 5 km) melanocratic metagabbros are present, and these bodies could be contemporaneous with the metabasalts in the Adi Hageray Block.

Owing to the low competence of many of the country rocks, especially the ultramafic units, the rocks have been extensively sheared. The intrusive margins are sheared, but little deformation is evident in the centre of the bodies. Figure 7.4 presents the location of the Adi Dairo Licence concessions overlain on the 1:250,000 scale Bedrock Map from the Geological Survey of Ethiopia (GSE).

**Figure 7.3 Typical Rock Types found Throughout the Adyabo Property**



*A. Sericite schist*

*B. Felsic volcanic rock with quartz vein*

*C. Banded chert*

*D. Phyllite*

E. Sheared black shale

F. Gossan

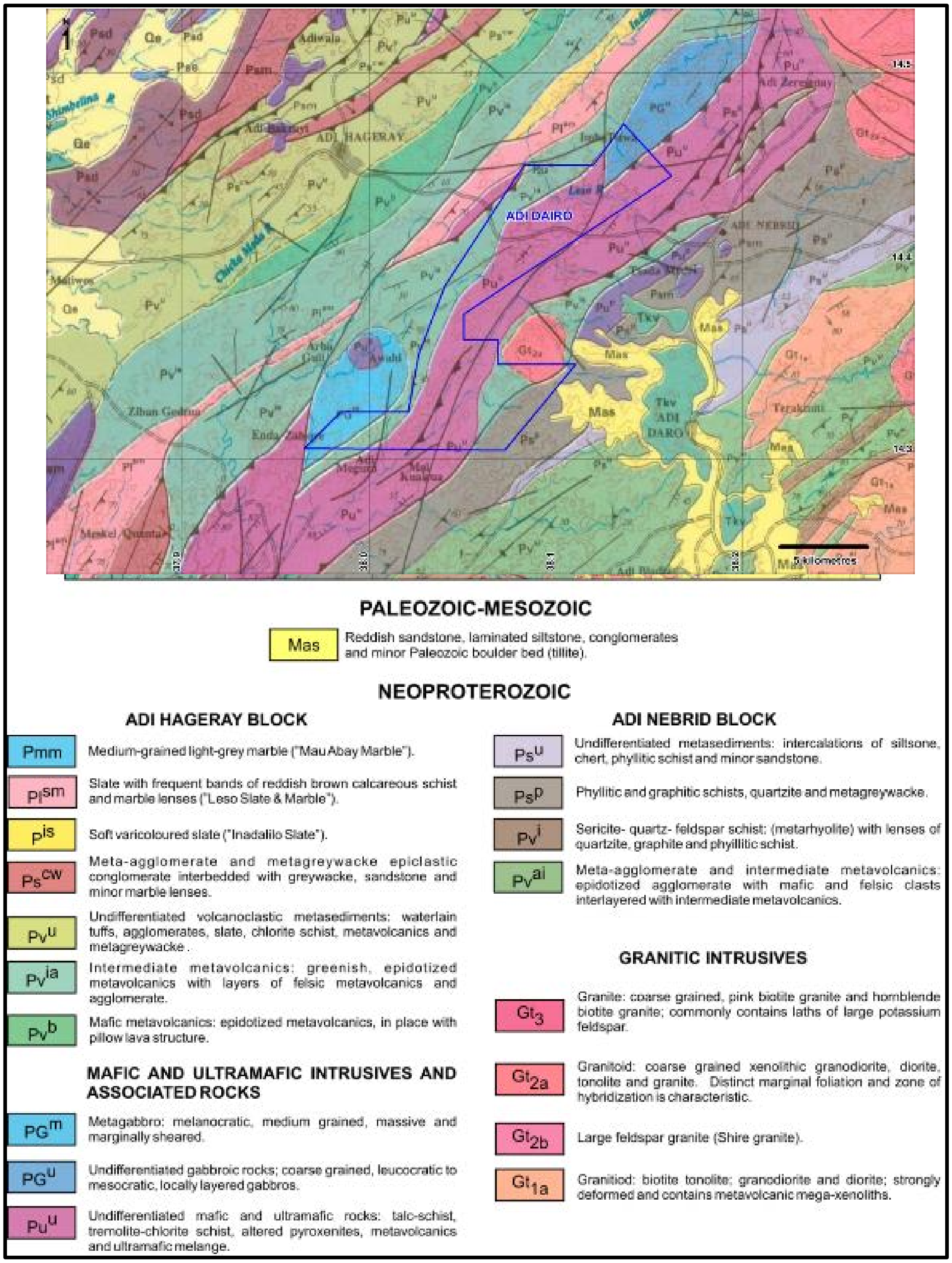
G. Hornblende mafic (diorite)

H. Dolerite

I. Ultramafic unit (talc schist, tremolite-chlorite schist)

J. Visible gold

**Figure 7.4 Local Geology from the 1:250,000 Geological Survey of Ethiopia (1999) Axum Map (Host Geology of the Da Tambuk Deposit)**



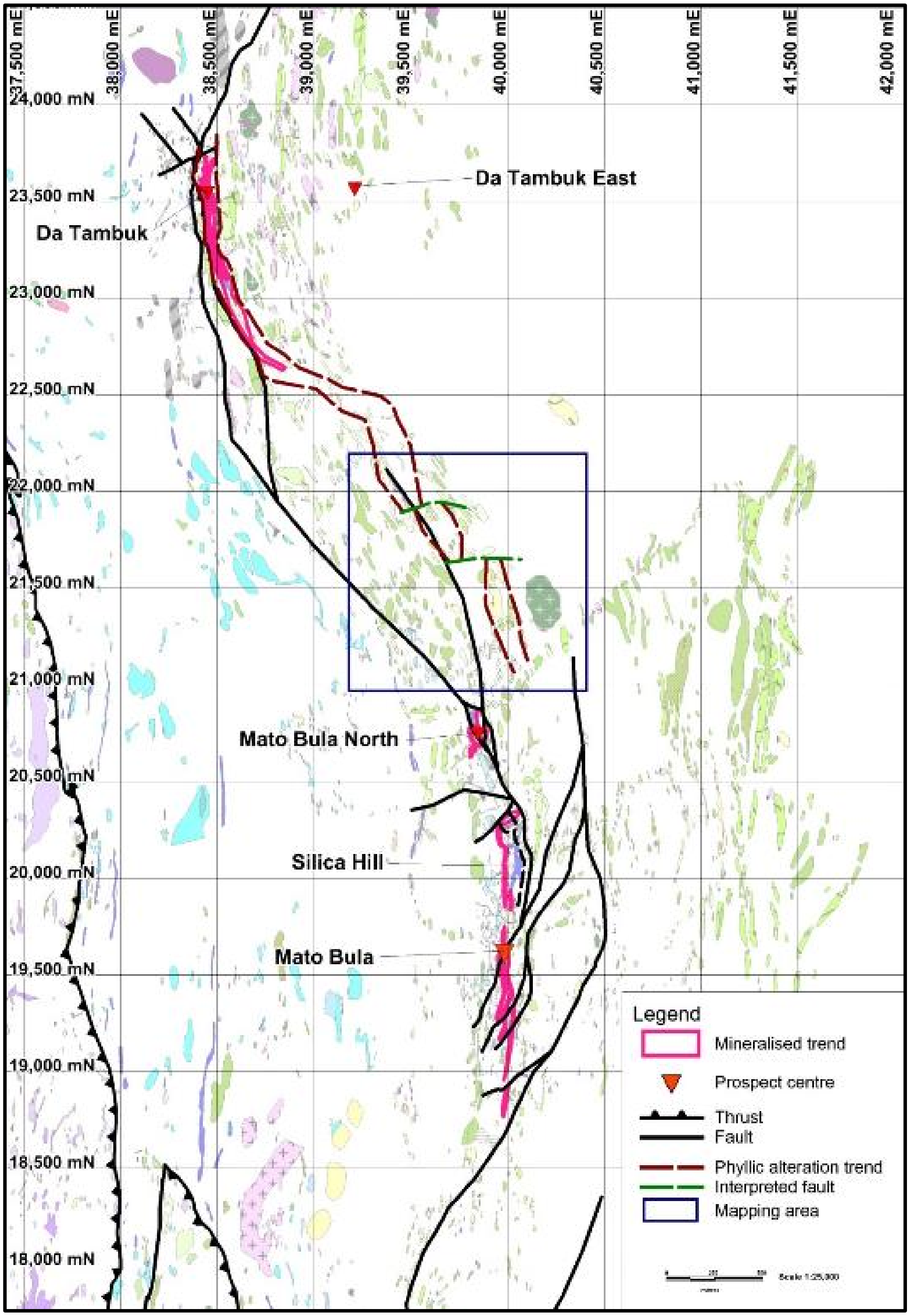
The geology near the Da Tambuk deposit comprises a northeast trending assemblage, from west to east, that includes a thick sequence of black and grey shales (locally with rare graphitic beds), mafic tuff and bedded chert, chlorite sericite schist and variable chlorite sericite schist. Locally, the assemblage is intruded by feldspar phyric quartz eye porphyry, and leuco grabbroic units. In the area of mineralization, strong silicification is noted locally, along with quartz veining.

A zone of phyllic alteration (sil-ser-py) has been mapped over 700 m of north-south trending strike between the Mato Bula north and Da Tambuk south (Figure 7.5). This zone of alteration may prove to be the linking structure between the Mato Bula north and Da Tambuk prospect, and if true, presents 700 m of prospective strike.

This trend passes 200 m to the east of Mato Bula North, which is a gold-rich volcanic-hosted massive sulphide (VHMS)-type target found on the southern licence boundary of the Adi Dairo concession. The alteration indicates that Da Tambuk prospect appears to be on a separate trend with Mato Bula and Silica Hill. This hypothesis is supported by the different geochemical nature of Mato Bula North (high copper, low gold) verses Mato Bula, Silica Hill and Da Tambuk (high gold, low copper). In addition, Mato Bula and Silica Hill are hosted within altered schist, whereas Mato Bula North is hosted higher up in the sequence in the VTSM unit. However, this theory cannot be confirmed without further detail mapping to the south.

Foliation in the area is trending south-southwest (190°), dipping steeply (60 to 80°) towards west-northwest, locally swinging up to 30° to trend 218°, dipping (80 to 85°) towards northwest.

**Figure 7.5 Mapping Zone of Phyllic Alteration (sil-ser-py) Mapped over 700 m of North-South Trending Strike between the Mato Bula and Da Tambuk Prospects**

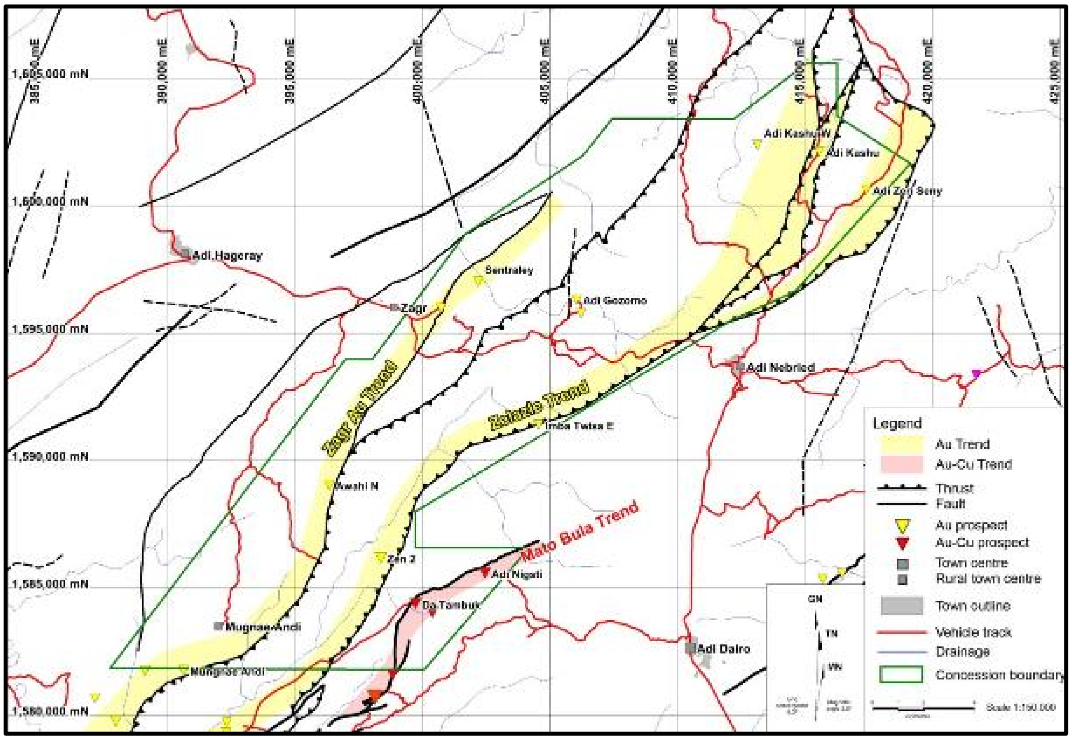



Note: The blue box defines the mapping area.

## 7.2 MINERALIZATION

Exploration efforts on the Adyabo Property currently target two deposit types: gold-rich VHMS and orogenic lode-gold mineralization. A spatial relationship between these deposit types is noted on the property and may be related to reactivation of hydrothermal pathways or redistribution of deposited mineralization during orogenesis. Further discussion of orogenic gold style of mineralization is not included in this report. Figure 7.6 highlights the distribution of current targets and trends at Adyabo.

**Figure 7.6 Da Tambuk Exploration Target Locations by defined Mineralized Trend**




Source: Adi Dairo Annual Report (2015)

The Da Tambuk deposit, located 4 km northeast along strike from Mato Bula, was originally targeted due to its intense alteration signature determined from Landsat image interpretation. Systematic exploration, including reconnaissance regional soil sampling, delineated a 1.2 km long gold-in-soil anomaly with concentrations greater than 100 ppb gold. Local associations of lead and molybdenum soil anomalies were also present. The highest gold concentration recorded in soils was 5 ppm gold, and no previous artisanal workings were identified in this area. Several trenches were excavated, and one trench intersected 16 m grading at 3.95 g/t gold, including 4 m at 14.53 g/t gold.

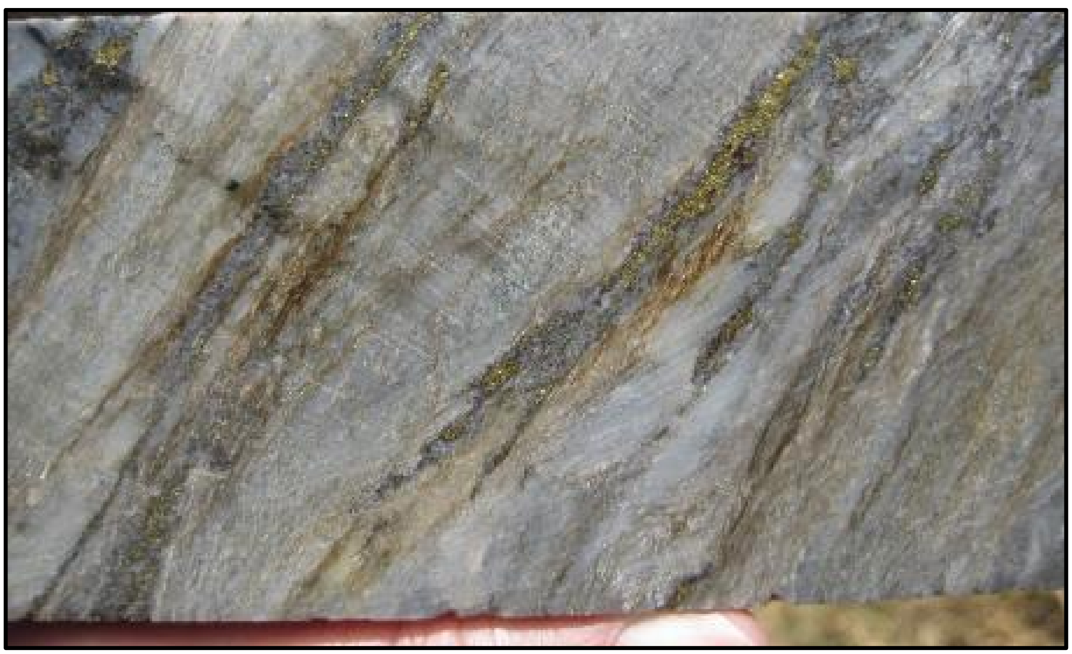
Upon initiation of trenching, artisanal activities commenced. Staged trenching and subsequent drilling determined that mineralization is associated with moderate to intense silica alteration and quartz veining, and disseminated to semi-massive pyrite, minor chalcopyrite, and sphalerite (drill and trench plan map Section 10.0). The host rock is a pyrite-rich (greater than 10%) sericite schist that attains a thickness of 50 m.

Information from drilling and trenching defines the mineralization as a 13 m wide (true thickness) high-grade gold shoot that is present over a strike length of 135 m (high-grade mineralization core photo Figure 7.7). This shoot is drilled to 150 m depth and appears to remain open along strike, towards the northeast, and down plunge. The shoot is also sub-vertical, but might have a high-grade component that dips shallowly to the southeast, and plunges at approximately 45° to the northeast.

The exploration programs to date have emphasized defining early resource footprints, with significant down dip and along strike exploration targets remaining for additional testing along the interpreted mineralized trend.

To date, the company has defined one deposit system, the gold-rich VMS Mato Bula/Da Tambuk deposit, by completing a Mineral Resource Estimate in accordance with the CIM Definition Standards for Mineral Resources and Mineral Reserves (2014). Drilling was based on 40 and 80 m intersections along strike and to depth on the mineralized trend in key areas where mineralization was interpreted from surface exploration.

**Figure 7.7 High-grade Gold Mineralization from Da Tambuk (ADD006, 56.7 g/t Gold and 1.60% Copper); Wispy Chalcopyrite within a Silicified Sericite Schist**



# 8.0 DEPOSIT TYPES

The ANS hosts approximately 60 VMS deposits in several districts, most notably in Saudi Arabia, Sudan and Eritrea (Barrie & Hannington 1999; Barrie et al. 2007), and the largest examples are illustrated in Figure 8.1. The geology of the Adyabo Project area is analogous to the host rocks for gold-rich VMS deposits located at Bisha and the Hassai districts, which occur within the Adi Nebried/Asmara back arc basin.

The VMS mineralization in the Adi Nebried/Asmara back arc basin have been variably described as Kuroko-type (Chewaka and DeWit 1981) and bi-modal mafic type (Hannington 2009), with mineralization hosted within volcanic and metasedimentary rocks. Generally, VMS deposits contain footwall mineralization consisting of quartz-chalcopyrite stringers (stockwork), overlain by primary bedded (stratiform) sulphides composed of pyrite, chalcopyrite, ± sphalerite, ± galena, ± barite, ± tetrahedrite/tennantite. In some deposits, the stratiform massive sulphide lens makes up the entire economic deposit, whereas in other deposits, large quantities of ore are also mined from the stockwork zone. The stratiform sulphides are typical overlain by, or grade into, an iron-rich silica facies that is usually manifested as a banded iron formation (BIF). Surficial weathering results in the primary sulphides forming secondary, supergene minerals such as chalcocite, covellite, digenite, and bornite. The surface manifestation of a VMS system is the total leaching of metals with the exception of silica and iron to produce a hematite-goethite gossan. VMS deposits usually consist of several mineralized lenses that can attain thicknesses up to 50 m and strike lengths up to 1,500 m (Galley 2004; Franklin et al. 2005).

Gold-rich VMS are a sub-type of both VMS and lode gold deposits (Poulsen & Hannington 1996; Hannington et al. 1999; Huston 2000; Poulsen et al. 2000; Dubé et al. 2007a). This sub-type consists of semi-massive to massive sulphide lenses, which are underlain by discordant stockwork feeder zones. However, gold-rich VMS deposits differ from other types of VMS deposits by their gold concentration (in grams per tonne gold), which exceeds the associated combined copper, lead, and zinc grades (in weight percent) (Dubé et al. 2001).

**Figure 8.1 Gold-rich VMS and Orogenic Gold Deposits of the Arabian-Nubian**


Source: Trench and Groves (2015)

Host rocks are exclusively felsic to intermediate volcanic or volcaniclastic rocks, with subvolcanic tonalitic intrusions common at the district scale, e.g., Bousquet 2 – LaRonde 1 and LaRonde Penna (Dubé et al. 2007b; Dubé et al. 2013). Alteration is advanced argillic at the deposit scale, and when present in a metamorphosed environment (aluminous alteration with andalusite) may be common at the deposit scale (Dubé et al. 2007a; Pilote et al. 2014). The sulphide mineralogy of the gold-bearing ores is commonly more complex than in traditional gold-poor VMS deposits (Hannington et al. 1999). Sulphide minerals are mainly pyrite, chalcopyrite, sphalerite, pyrrhotite, and galena with a complex assemblage of minor phases including locally significant amounts of bornite, tennantite, sulphosalts, arsenopyrite, mawsonite, and tellurides (Hannington et al. 1999; Dubé et al. 2007a; Mercier-Langevin et al. 2011).

### 8.1.1 Orogenic Gold Deposits

Lode-gold deposits are intimately associated with orogeny and other plate collision events within geologic history. Most lode-gold deposits are sourced from metamorphic rocks because it is thought that most are formed by dehydration of basalt during metamorphism. The gold is transported up faults by hydrothermal fluids and deposited when the water cools, boils, and reacts with the wall rock or with another fluid, precipitating the gold in solution.

The ANS is also a significant gold producer with numerous gold deposits and artisanal workings across the whole terrane. The host rocks range from graphitic mica schist and ultramafic rocks (Lega Dembi, Ethiopia), to granite stocks (Sukhaybarat East, Saudi Arabia), and along granite contact facies (El Sid and Umm Rus, Egypt). Other host rocks from the area include metamorphosed mafic lavas, volcaniclastic tuff, phyllites and deformed granodiorites. All the mineralization is epigenetic and present in a variety of forms, e.g., quartz veins, pods, veinlets, stringers, stockworks, and breccias. Vein mineralogy is dominated by quartz, carbonate (calcite, dolomite and siderite), pyrite, arsenopyrite and pyrrhotite, and the wallrock alteration is typically sericite, chlorite, and carbonate.

Many gold occurrences are also noted in the district with widespread artisanal workings. Gold is associated with shear hosted quartz veining and often occurs in association with sulphides hosted within vein quartz. The lode dimensions and orientation are varied across the terrane. At Lega Dembi, the steeply-dipping ore zones are located within a 1,500 m long by 200 m wide belt. Individual veins are up to 3 m thick. Quartz veins at the Zalm mine are as long as 300 m and as wide as 3 m. In the Al Wajh district, individual veins are less than 100 m long and 1 m wide, but combined to make sheeted zones 100 to 200 m long and greater than 2 m wide. Most lodes are oriented north-south, parallel to the main trend of the orogen.

Typically, the ore minerals are pyrite, arsenopyrite, and pyrrhotite. In Saudi Arabia, grades average 2.5 g/t at the Sukhaybarat East deposit and 3 to 4 g/t for veins in the Al Wajh district. Some small southern Saudi Arabian vein systems are much higher grade (e.g., Ad Duwayah is 11 g/t and Bi'r Tawilah is 14 g/t). Parts of the vein system at the Zalm mine grade near 100 g/t, although grades typically average between 2.5 to 12.5 g/t.

Exploration efforts on the Adyabo Property currently target two deposit types: gold-rich VHMS and orogenic lode-gold mineralization. A spatial relationship between these deposit types is noted on the property and may be related to reactivation of hydrothermal pathways or redistribution of deposited mineralization during orogenesis. Further discussion of orogenic gold style of mineralization is not included in this report.

# 9.0 EXPLORATION

All mineral exploration by EAM to date has been conducted by EAM permanent- and contract- staff, except for petrographic work conducted by Dr. Gawen Jenkin (Leicester University), Dr. Graham Wilson (Turnstone Geological Services), and Mallory Dalsin (Hummingbird Geological Services).

## 9.1 GEOLOGICAL MAPPING

As noted in Section 6.0, geological mapping of the Adyabo Property was performed by the EGS and Ezana. However, the first detailed mapping of the Adyabo Property was undertaken by EAM geologists in March 2012 at a scale of 1:2,000 and covering an area of 1.2 $km^2$ at Mato Bula. This was followed by the mapping of a 1 $km^2$ area at 1:500 in May 2012, and 3.75 $km^2$ at 1:2,000 scale in August 2012. Additional mapping programs have been carried out since 2012 on other prospects on the property at scales varying from 1:2000 to 1:250. However, most mapping is performed at 1:500 scale.

The study involved investigating as many of the outcrops in the mapping area as possible and accurately describing the geology (lithology, alteration, grain size variations) and taking structural measurements (bedding, foliation, lineation, etc). Non-orthorectified registered 2012 Worldview images were employed as a base map, with geological locations collected using a handheld Garmin 60 CSX global positioning system (GPS) unit for accurate location. Over 1,900 outcrops and sub-crop areas were recorded and digitized into MapInfo for the Mato Bula-Da Tambuk area. Additional structural data were collected to record strike and dip of bedding, lineations and plunge directions associated with folds, and veining using dip and dip direction. All information was recorded in Microsfot® Excel prior to being transferred into the main Microsoft® Access database.

An example of the fact geology map is present in Figure 9.1. Once the fact geology map is completed it is integrated with additional data, such as x-ray fluorescence (XRF) multielement soil geochemistry and drilling, to produce an interpreted geology map (e.g., Figure 7.4).

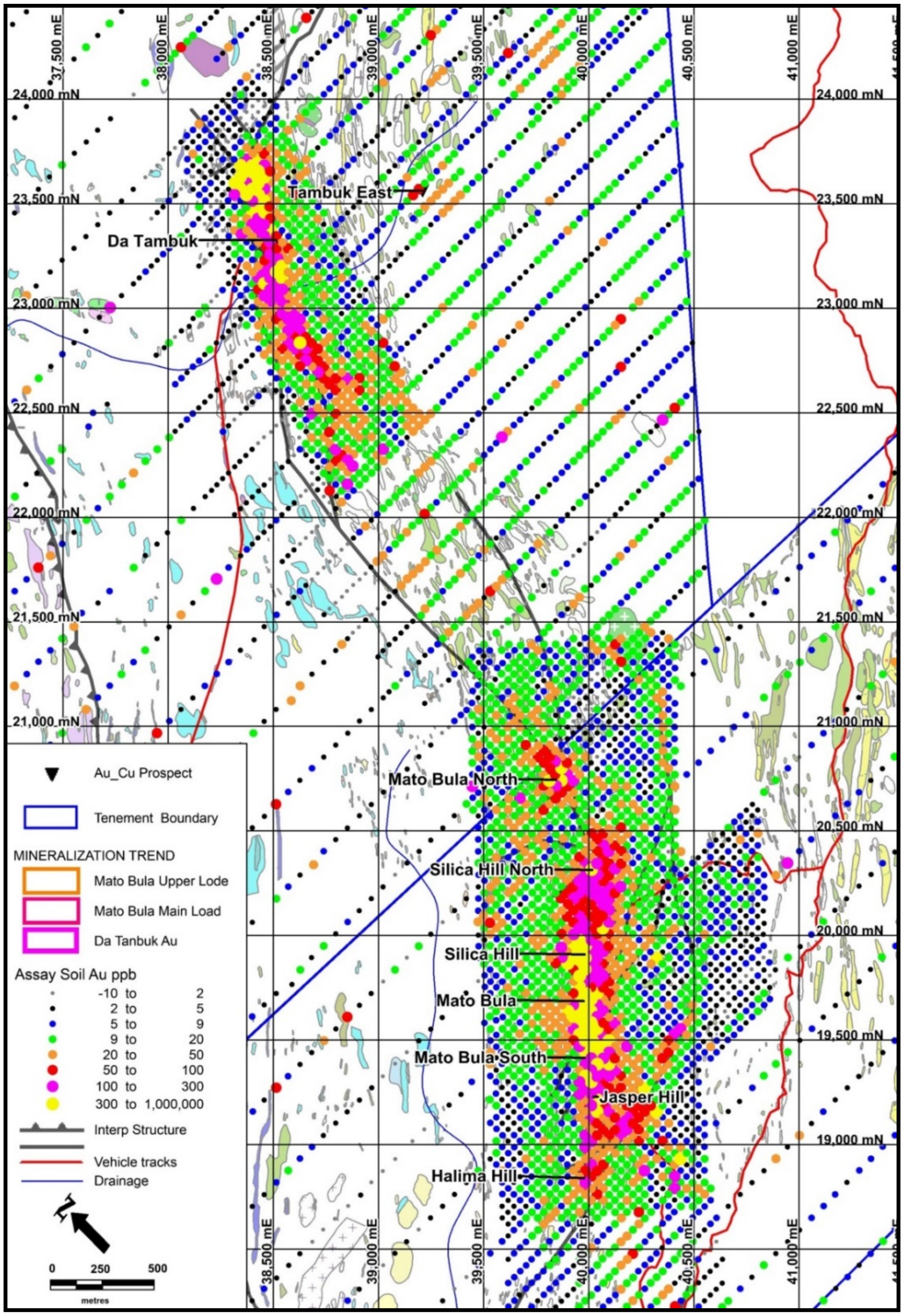
## 9.2 SOIL SAMPLING

### 9.2.1 GOLD SOIL GEOCHEMISTRY

EAM has carried out regional and detailed soil geochemistry surveys over much of the Adyabo Property. A total of 25,373 soil samples (18,104 in 2012, 6,210 in 2013, and 1,059 in 2014) were collected throughout the property and analyzed for gold. The initial measurements were taken with a sample spacing of 80 m on an east-west oriented line, with a line spacing of 320 m. An infill grid of 40 m by 160 m was employed over areas that were considered anomalous following the initial survey. If anomalism persisted then a grid with a spacing of 40 m by 40 m was employed to resolve the anomaly.

From this work, a number of elongate gold soil anomalies were identified, including the Mato Bula-Da Tambuk trend (Figure 9.1).

**Figure 9.1 Distribution of Gold Shallow Soil Sampling on the Mato Bula Trend**




Source: EAM (2015)

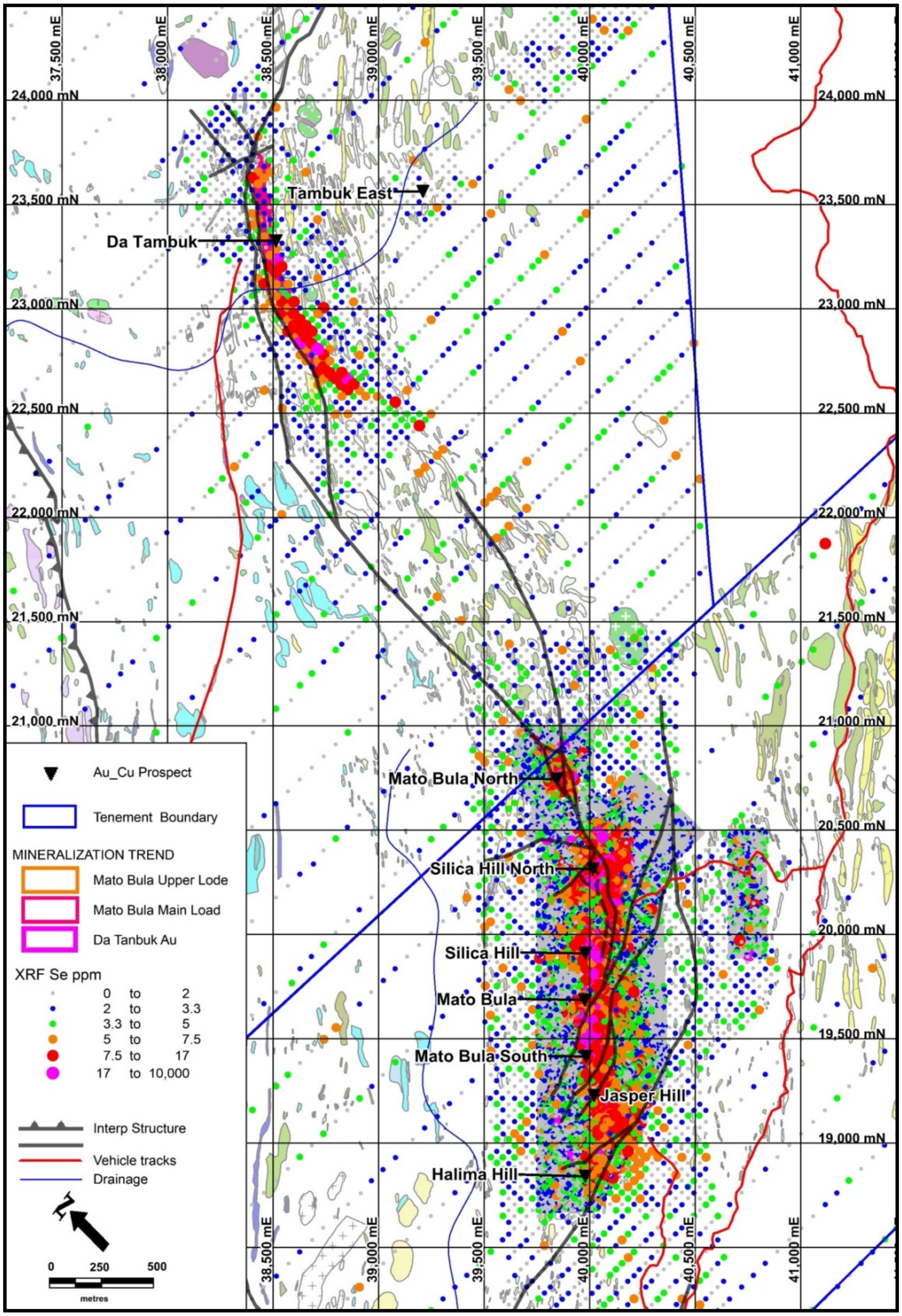
### 9.2.2 PORTABLE X-RAY FLUORESCENCE GEOCHEMISTRY

A total of 47,987 soil samples (20,060 in 2012, 10,132 in 2013, 13,440 in 2014, and 4355 in 2015) were collected throughout the Adyabo Property (including relinquished parts of the Adyabo licence) and analyzed for multiply elements.

The survey was conducted using a portable (handheld) *Thermo Scientific Niton* XRF analyser. The measurements were taken on grid of 10 m by 10 m. Elements analyzed include arsenic, bismuth, barium, calcium, cobalt, chromium, caesium, copper, iron, mercury, potassium manganese, molybdenum, nickel, lead, rubidium, sulphur, selenium, tin, strontium, tellurium, thorium, thallium, uranium, vanadium, tungsten, zinc and zirconium.  This technique was previously employed to great effect by EAM on its Terakimti VMS property to identify base-metals (Archibald et al. 2014).

The average copper concentration of the soil samples was 148 ppm, with a lower analytical limit of detection of approximately 10 ppm. From the total samples collected 1,105 (2.3%) had copper concentrations greater than 500 ppm. The maximum concentration recorded was 53,126 ppm (5.3%) copper from the Mato Bula North prospect. Thematic element maps were constructed for several pathfinder elements, e.g., copper, lead, zinc, silver, barium, molybdenum, and selenium, in a successful effort to identify precious and base metal accumulations. An example of showing the distribution of selenium over the Matu Bula Trend is presented in Figure 9.2.

**Figure 9.2 XRF Soil Sampling Results for Selenium Distribution over the Mato Bula Trend**




Source: EAM (2015)

## 9.3 STREAM SEDIMENT SAMPLING

Steam sediment sampling was carried out by EAM over both concessions, but most of the samples are out with the current licence boundaries. Stream sediment sampling occurred in 2012 with a total of 2,966 samples collected and analysed, of which 696 are present within the current Adyabo Property. Elements analyzed include gold, silver, arsenic, barium, copper, lead, and zinc. This method was utilized to quickly prospect a large area of ground when the concessions were first acquired.

## 9.4 LITHOGEOCHEMICAL SAMPLING/TRENCHING

A total of 8,647 rock samples were collected from February 2012 to November 2014 of the Adyabo Property, of which 6,561 are located on the current concessions.

Lithogeochemical samples (grab, chip or channel) were taken during routine prospecting and also during trenching programs (August 2012 to November 2013). Samples are analysed using the *Niton* XRF analyser and assayed for gold.

Trenching and channel sampling at Da Tambuk consisted of seven trenches totalling 624 m and including 422 samples.

Results were encouraging, and provided targets for the subsequent drilling. A summary of the trench results at Da Tambuk is provided in Table 9.1.

**Table 9.1 Da Tambuk Trench Results**

| Trench ID | | From (m) | To (m) | Interval (m) | Copper (%) | Gold (g/t) | Silver (g/t) | Lead (%) | Prospect |
|---|---|---|---|---|---|---|---|---|---|
| ADT004 | - | 33.00 | 49.00 | 16.00 | 0.02 | 3.96 | 0 | 0.01 | Da Tambuk |
| | including | 41.00 | 45.00 | 4.00 | 0.04 | 14.53 | 1 | 0.02 | |
| ADT005 | - | 20 | 38 | 18 | 0.01 | 0.43 | 0 | 0.01 | Da Tambuk |
| ADT011 | - | 42.00 | 48.00 | 6.00 | - | 0.67 | - | - | Da Tambuk |
| ADT012 | - | 16.00 | 23.00 | 7.00 | - | 1.80 | - | - | Da Tambuk |
| ADT013 | - | *60.00* | *65.00* | *5.00* | - | *0.29* | - | - | Da Tambuk |
| | - | 84.00 | 90.00 | 6.00 | - | 0.48 | - | - | |
| ADT014 | - | *0.00* | *8.00* | *8.00* | - | *0.38* | - | - | Da Tambuk |
| ADT015 | - | No Significant Results | | | | | | | Da Tambuk |

Note: Initial prospect trench values use a 0.3 g/t cut-off. Trench values may be revised to a 0.1 g/t cut-off *(shown in italics)* if proven significant by more detailed exploration results.

## 9.5 AIRBORNE GEOPHYSICS

A single airborne geophysical survey was performed on the Adyabo Property previously by Aberdeen International in 2007. EAM did not perform their own survey, but reinterpreted some of the data from the 2007 survey.

### 9.5.1 AEROQUEST SURVEYS (JULY 2007)

In July 2007 Aeroquest, on behalf of Aberdeen, conducted a heliborne aeromagnetic, radiometric, and AeroTEM surveys on their EM 1 Block and EM 2 Block licences (Dudek 2008). EM 1 Block was the original licence area currently covered by the Adyabo Project.

Most of the EM anomalies are linear in nature, and appear to be related to black- and graphitic-shale units in the region

## 9.6 PETROGRAPHIC STUDIES

### 9.6.1 TURNSTONE GEOLOGICAL SERVICES (2014)

A total of 25 drill core samples were examined for mineralogical and textural features. Described minerals for the deposit zone include pyrite, chalcopyrite, with lesser amounts of iron poor sphalerite, galena, tetrahedrite, bornite, chalcocite, and covellite, as well as oxides hematite and rutile. Sulphides are dominated by chalcopyrite, with traces of bornite, covellite, chalcocite and tetrahedrite. Native gold was also identified. The mean modal mineralogy from grain-counting exercises on 25 samples indicated that quartz (64%), pyrite (5%), micas (17%), chlorites (5%) and carbonates (7%) were the dominant gangue phases. Hydrothermal alteration was again widely reported in the petrographic studies, suggesting some of the micas may have converted to forms of clay. All four grains of gold found were associated with sulphides and were relatively coarse, typically 20 to 60 µm.

### 9.6.2 HUGH GRAHAM (2016)

Hugh Graham of the University of Leicester completed an MSc thesis entitled *Understanding the Mato Bula-Da Tambuk Au-rich VMS system in the Arabian-Nubian Shield, Northern Ethiopia*. A total of 27 samples were selected for use from the variety of mineralized zones along the Mato Bula Trend.

Petrographic and qualitative element analyses (scanning electron microscope and electron microprobe) were conducted, revealing a relative abundance of selenium- and tellurium-bearing minerals along the trend. Additionally, saline fluid inclusions (0.2 to 13.4 wt.% NaCleq.) and cool fluid temperature (105 to 190°C) may indicate a distal setting. Light $\delta^{34}S$ signatures range from –9.29‰ to –2.27‰. Several phases of mineralization deposition are suggested, varying from proximal to distal in setting. Affinities to both VMS and epithermal processes are noted.

## 9.7 REMOTE SENSING

In 2013 Worldview-2 colour satellite imagery was purchased from, and interpreted by, PhotoSat Information Ltd, Vancouver. The 50 km$^2$ 0.46 cm resolution image was used to generate 1 m topographic contours. The image and contour files are used as base maps during field exploration.

# 10.0 DRILLING

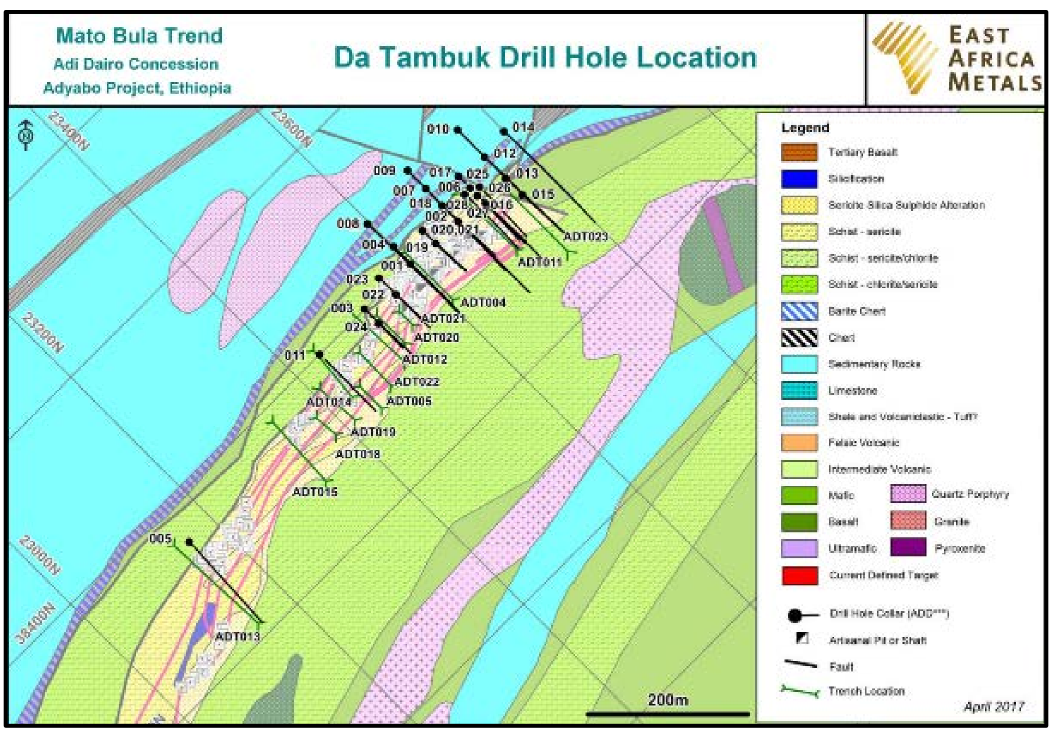
Drilling was undertaken to define gold mineralization identified by earlier prospecting, geochemical sampling, mapping, and trenching. The initial drill program was conducted in 2013, and the most recent program was completed in 2016. Core was predominately NTW rod diameter, with the final four holes drilled with HTW diameter rods, to facilitate additional samples potentially required for more metallurgical work.

**Table 10.1 Summary of Drilling at the Da Tambuk Deposit**

| Year | Diamond | |
|---|---|---|
| | Holes | Metres |
| 2013 | 4 | 514.24 |
| 2014 | 7 | 1,434.29 |
| 2015 | 10 | 1,456.35 |
| 2016 | 7 | 780.89 |
| **Totals** | **28** | **4,185.77** |

A plan of all drill holes completed to date is presented in Figure 10.1.

**Figure 10.1 Da Tambuk Drillhole Plan Showing Collar and Trench Locations**



## 10.1 DIAMOND DRILLING

### 10.1.1 DRILL CONTRACTORS

Diamond drilling at the Adyabo Property was conducted by one contractor, Kluane Drilling Ltd. (Kluane) (Yukon, Canada). Kluane conducted programs of drilling from 2013 to 2016, as outlined in Table 10.1, using a man-portable diamond drill rig and completed all holes drilling both NTW and HTW diameter drill rod equipment.

### 10.1.2 DRILL SURVEYING

Drilling collar locations were accurately surveyed using a differential GPS system, where drilling pads were cleared and built up. Most diamond drill holes were completed on a 40 m to 40 m grid spacing and were drilled at an azimuth of grid 90°. This proposed drill spacing was chosen to facilitate resource estimation, and to allow infill drilling to maintain an evenly spaced grid. Drilling down dip was planned to intersect the mineralization at 40 m and 80 m down dip intervals. Pierce points for the drilling targets were perpendicular to the interpreted strike of targeted mineralization to try to make sure intersections were as close to true thickness as possible in the target rocks. Downhole survey measurements were taken at various depths, ranging from 6 m to 50 m intervals down each drillhole using a Reflex EZ-Shot orientation instrument. A final reading was taken approximately 6 m from the bottom.

During exploration, TRI and the drilling contractor conducted the drilling programs according to industry best practices. Drillhole collar coordinates were again surveyed at completion the holes and capped with concrete monuments. Both before and after drilling, coordinates were surveyed by a qualified TRI mining surveyor using a DGPS Epoch 25 with a measurement accuracy of ±1 cm. The drill contractor used a multi-shot Reflex EZ-Shot orientation instrument for downhole surveys for all drillholes azimuth, and dip information was recorded down hole at roughly 30 m intervals, with a final reading approximately 6 m from the bottom of every hole.

Core orientation information was initially taken at approximately 30 m intervals, and reduced to 6 m intervals in areas of mineralization to determine the orientation of mineralization and structures (e.g., foliation) within the rock.

## 10.2 CORE RECOVERY

Drill core recoveries for the project were acceptable, and the samples collected were representative of the observed mineralization. Determining the exact true thickness from individual drill holes is difficult, but generally, based on the consistent drill-hole orientation, the intercepts represent 60 to 90% of the true thickness.

### 10.2.1 SIGNIFICANT DRILL CORE MINERAL INTERSECTIONS

Diamond drillhole information from the late 2016 drill program is presented in Table 10.2. Significant mineralized intercepts from that program are presented in Table 10.3. A general description of the mineralization encountered is presented in previous sections of this report.

A type drill section (Figure 10.2) illustrates the typical lode expressions at surface and to depth, in the central area of the deposit. Long section reinterpretations over time are provided in Figure 10.3 and Figure 10.4.

**Table 10.2 Drillhole Information for Late 2016 Da Tambuk Drill Program**

| Hole ID | Easting | Northing | Azimuth (°) | Dip (°) | Total Depth (m) |
|---|---|---|---|---|---|
| ADD025 | 399895.38 | 1584757.08 | 136.5 | -51.0 | 134.11 |
| ADD026 | 399907.31 | 1584758.48 | 137.0 | -49.0 | 129.54 |
| ADD027 | 399904.53 | 1584747.50 | 137.5 | -49.0 | 115.82 |
| ADD028 | 399888.91 | 1584749.01 | 135.0 | -46.0 | 135.64 |

Note: Projection is WGS84 Zone 37N

**Table 10.3 Significant Intercepts at the Da Tambuk Deposit**

| Hole ID | | From (m) | To (m) | Interval (m)* | Copper (%) | Gold (g/t) | Silver (g/t) | Zinc (%) | Local Azimuth (°) | Dip (°) |
|---|---|---|---|---|---|---|---|---|---|---|
| ADD025 | - | 105.00 | 125.00 | 20.00 | 0.20 | 4.70 | 4.7 | 0.26 | 87 | -51 |
| | including | 115.00 | 120.00 | 5.00 | 0.10 | 13.80 | 7.3 | 0.36 | | |
| ADD026 | - | 92.00 | 95.81 | 3.81 | 0.32 | 2.88 | 5.5 | 0.07 | 87 | -49 |
| | - | 98.49 | 110.00 | 11.51 | 0.31 | 5.60 | 21.3 | 0.75 | | |
| | including | 101.39 | 110.00 | 8.61 | 0.33 | 7.38 | 23.1 | 0.73 | | |
| ADD027 | - | 82.50 | 85.00 | 2.50 | 0.39 | 2.43 | 3.8 | 0.06 | 88 | -49 |
| | - | 88.80 | 94.00 | 5.20 | 0.09 | 0.78 | 4.3 | 0.34 | | |
| | - | 110.00 | 114.00 | 4.00 | 0.08 | 1.11 | 4.0 | 0.37 | | |
| ADD028 | - | 87.00 | 103.54 | 16.54 | 0.08 | 2.63 | 2.0 | 0.07 | 85 | -46 |
| | - | 115.00 | 118.00 | 3.00 | 0.05 | 2.15 | 2.4 | 0.20 | | |
| | - | 130.00 | 133.00 | 3.00 | 0.02 | 0.79 | 1.8 | 0.22 | | |

Note: *Intervals stated are 40 to 100% true thickness. Intervals use a 0.3 g/t gold cut-off value. No top cut has been used on assay values. Calculated intervals for gold are based on rounding to two decimal places.

**Figure 10.2 Da Tambuk Section 23,680N**

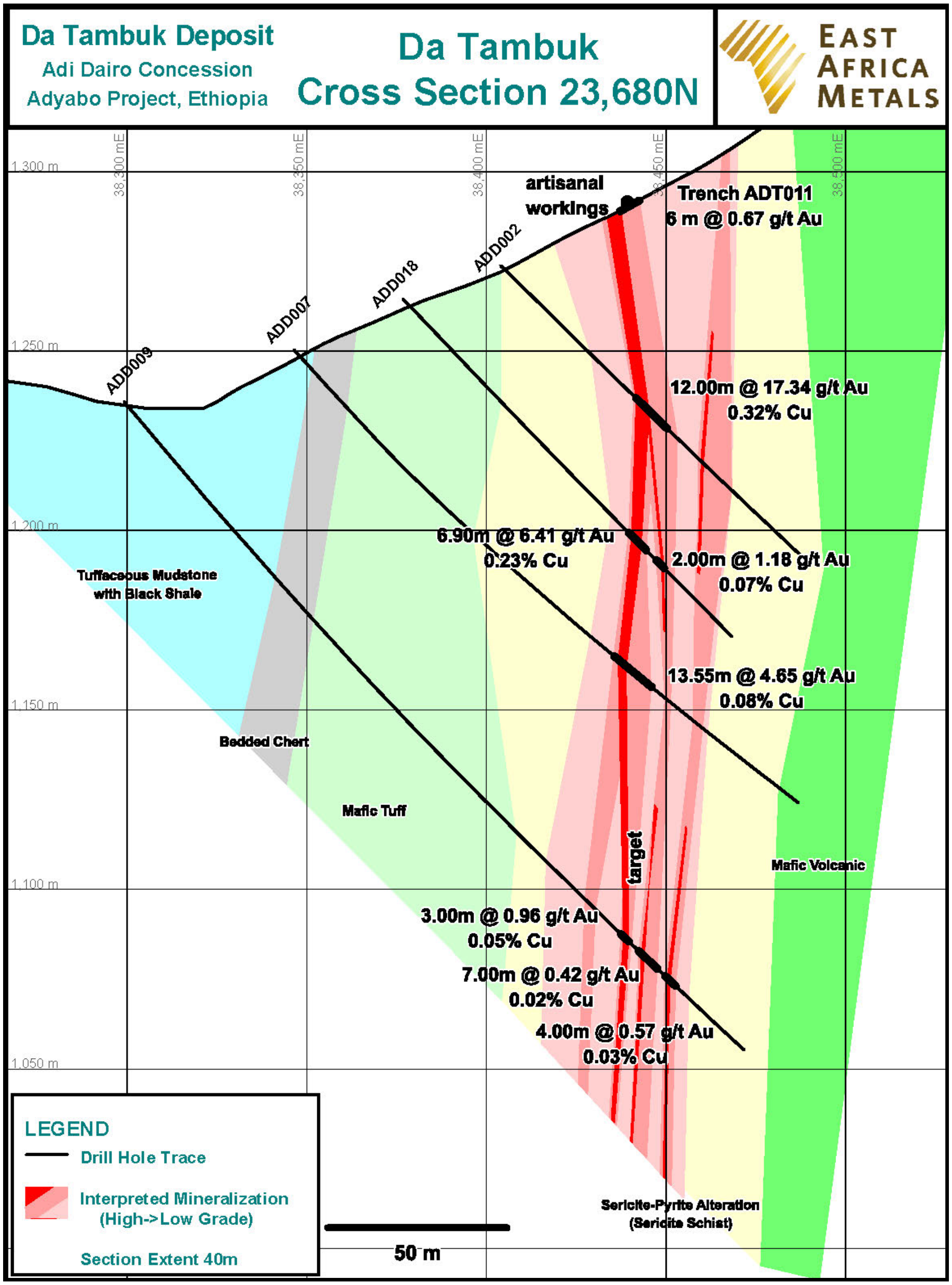


**Figure 10.3 Early Exploration Stage Da Tambuk Long Section (2015 - looking grid west)**

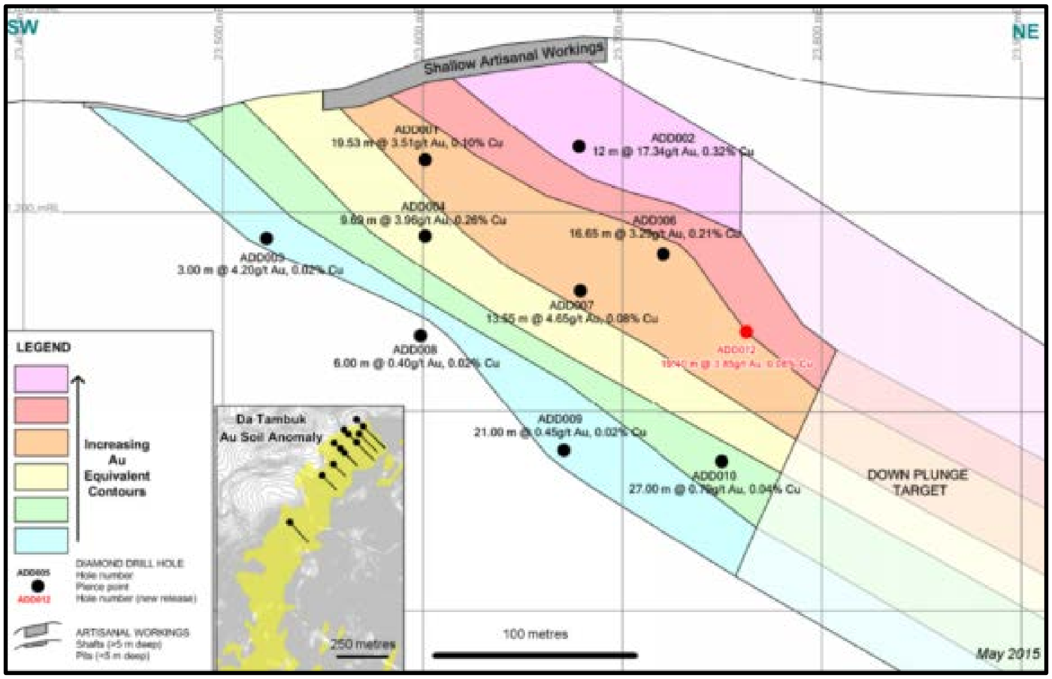
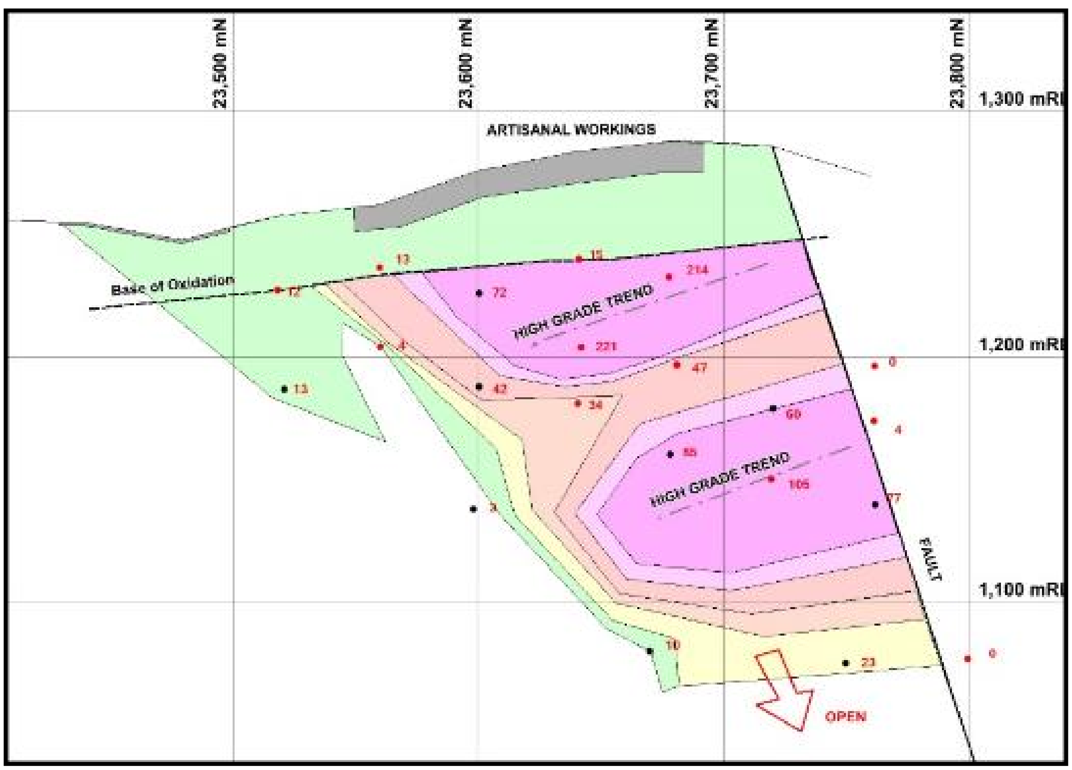



**Figure 10.4 2016 Da Tambuk Long Section with End Echelon Stepping Lodes**




Note: Only the Base of Oxidation could be interpreted from the drilling to date.

# 11.0 SAMPLE PREPARATION, ANALYSES AND SECURITY

The following sections summarize the extent of the author's knowledge regarding the sample preparation, analysis, security and QA/QC protocols used in the drilling programs at the Adyabo Property.

## 11.1 SAMPLING METHOD AND APPROACH

Several exploration sampling techniques are employed on the Adyabo Property including: sieved soil samples, stream sediment samples, rock chip samples, channel samples, and diamond drilling. The emphasis of the collection techniques is to collect geological material using standardised sample procedures, and insertion of suitable blanks, standards and replicates to monitor the accuracy and precision of sampling errors and deficiencies in laboratory procedures and results. Although not stated in the text most lithological samples are 2 kg. The following descriptions of sampling procedures, except for drilling, are taken from the EAM protocol manual and 2014 TRI Annual Report (Gardoll et al. 2014).

### 11.1.1 STREAM SAMPLE PROCEDURE

Stream sediment samples are taken on a regional scale to identify anomalous catchment areas for further follow up work. Samples are taken from the surface of the stream bed and sieved using –60 mesh (250 µm) with a final weight of approximately 250 g. Active river sediment (excluding sand) is collected in stream samples. All samples are bagged into soil packets or plastic bags to avoid contamination. Standards and replicates are routinely inserted for quality control and quality assurance purposes. Pans are cleaned between sample sites to avoid contamination.

The productivity of a stream sample program is routinely maximised with the geologist making notes on geology, taking grab samples of any mineralised float or outcrop, and recording the location of alluvial workings as appropriate. This process is delayed in the wet weather when sieving samples is impossible and streams are flowing.

### 11.1.2 SOIL SAMPLE PROCEDURE

Soil samples are collected on a predetermined soil sample grid at a variety of scales depending on the stage of exploration (e.g., regional soil programs or detailed infill grids over a prospect).

A sample is taken from a depth of 0.15 m below surface and sieved using –60 mesh (250 µm) to remove coarse material. The total sample weight aims to be at least 200 g.

Standards and replicates are routinely inserted for quality control and quality assurance purposes. Pans are cleaned between sample sites to avoid contamination.

The sampler may adapt the program in the field if required. For example; issues with the safety of sample site or non-representative surface material (e.g., flood plain material or disturbed ground chemically altered by farming processes). This process is delayed in wet weather when sieving samples is impossible.

The 2 kg samples were collected in clear plastics bags and a sample tag was inserted prior to sealing.  Sample standards and duplicate samples were inserted at 50 sample intervals. The samples were transported to the assay laboratory (Ultratrace, Perth, Australia), and upon arrival they were dried, sieved using a 2 mm screen, split to produce a 25 to 50 g aliquot, which was digested in aqua regia and diisobutyl ketone (DIBK), prior to atomic absorption (AA) gold analysis.

### 11.1.3 Rock Chip Sample Procedure

Rock chip samples are taken from surface outcrops or float material to assess metal contents of selected rock samples. Wherever possible, fresh material is sampled.  The location of the sample should be recorded with accurate GPS coordinates.

### 11.1.4 Trenching Procedure

Trenches are dug down to fresh or saprolitic rock, generally 1 m. Trenches are not dug above shoulder height for safety reasons and during the rainy season care must be taken to only work when conditions are safe. They are dug with a pre-planned orientation perpendicular to mineralization. The geologist will adapt the trench as required for safety or geological reasons.

### 11.1.5 Channel Sample Procedure

Channel rock chip samples are taken as a method of continuous geochemical analysis. They are collected along the face of an artisanal working or from a purpose dug exploration trench. Samples are typically taken over 1 m intervals (dependant on geology) with continuous chips taken equally along the length of the sample interval.

### 11.1.6 Handheld XRF Analysis

All exploration samples are analysed on site using a handheld XRF instrument (Niton®) for a range of elements including base metals: silver, arsenic, barium, bismuth, calcium, cadmium, cobalt, chromium, caesium, copper, iron, mercury, potassium, manganese, molybdenum, niobium, nickel, lead, palladium, rubidium, sulphur, antimony, scandium, selenium, tin, strontium, tellurium, thorium, titanium, uranium, vanadium, tungsten, zinc, and zirconium.  This technique can also be used in the field to allow for geochemical traverses of either soil or rock material.

To ensure the XRF is operating correctly the instrument is routinely calibrated, and a range of standards are analysed before and during sampling exploration materials, typically every one hundred analyses. Sample standards were purchased from the Canadian National Laboratory, and are created via inductively coupled plasma-atomic emission spectroscopy (ICP-AES) and atomic absorption spectroscopy (AAS) finish. A silicon dioxide ($SiO_2$) blank was provided by the XRF manufacturer to limit contamination in the XRF sample window. The XRF data is currently used for internal company reconnaissance checks.

## 11.2 LABORATORY PROCEDURES

All drillcore samples were collected and provided to independent laboratories by EAM. This report presents an independent review and validation of the procedures and data for results that have been analysed to the date of March 31st, 2015.

As discussed in Section 10.1 of this report, diamond drilling programs on the property was performed at Mato Bula, Mato Bula North and Da Tambuk. Drilling was undertaken between November 2013 and February 2015 by Kluan and consisted of 35 diamond drillholes on the Mato Bula prospect, 6 diamond drillholes on the Mato Bula North prospect, and 12 diamond drillholes on the Da Tambuk prospect for a total depth of 11,041.64 m.

Sampling was performed systematically on each drillhole where mineralization and/or alteration were recorded during the core logging procedure. The resultant samples were submitted to ACME Analytik Ankara (the Turkish subsidiary of ACME Analytical Labs Laboratories) (ACME Turkey) for sample preparation (crushing and pulverization) analysis. The sample powders were then shipped to ACME Analytical Laboratories (Vancouver) Ltd. (ACME Vancouver) for geochemical analysis. ACME Turkey has International Organization for Standardization (ISO) 9001:2008 Quality Management System accreditation, and ACME Vanouver carries current ISO 9001:2008 accreditation for the provision of assays and geochemical analyses.

The sample preparation and assay methodologies used at each of the laboratories, employed by EAM, are largely comparable. A summary of the preparation and analytical procedures at Ultratrace and ACME is detailed in Table 11.1.

**Table 11.1 Preparation and Assay Methods used during Analysis of Exploration Samples at ACME and Ultratrace**

| Sample Type | Laboratory | Preparation | Analytical Technique | Analytes | Detection Limit |
|---|---|---|---|---|---|
| Soil and Stream | Ultratrace | Samples pulverised | Aqua Regia digest and ICP-MS analysis | Au | 1 ppb |
| | | | | Ag | 0.05 ppm |
| Drilling, (diamond), rock chip, trenching and channel sample | ACME | Samples crushed 1 kg to 80% passing 10 mesh, split 1,000 g and pulverized to 85% passing 200 mesh | Hot Aqua Regia digestion for base metal sulphide and precious-metal ores. ICP-ES analysis. | Cu, Pb, Zn, Ag plus other multi-elements; Al, As, Bi, Ca, Cd, Co, Cr, Fe, Hg, K, Mg, Mn, Mo, Na, Ni, P, Pb, S, Sb, Sr, W. | Ag 2 ppm |
| | | | | | Cu 0.001% |
| | | | | | Pb 0.01% |
| | | | | | Zn 0.01% |
| | | | Fire assay | Au | 0.005 ppm |
| | | | Gravimetric fire assay if Au >10 ppm | Au | >10 ppm |
| | | | Gravimetric fire assay if Ag >300 ppm | Ag | >300 ppm |
| | | | Volumetric titration if Cu >20% | Cu | >20% |
| | | | Titration if Pb >10% | Pb | >10% |
| | | | Titration if Zn >40% | Zn | >40% |

Source: EAM 2015

In the author's opinion, all drillcore samples were prepared and assayed using appropriate techniques at the laboratories.

## 11.3 SAMPLE SECURITY AND CHAIN OF CUSTODY PROCEDURES

The chain of custody procedure from the extraction of the core from the core barrel, through logging and sampling up to the point of dispatch to the laboratory is described in Section 11.2. Through all of these stages the responsibility for security lies with EAM and their on-site personnel. Samples are transported from Shire to the MoMPNG in Addis Ababa, then onwards to Bole International Airport by an Ethiopian haulage company. After this the samples are in the care of airline cargo companies and international courier companies when shipped to the overseas laboratories. The security of the sample during transit cannot be guaranteed as tamper proof seals are not used on the sample bags. Upon receipt at the laboratory, the chain of custody passes to the assayer. Following assay, the remaining material is stored under secure conditions at the laboratory facilities. Approximately 1 kg of pulp is created from each drillcore sample, with 100 g sent to the ACME Vancouver laboratory for analysis and the remaining 900 g stored in

Turkey for potential follow-up work. The chain of custody reverts to TRI if the samples leave the assay laboratory storage facilities. This is the case with remaining pulp material following analyses, which is transferred back to TRI in Vancouver, who then sent to a secured warehouse location for storage.

In general, industry best practices with respect to chain of custody procedures are followed on site. However, the weakest point in any chain of custody is during transport. The absence of tamper proof fastenings on the samples has been noted and their introduction would greatly improve the chain of custody between the site and laboratory. However, the physical inspection and weighing of all exported material by the MoMPNG in Addis Ababa adds complexity to this solution.

## 11.4 QA/QC Review

Fladgate briefly reviewed the QA/QC data used by EAM to monitor the quality of the assay data in the 2015-2016 drilling campaign.

Diamond drilling at Mato Bula and Da Tambuk was supervised at all times by EAM geologists. The geologists directed and managed the preparation, logging and sampling of core. With several geologists logging the drillholes variation in lithologies invariably occurs. However, this potential variation is mitigated by the senior geology staff that reviewed the drillcore and logs and amended any discrepancies that arose.

During sampling, quality control standards and blanks were inserted to confidentially monitor laboratory performance. Refinement of QA/QC procedures during the drill program included the implementation of field, reject and pulp duplicates, as well as specific programs of re-analysis and umpire laboratory assaying; all consistent with industry best practice.

The samples from the drillholes were prepared at the ACME laboratory in Turkey and analyzed at the ACME laboratory in Vancouver. QA/QC procedures and results are presented in the following sections.

During sampling, quality control standards and blanks were inserted to independently monitor laboratory performance. The QA/QC procedures at the Da Tambuk deposit included the implementation of field, reject and pulp duplicates, as well as specific programs of re-analysis and check assaying at secondary laboratories; all consistent with industry best practice.

### 11.4.1 ACME Laboratory Accuracy

*Standard Reference Material*

To monitor the accuracy of the assay data, EAM submitted samples of Standard Reference Materials (SRMs) inserted into the sequence of regular samples submitted for analysis. A total of 177 SRMs were submitted for analysis for an insertion rate of approximately 10%. Although individual SRMs show biases of more than 5%, overall the biases are within acceptable limits (less than 5%).

**Table 11.2 SRM Summary Statistics, 2015-2016 Drill Campaign Mato Bula and Da Tambuk - All New Standards (Since last resource)**

| Standard | Gold | | | | Copper | | | | Silver | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Number | Expected (g/t) | Mean (g/t) | Bias (%) | Number | Expected (%) | Mean (%) | Bias (%) | Number | Expected (g/t) | Mean (g/t) | Bias (%) |
| CDN-CGS-28 | 3 | 0.73 | 0.77 | -6 | 3 | 2.03 | 2.05 | -1 | 0 | - | - | - |
| CDN-CM-15 | 13 | 1.25 | 1.29 | -3 | 13 | 1.28 | 1.30 | -2 | 0 | - | - | - |
| CDN-CM-18 | 6 | 5.28 | 5.30 | 0 | 6 | 2.37 | 2.48 | -4 | 0 | - | - | - |
| CDN-CM-19 | 7 | 2.11 | 2.17 | -3 | 7 | 2.04 | 2.04 | 0 | 0 | - | - | - |
| CDN-CM-22 | 8 | 0.72 | 0.75 | -4 | 8 | 1.00 | 0.99 | 0 | 0 | - | - | - |
| CDN-CM-23 | 2 | 0.55 | 0.64 | -14 | 2 | 0.47 | 0.47 | 0 | 0 | - | - | - |
| CDN-CM-35 | 22 | 0.32 | 0.33 | -3 | 22 | 0.25 | 0.25 | -1 | 0 | - | - | - |
| CDN-GS-20A | 6 | 21.12 | 21.82 | -3 | 0 | - | - | - | 0 | - | - | - |
| CDN-GS-2M | 4 | 2.21 | 2.27 | -3 | 0 | - | - | - | 0 | - | - | - |
| CDN-GS-7F | 7 | 6.90 | 6.86 | 1 | 0 | - | - | - | 0 | - | - | - |
| CDN-ME-1204 | 2 | 0.98 | 0.95 | 2 | 2 | 0.52 | 0.53 | -2 | 2 | 58.00 | 60.50 | -4 |
| CDN-ME-1205 | 11 | 2.20 | 2.20 | 0 | 11 | 0.22 | 0.22 | -1 | 11 | 25.60 | 27.32 | -6 |
| CDN-ME-1304 | 6 | 1.80 | 1.84 | -2 | 6 | 0.27 | 0.27 | -1 | 6 | 34.00 | 36.62 | -7 |
| CDN-ME-1305 | 2 | 1.92 | 2.01 | -5 | 2 | 0.62 | 0.61 | 0 | 2 | 231.00 | 235.90 | -2 |
| G306-3 | 6 | 8.66 | 8.34 | 4 | 0 | - | - | - | 0 | - | - | - |
| G900-7 | 5 | 3.19 | 3.14 | 1 | 0 | - | - | - | 0 | - | - | - |
| G995-1 | 2 | 2.64 | 2.88 | -8 | 0 | - | - | - | 0 | - | - | - |
| G995-4 | 9 | 8.48 | 8.80 | -4 | 0 | - | - | - | 0 | - | - | - |
| G398-2 | 13 | 0.42 | 0.53 | -20 | 0 | - | - | - | 0 | - | - | - |
| G901-7 | 7 | 1.53 | 1.50 | 2 | 0 | - | - | - | 0 | - | - | - |
| G302-10 | 14 | 0.18 | 0.18 | 2 | 0 | - | - | - | 0 | - | - | - |
| G903-10 | 22 | 0.21 | 0.20 | 6 | 0 | - | - | - | 0 | - | - | - |
| Overall Bias (Slope) | 177 | - | - | 2.4 | 82 | - | - | 2.7 | 21 | - | - | 1.4 |
| Overall Bias (Mean) | - | 2.69 | 2.74 | 1.8 | - | 0.88 | 0.89 | 1.5 | | 50.65 | 53.00 | 4.6 |

### 11.4.2 CHECK ASSAYS

A total of 24 check assays were submitted by EAM to Met-Solve Analytical Services (Met-Solve), a secondary laboratory, for check assay. The results are shown in Table 10.4. Fladgate concludes that the observed biases are within acceptable limits (less than 5%).

*MET-SOLVE ANALYTICAL SERVICES*

Met-Solve is an accredited testing laboratory (ISO/International Electrotechnical Commission (IEC) 17025:2005) based in Langley, British Columbia.

**Table 11.3 Check Assays Summary Statistics, 2015-2016 Drill Campaign**

| Element | ACME Mean | Met-Solve Mean | Bias in Mean (%) | Bias in Slope of Regression (%) |
|---|---|---|---|---|
| Gold | 3.04 | 2.90 | 4.6 | 2.3 |
| Silver | 1.97 | 2.09 | -6.1 | 5.0 |
| Copper | 0.22 | 0.21 | 4.5 | 3.5 |

### 11.4.3 ACME PRECISION FROM DUPLICATE ANALYSES

EAM submitted 113 quarter core samples, 100 coarse reject duplicates, and 101 pulp duplicates for analysis at the ACME laboratory. Overall, the duplicate insertion rate is approximately 6 to 7%. Fladgate calculated 90% absolute relative difference (ARD) (absolute pair difference/pair mean) values for pairs of duplicate samples. The 90% ARD values are shown below in Table 10.5. The variability of the gold assay duplicates is somewhat high (e.g., 10% of the gold coarse duplicates show differences of more than 43.6%); however, it is acceptable for Mineral Resource estimation.

**Table 11.4 90% ARD Values for Duplicate Samples, 2015-2016 Drill Campaign**

| | Gold (%) | Copper (%) |
|---|---|---|
| Pulps | ±18.90 | ±9.80 |
| Coarse Rejects | ±43.60 | ±22.00 |
| 1/4 Core | ±110.80 | ±56.80 |

### 11.4.4 BLANK ANALYSES

EAM submitted a total of 168 samples (for an insertion rate of approximately 10%) of analytical blank material together with regular samples to check for sample contamination during sample preparation. Only one sample assayed more than 5 times the detection limit (0.09 g/t).

### 11.4.5 DIAMOND DRILLING QA/QC SUMMARY

Fladgate concludes that sample preparation, analysis and security are generally performed in accordance with exploration best practices and industry standards.

Fladgate concludes that the assay data show no evidence of significant sample contamination.

Following the review of the QA/QC data, Fladgate concludes that the assay data are acceptable for estimating Mineral Resources.

## 11.5 QA/QC REVIEW – LATE 2016 PROGRAM

Fladgate briefly reviewed the QA/QC data used by EAM to monitor the quality of the assay data in the late 2016 drilling campaign.

Diamond drilling at Da Tambuk was supervised at all times by EAM geologists. The geologists directed and managed the preparation, logging and sampling of core. With several geologists logging the drillholes variation in lithologies invariably occurs. However, this potential variation is mitigated by the senior geology staff that reviewed the drillcore and logs and amended any discrepancies that arose.

During sampling, quality control standards and blanks were inserted to confidentially monitor laboratory performance. Refinement of QA/QC procedures during the drill program included the implementation of field, reject and pulp duplicates, as well as specific programs of re-analysis and umpire laboratory assaying; all consistent with industry best practice.

The samples from the drillholes were prepared at the Bureau Veritas laboratory in Turkey and analyzed at the Bureau Veritas laboratory in Vancouver (formerly known as ACME). QA/QC procedures and results are presented in the following sections.

During sampling, quality control standards and blanks were inserted to independently monitor laboratory performance. The QA/QC procedures at the Da Tambuk deposit included the implementation of field, reject and pulp duplicates, as well as specific programs of re-analysis and check assaying at secondary laboratories; all consistent with industry best practice.

### 11.5.1 BUREAU VERITAS LABORATORY ACCURACY

*STANDARD REFERENCE MATERIAL*

To monitor the accuracy of the assay data, EAM submitted samples of SRMs inserted into the sequence of regular samples submitted for analysis. A total of 10 SRMs were submitted for analysis for an insertion rate of approximately 5.9%. Although individual SRMs show biases of more than 5%, overall the biases are within acceptable limits (approximately 5%).

**Table 11.5 SRM Summary Statistics, Late 2016 Drill Campaign Da Tambuk - All New Standards (Since last resource)**

| Standard | Gold | | | | Copper | | | | Silver | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Number | Expected (g/t) | Mean (g/t) | Bias (%) | Number | Expected (%) | Mean (%) | Bias (%) | Number | Expected (g/t) | Mean (g/t) | Bias (%) |
| CDN-GS-2M | 1 | 2.21 | 2.17 | 2 | - | - | - | - | - | - | - | - |
| CDN-GS-7F | 1 | 6.90 | 6.99 | -1 | - | - | - | - | - | - | - | - |
| CDN-ME-1304 | 1 | 1.80 | 1.77 | 2 | 1 | 0.27 | 0.27 | -2 | 1 | 34.00 | 36.10 | -6 |
| CDN-ME-1305 | 2 | 1.92 | 1.85 | 4 | 2 | 0.62 | 0.64 | -3 | 2 | 231.00 | 241.90 | -5 |
| G63 | 2 | 8.66 | 8.49 | 2 | - | - | - | - | - | - | - | - |
| STD N | 1 | 2.64 | 2.84 | -7 | - | - | - | - | - | - | - | - |
| STD P | 1 | 8.48 | 8.77 | -3 | - | - | - | - | - | - | - | - |
| STD R | 1 | 0.42 | 0.32 | 32 | - | - | - | - | - | - | - | - |
| Overall Bias (Slope) | 10 | - | - | 1.5 | 3 | - | - | 4.4 | 3 | - | - | 0.7 |
| Overall Bias (Mean) | - | 4.36 | 4.35 | 0.2 | - | 0.50 | 0.52 | -3.1 | - | 165.33 | 173.30 | 4.5 |

### 11.5.2 BUREAU VERITAS PRECISION FROM DUPLICATE ANALYSES

EAM submitted 17 quarter core samples, 10 coarse reject duplicates, and 10 pulp duplicates for analysis at the Bureau Veritas laboratory. Overall, the duplicate insertion rate is approximately 5.9%. Fladgate calculated 90% ARD (absolute pair difference/pair mean) values for pairs of duplicate samples. The 90% ARD values are shown below in Table 11.6. The variability of the gold assay duplicates is somewhat high (e.g., 10% of the gold coarse duplicates show differences of more than 43.6%); however, there are a very low number of duplicates. The drill data is acceptable for Mineral Resource estimation.

**Table 11.6 90% ARD Values for Duplicate Samples, Late 2016 Drill Campaign**

| | Gold (%) | Copper (%) |
|---|---|---|
| Pulps | ±44.9 | ±11.6 |
| Coarse Rejects | ±69.2 | ±17.0 |
| ¼ Core | ±74.5 | ±22.7 |

### 11.5.3 BLANK ANALYSES

EAM submitted a total of 10 samples (for an insertion rate of approximately 5.9%) of analytical blank material together with regular samples to check for sample contamination during sample preparation. No samples assayed more than 10 times the detection limit.

### 11.5.4 DIAMOND DRILLING QA/QC SUMMARY

Fladgate concludes that sample preparation, analysis and security are generally performed in accordance with exploration best practices and industry standards.

Fladgate concludes that the assay data show no evidence of significant sample contamination.

Following the review of the QA/QC data, Fladgate concludes that the assay data are acceptable for estimating Mineral Resources.

# 12.0 DATA VERIFICATION

In consideration of the data summarized below, as well as information provided elsewhere in this report, the author of this section believes the current EAM project data are acceptable for the purposes used in this report.

## 12.1 2017 DATA VERIFICATION

EAM's database integrity has been audited several times previously and, in each case, no significant errors were found. The procedures used in previous drill campaigns have been maintained. The data supporting mineral resource estimation was verified together with the data from Mato Bulo. The following sections summarize data verification completed for Mato Bulo, Mato Bulo North and Da Tambuk.

## 12.2 2016 DATA VERIFICATION

### 12.2.1 ELECTRONIC DATABASE

Fladgate requested the original certificates from the primary laboratory (ACME). The assay certificates were sent directly to Fladgate. A comparison of the assay certificates was made with the assay values within the EAM database.

A total of 1,329 out of 1,737 assays were compared, representing 76.5% of the drillhole assays from the 2015-2016 exploration campaign. Fladgate found no significant differences between the original assay certificates and the EAM assay database used for mineral resource estimation.

## 12.3 2015 DATA VERIFICATION

### 12.3.1 ELECTRONIC DATABASE

Initially, a Microsoft® Access database and related Microsoft® Excel spreadsheets were provided by EAM to Fladgate as a universal project dataset along with a full set of assay certificates. Additional GIS data was provided in the form of MapInfo data files.

Information recorded from diamond drillcore logging and assaying was integrated using industry standard data management software (Maxwell DataShed). The resultant data was reviewed, including validation of a random selection of data against the source information, and it is considered acceptable for the purpose of this report.

### 12.3.2 DRILLHOLE COLLARS

Seventeen drillhole collar checks were undertaken by Fladgate during the site visit using a hand-held Garmin GPSmap 62s unit. Thirteen checks were completed at the Mato Bula prospect. At Mato Bula the average deviation was 2.24 m for the easting and 1.77 m for the northing, with the largest easting deviation recorded being 2.49 m (WMD021), and the largest northing deviation of 5.42 m (WMD009).

In 2015, Fladgate also checked the collar location of three holes at Mato Bula. No significant differences between the coordinates in the database and the coordinates collected during the site visit.

## 12.4 FLADGATE DRILLCORE LOGGING VERIFICATION

During the site visit, Fladgate examined drillcore from four drillholes and verified the drillhole logging. Fladgate made a comparison of the logged intervals of sulphide mineralization in the database with Fladgate's own observations of the sulphide mineralization.

Fladgate found no significant differences.

## 12.5 DOWNHOLE SURVEY CHECKS

The original downhole survey documents were scrutinized and a comparison with the downhole survey records found in the project database was made. No discrepancies were found between the original documents and the database used for Mineral Resource estimation.

## 12.6 INDEPENDENT VERIFICATION OF MINERALIZATION

As part of the review of mineralized intervals within the EAM drillcore, four independent samples were collected for assaying. The samples consisted of quartered core from selected intervals from drillholes WMD012, WMD023, WMD028 (all Mato Bula), and ADD002 (and Da Tambuk). One CRM (CDN-ME-1305) was included with the core samples, which were then submitted to OMAC Laboratories Limited, a subsidiary of ALS Minerals based in Loughrea, Republic of Ireland for fire assay, using the Au-GRA21 technique, and base metal assaying using the ME-ICPORE technique.

Given the strong nugget effect typically seen with gold, the variation between the original ACME assay and the ALS verification results is in good agreement. Base metal concentrations are in good agreement with the original data.

# 13.0 MINERAL PROCESSING AND METALLURGICAL TESTING

Metallurgical test work was conducted on samples collected from the Da Tambuk deposit in 2015. The metallurgical test work program was performed by BCR located near Vancouver, British Columbia, Canada, with the test work report completed in February 2016. The sample used for the test work were the composite blended from crushed diamond drill cores collected from various mineralized zones within the Da Tambuk deposit. The objective of the test work was:

- to investigate metallurgical responses of gold and silver mineralization to industry standard recovery technologies
- to develop a process flowsheet for the treatment of the Da Tambuk mineralization.

One master composite sample was prepared and used for the testing program. The test work evaluated metallurgical responses of the sample to gravity concentration, agitated cyanide leaching, and flotation technologies. The key test work results are summarized as follows:

- Whole material cyanidation of the Da Tambuk sample returned a gold recovery of 97.3%, indicating that the gold in the composite sample is not refractory, and good gold recovery can be achieved using industry standard agitated cyanide leaching technology.
- Flotation was successful in producing reasonable copper-gold concentrate grades and recoveries from the Da Tambuk sample; however, the gold recovery was lower than that achieved by agitated cyanide leaching.
- Intensive agitated cyanide leaching of a pyrite scavenger flotation concentrate produced from the flotation testing achieved a gold extraction of 96.6% indicating that the gold in this concentrate is not refractory and can be recovered using industry standard technology.

The sample used in the test work has higher head grades, especially copper head grade, compared to the average feed grades that are planned to be fed to the proposed mill. Further test work should be conducted on more representative samples, including variability test samples, to confirm the metallurgical responses.

## 13.1 SAMPLE COLLECTION

Sample collection program was developed by TRI and BCR metallurgical and geological personnel after reviewing of the Da Tambuk deposit geological data including an assessment of grade, mineralogy, lithology, zonation, and distribution as recorded in diamond drill logs. The objective was to generate a suite of samples for the test work that represents the overall Da Tambuk mineralization, taking into account mineralogical variation and geographic distribution. The metallurgical samples comprised crushed diamond drill core samples. Approximately 1 kg of crushed drill core was selected from each specific interval of drill core selected. A total of 50 kg of sample was collected. The samples were weighed and logged, packaged, sealed and prepared for transport to the BCR Laboratory.

The locations of the drill holes from which the metallurgical samples were collected are shown in Figure 13.1 and the metallurgical drill core samples are detailed in Table 13.1.

**Figure 13.1 Da Tambuk Drillhole Locations**

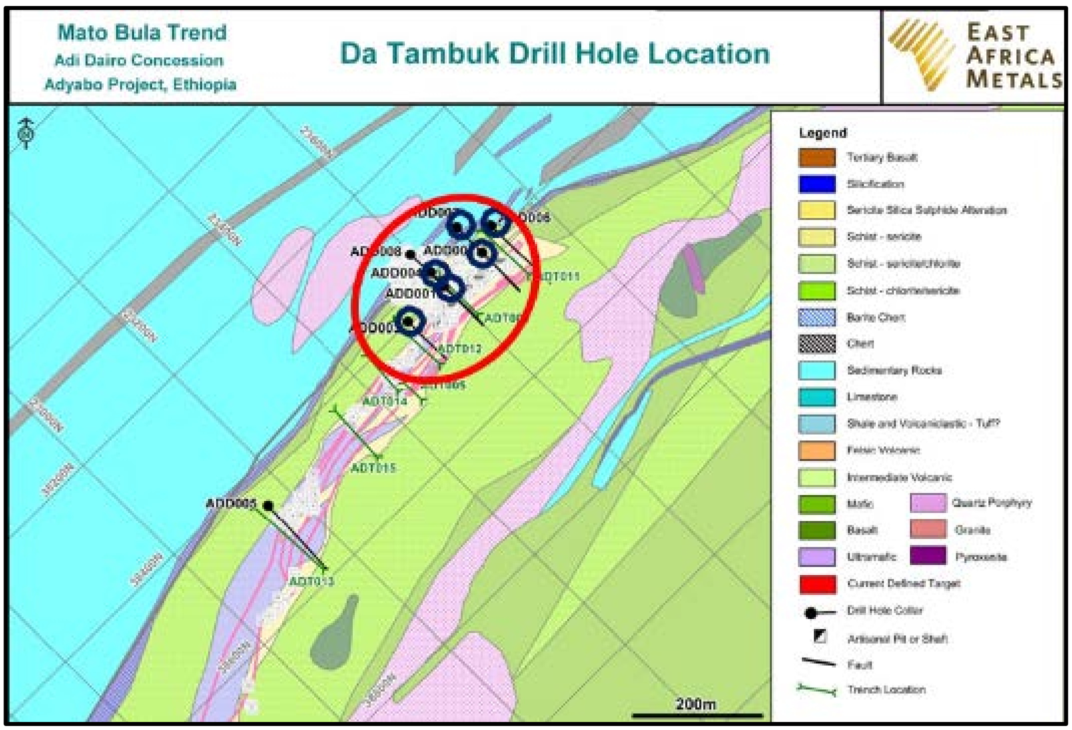


**Table 13.1 Metallurgical Drillhole Sample Details**

| Hole No. | From (m) | To (m) | Sample ID | Interval Length (m) | Weight to Composite (kg) | Au (g/t) | Ag (g/t) | Cu (%) |
|---|---|---|---|---|---|---|---|---|
| ADD001 | 41.30 | 42.30 | 71623 | 1.00 | 1.1 | 2.46 | 18 | 0.04 |
| ADD001 | 42.30 | 43.30 | 71506 | 1.00 | 1.1 | 0.28 | 2 | 0.06 |
| ADD001 | 43.30 | 44.36 | 71507 | 1.06 | 1.2 | 0.86 | 2 | 0.11 |
| ADD001 | 44.36 | 45.31 | 71508 | 0.95 | 1.0 | 9.20 | 5 | 0.06 |
| ADD001 | 45.31 | 46.26 | 71509 | 0.95 | 1.0 | 14.40 | 8 | 0.11 |
| ADD001 | 46.26 | 47.23 | 71510 | 0.97 | 1.1 | 0.41 | 0 | 0.07 |
| ADD001 | 47.23 | 48.23 | 71511 | 1.00 | 1.1 | 0.27 | 0 | 0.05 |
| ADD001 | 48.23 | 49.23 | 71512 | 1.00 | 1.1 | 0.32 | 0 | 0.34 |
| ADD001 | 49.23 | 50.28 | 71513 | 1.05 | 1.2 | 0.20 | 0 | 0.01 |
| ADD001 | 50.28 | 51.33 | 71514 | 1.05 | 1.2 | 10.70 | 2 | 0.03 |
| ADD001 | 51.33 | 52.38 | 71516 | 1.05 | 1.2 | 4.85 | 0 | 0.05 |
| ADD001 | 52.38 | 53.43 | 71517 | 1.05 | 1.2 | 0.40 | 0 | 0.02 |
| ADD001 | 53.43 | 54.48 | 71518 | 1.05 | 1.2 | 0.18 | 0 | 0.03 |
| ADD001 | 54.48 | 55.54 | 71519 | 1.06 | 1.2 | 0.39 | 0 | 0.02 |
| ADD001 | 55.54 | 56.54 | 71520 | 1.00 | 1.1 | 0.17 | 0 | 0.01 |
| ADD001 | 56.54 | 57.54 | 71521 | 1.00 | 1.1 | 0.23 | 0 | 0.02 |
| ADD001 | 57.54 | 58.54 | 71522 | 1.00 | 1.1 | 0.48 | 0 | 0.05 |
| ADD001 | 58.54 | 59.63 | 71523 | 1.09 | 1.2 | 20.60 | 7 | 0.75 |
| ADD001 | 59.63 | 60.83 | 71524 | 1.20 | 1.3 | 0.42 | 0 | 0.03 |
| ADD002 | 52.75 | 53.75 | 71653 | 1.00 | 1.1 | 3.03 | 4 | 0.25 |
| ADD002 | 53.75 | 54.75 | 71654 | 1.00 | 1.1 | 85.80 | 16 | 1.60 |
| ADD002 | 54.75 | 55.75 | 71656 | 1.00 | 1.1 | 56.70 | 10 | 0.65 |
| ADD002 | 55.75 | 56.75 | 71657 | 1.00 | 1.1 | 57.60 | 5 | 0.29 |
| ADD002 | 56.75 | 57.75 | 71658 | 1.00 | 1.1 | 1.71 | 0 | 0.15 |
| ADD003 | 83.42 | 84.42 | 71801 | 1.00 | 1.1 | 0.75 | 4 | 0.02 |
| ADD003 | 84.42 | 85.42 | 71802 | 1.00 | 1.1 | 0.65 | 2 | 0.02 |
| ADD003 | 85.42 | 86.42 | 71803 | 1.00 | 1.1 | 11.20 | 5 | 0.03 |
| ADD004 | 86.21 | 87.21 | 71857 | 1.00 | 1.1 | 0.38 | 0 | 0.02 |
| ADD004 | 87.21 | 88.21 | 71858 | 1.00 | 1.1 | 14.60 | 2 | 0.12 |
| ADD004 | 88.21 | 89.21 | 71859 | 1.00 | 1.1 | 11.90 | 3 | 0.07 |
| ADD004 | 89.44 | 90.40 | 71860 | 0.96 | 1.1 | 0.38 | 0 | 0.01 |
| ADD004 | 90.40 | 91.40 | 71861 | 1.00 | 1.1 | 0.17 | 0 | 0.03 |
| ADD004 | 91.40 | 92.40 | 71862 | 1.00 | 1.1 | 0.17 | 0 | 0.02 |
| ADD004 | 92.40 | 93.40 | 71863 | 1.00 | 1.1 | 0.18 | 0 | 0.03 |
| ADD004 | 93.40 | 94.40 | 71864 | 1.00 | 1.1 | 0.26 | 0 | 0.01 |
| ADD004 | 94.40 | 95.15 | 71866 | 0.75 | 0.8 | 11.90 | 8 | 1.97 |
| ADD004 | 95.15 | 95.90 | 71867 | 0.75 | 0.8 | 1.88 | 5 | 0.98 |
| ADD006 | 107.50 | 108.50 | 74827 | 1.00 | 1.1 | 17.80 | 19 | 0.60 |
| ADD006 | 108.50 | 109.15 | 74828 | 0.65 | 0.7 | 18.40 | 10 | 0.15 |
| ADD006 | 109.15 | 110.00 | 74829 | 0.85 | 0.9 | 3.92 | 7 | 0.09 |

*table continues...*

| Hole No. | From (m) | To (m) | Sample ID | Interval Length (m) | Weight to Composite (kg) | Au (g/t) | Ag (g/t) | Cu (%) |
|---|---|---|---|---|---|---|---|---|
| ADD006 | 110.00 | 110.80 | 74830 | 0.80 | 0.9 | 9.14 | 9 | 0.08 |
| ADD006 | 110.80 | 111.80 | 74831 | 1.00 | 1.1 | 3.16 | 2 | 0.09 |
| ADD007 | 123.55 | 124.30 | 74966 | 0.75 | 0.8 | 0.31 | 0 | 0.24 |
| ADD007 | 124.30 | 125.10 | 74967 | 0.80 | 0.9 | 0.60 | 0 | 0.50 |
| ADD007 | 125.10 | 126.10 | 74968 | 1.00 | 1.1 | 3.23 | 0 | 0.04 |
| ADD007 | 126.10 | 127.10 | 74969 | 1.00 | 1.1 | 54.20 | 4 | 0.17 |
| **Total** | | | | | **49.3** | **9.50** | **3.3** | **0.20** |

## 13.2 SAMPLE COMPOSITE PREPARATION AND HEAD ASSAYS

The composite sample received at BCR was splits (portions) of crushed drill cores that had been sent for assay, otherwise known as “coarse assay rejects”. At BCR, this composite sample was screened to remove finer than 1.7 mm (10 mesh) material and the screen oversize was crushed to finer than 1.7 mm. Then the composite was thoroughly blended using a rotary splitter, and a series of 2.0 kg metallurgical test charges were prepared. Triplicate head assay sub-samples were taken from the composite. The head assay samples were analyzed for gold, copper, zinc, arsenic, iron and sulphur. Base metal assays were conducted using AAS analysis with aqua regia digestion, gold by fire assay, and sulphur by Leco analyzer. The head assay results for the composite sample are summarized in Table 13.2.

**Table 13.2 Da Tambuk Head Assay Data**

| Sample ID | Au* (g/t) | Cu** (%) | Zn** (%) | As** (%) | Fe** (%) | S*** (%) |
|---|---|---|---|---|---|---|
| Composite Head A | 8.55 | 0.18 | 0.15 | 0.003 | 4.62 | 4.66 |
| Composite Head B | 9.03 | 0.19 | 0.15 | 0.000 | 4.58 | 4.55 |
| Composite Head C | 6.57 | 0.20 | 0.16 | 0.000 | 4.52 | 4.60 |
| Average | 8.05 | 0.19 | 0.15 | 0.001 | 4.57 | 4.6 |
| Drill Core Assay | 9.5 | 0.2 | - | - | - | - |

Note: *by fire assay
**by aqua regia digestion with AA finishing
***by LECO analyser

Compared to the drill core assay data provided by TRI (copper and gold only), the metallurgical composite assays reconcile well with the average resource drill core assays as shown in Table 13.2. However, there is a variability in the gold assays. The gold assay variance is likely due to the presence of coarse or particulate free gold in the sample.

The sample used in the test work has much higher head grades, especially copper head grade, compared to the average feed grades that are planned to be fed to the proposed mill. Further test work should be conducted on the better representative samples to confirm the metallurgical responses.

## 13.3 METALLURGICAL TEST WORK RESULTS

This test work program assessed copper and gold metallurgical responses to gravity concentration, agitated cyanide leaching and copper and gold flotation. The agitated cyanide leaching tests include the tests on the head sample and the flotation scavenger pyrite concentrate produced from the flotation tests.

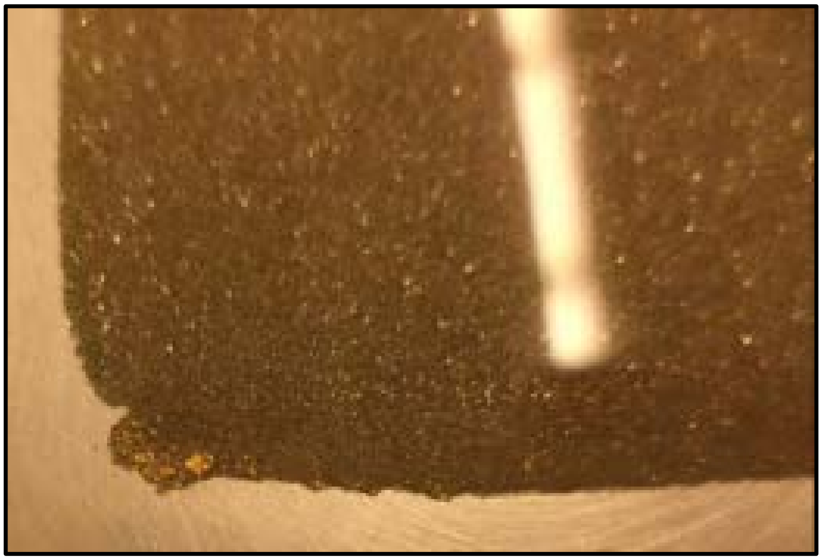
## 13.4 GRAVITY CONCENTRATION TEST WORK

The gravity concentration tests were conducted on a 2 kg sample which was ground to a particle size of 80% 75 µm. The ground sample was passed through a Knelson concentrator at standard operating parameters and the resulting concentrate from the Knelson concentrator was further upgraded on a MAT table to produce a table concentrate and a table tailings. These products, along with the Knelson concentrator tailings, were assayed for gold by fire assay, and a metallurgical balance was calculated. The results are summarized in Table 13.3 while Figure 13.2 shows a photo of visible gold grains concentrated into the MAT table concentrate. The table concentrate recovered approximately 18.4% of the gold from the feed into a concentrate containing 4,818 g/t gold.

**Table 13.3 Gravity Concentration Test Results - Da Tambuk**

| Product | Mass (g) | Weight (%) | Grade (Au g/t) | Recovery (Au %) |
|---|---|---|---|---|
| MAT Concentrate | 0.58 | 0.03 | 4817.7 | 18.4 |
| MAT Tailings | 96.7 | 4.83 | 86.4 | 55.2 |
| Knelson Tailings | 1903.4 | 95.14 | 2.11 | 26.4 |
| **Total** | **2000.7** | **100.00** | **7.57** | **100.0** |
| Measured Head | 2000.0 | - | 8.05 | - |
| Reconciliation | 100% | - | 94.0% | - |

Figure 13.2 Visible Gold Grains in Table Concentrate – Da Tambuk



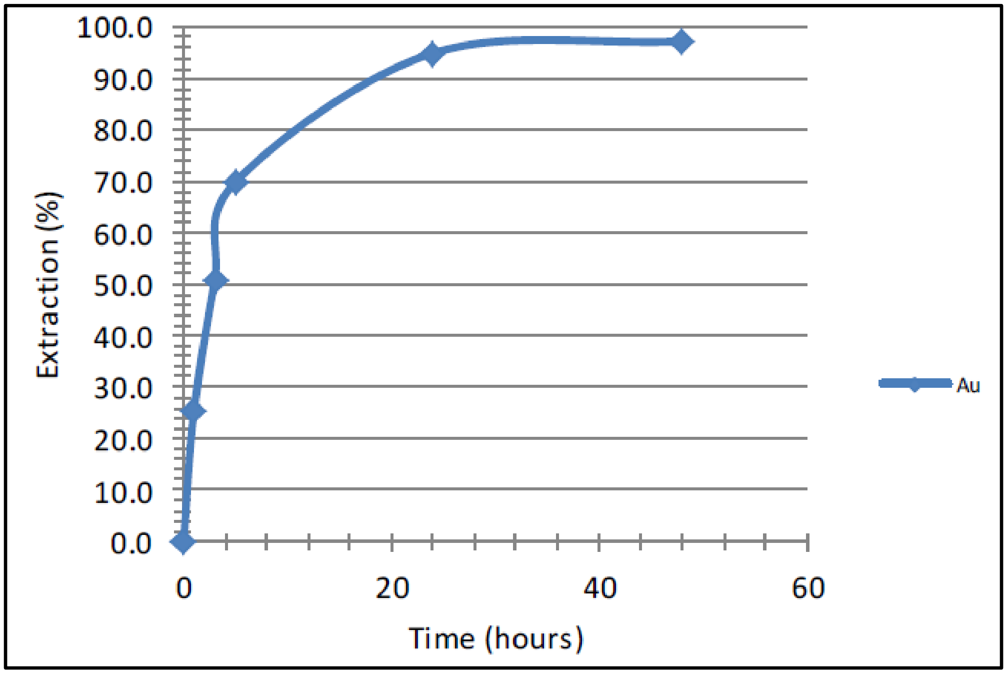
## 13.5 WHOLE MATERIAL CYANIDATION

A whole material bottle roll cyanidation test (to simulate agitated cyanide leach) on the composite was performed to assess gold metallurgical responses to cyanidation. The test achieved 97.3% gold recovery, which confirmed that agitated cyanide leaching could achieve good gold recovery from the composite sample. The conditions employed for this test are as below:

- leach retention time: 48 hours
- sodium cyanide (NaCN) concentration maintained: 4 g/L
- pulp density: 40% w/w solids
- pulp pH: higher than 10.5 with lime
- air sparging as required to maintain dissolved oxygen level above 7.

This test returned an overall gold extraction of 97.3% with a leaching retention time of 48 hours. NaCN consumption was 3.3 kg/t. As shown in Figure 13.3, the gold leach kinetics is rapid in the initial leaching stage.

**Figure 13.3 Gold Leach Kinetics Curve - Test CN-4**




## 13.6 FLOTATION TESTS

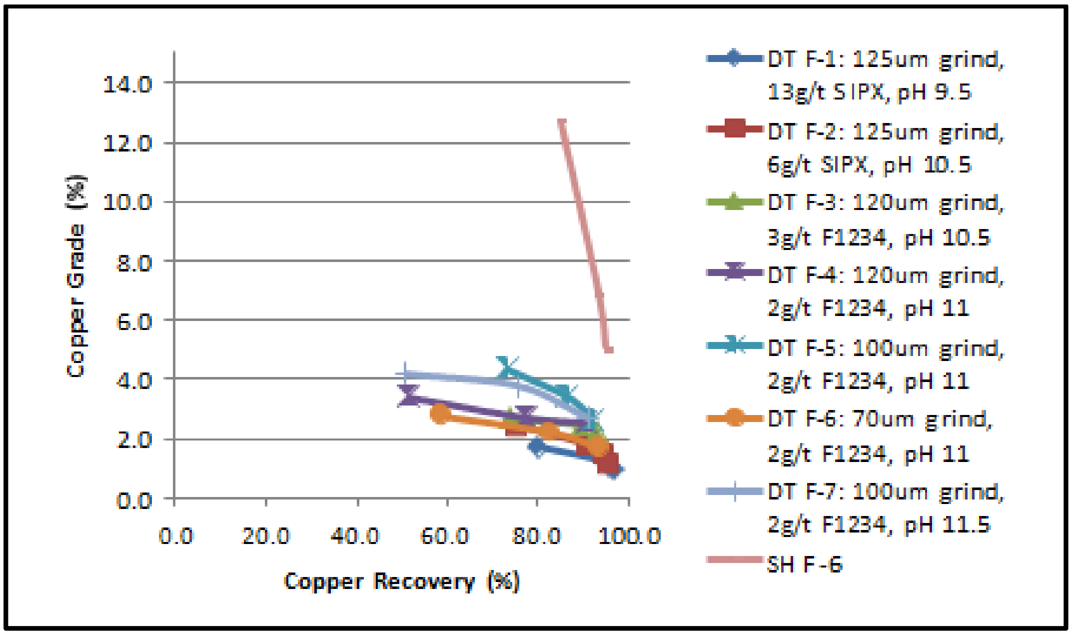
A total of ten rougher flotation tests were performed on the composite. The initial tests resulted in a relatively low flotation selectivity. Therefore, a slightly broader scope of optimization test work was conducted to improve metallurgical performance of flotation. This included rougher flotation tests to evaluate the impact of lower collector dose, alternative collector type, higher pH, finer primary grind, addition of depressants such as sodium meta bisulphite (SMBS), carboxymethyl cellulose (CMC) and sodium silicate, and low pulp density flotation. Table 13.4 summarizes the conditions employed for the ten rougher flotation tests.

### Table 13.4 Rougher Flotation Test Condition Summary

| Test ID | Grind P80 (µm) | Rougher pH | Pyrite Scavenger | SIPX (g/t) | F-1234 (g/t) | SMBS (g/t) | CMC (g/t) | Sodium Silicate (g/t) | Pulp Density (%) | Flotation Time (min) |
|---|---|---|---|---|---|---|---|---|---|---|
| DT F-1 | 125 | 9.5 | No | 13 | - | - | - | - | ~38 | 8 |
| DT F-2 | 125 | 10.5 | No | 6 | - | - | - | - | ~38 | 8 |
| DT F-3 | 120 | 10.5 | Yes | - | 3 | - | - | - | ~38 | 12 |
| DT F-4 | 120 | 11.0 | Yes | 10 | 2 | - | - | - | ~38 | 10 |
| DT F-5 | 100 | 11.0 | Yes | 10 | 2 | - | - | - | ~38 | 10 |
| DT F-6 | 70 | 11.0 | Yes | 10 | 2 | - | - | - | ~38 | 10 |
| DT F-7 | 100 | 11.5 | Yes | 10 | 2 | - | - | - | ~38 | 10 |
| DT F-8 | 100 | 11.5 | Yes | 10 | 2 | 500 | - | - | ~38 | 10 |
| DT F-9 | 100 | 11.0 | Yes | 10 | 2 | - | 60 | - | ~38 | 10 |
| DT F-10 | 120 | 11.0 | Yes | 10 | 2 | - | - | 120 | ~22 | 10 |

The results of the first seven rougher flotation tests are summarized in the grade-recovery curves in Figure 13.4.

### Figure 13.4 Grade-Recovery Curves - Copper Rougher Flotation – Tests DT F-1 to DT F-7



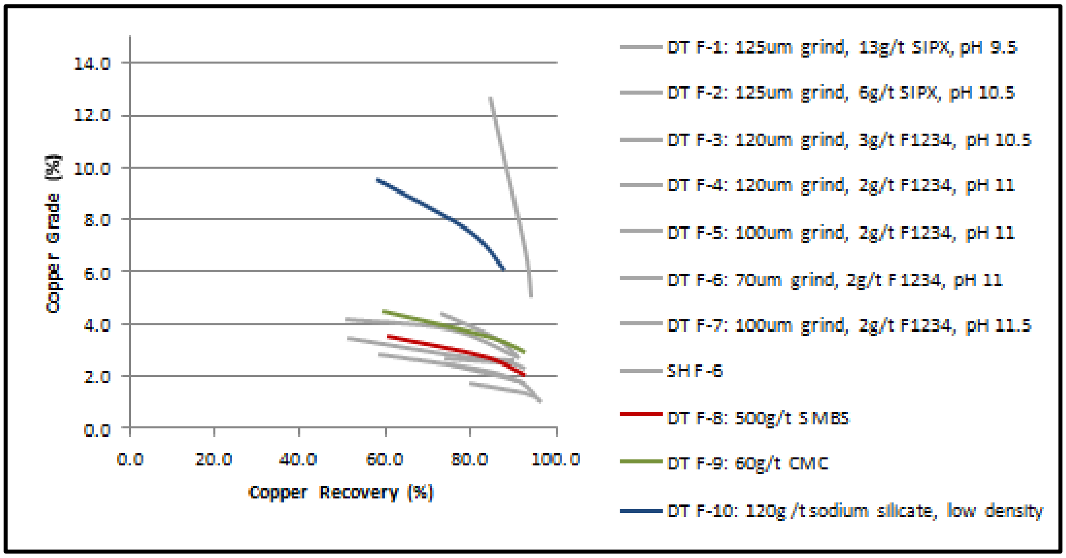

Note: *SH F is the test result from Silica Hill deposit

The data in Figure 13.4 indicates that copper rougher flotation was relatively poor, and the copper rougher selectivity was not satisfactory. It was concluded that a significant portion of the sample may comprise floatable gangue material. The test work included an attempt to suppress pyrite by decreasing collector dosage and increasing grind fineness and pH in the initial tests.

Further tests were conducted to improve rougher concentrate grade. Test DT F-8 employed a relatively high SMBS dosage of 500 g/t in the primary grind. As shown in Figure 13.5, this test did not improve copper rougher metallurgical performance compared to the results from Tests DT F-1 to DT F-7. Test DT F-9 was conducted with 60 g/t of CMC (talc depressant) that was stage-added throughout the rougher flotation, and this test also yielded no additional benefit.

Mineralogical analysis of a rougher 1 flotation concentrate from Test DT F-9 was conducted at AuTec in Vancouver, British Columbia. The x-ray diffraction (XRD) analysis data suggests that the concentrate contained 36% quartz, 20% muscovite (mica), and 5% chlorite. Accordingly Test DT F-10 was conducted with 120 g/t of sodium silicate, stage-added through the rougher flotation in an effort to suppress quartz. This test was also conducted at a diluted pulp density of approximately 22% in an 8 L flotation cell, compared to a solid density of approximately 38% in a 4 L cell.

Figure 13.5 Grade-Recovery Curves-Rougher Flotation Copper with Tests DT F-8 to F-10




Note: *SH F is the test result from Silica Hill deposit

As shown in Figure 13.5, a combination of addition of sodium silicate and lower pulp solid density had a marked effect on rougher flotation selectivity. In Test DT F-10, a significantly higher copper rougher concentrate grade was produced (6.0% copper) at an 88.6% copper recovery. Gold recovery to the copper rougher concentrate was 79.4%. With the pyrite scavenger concentrate, the overall gold recovery was up to 88.8%.

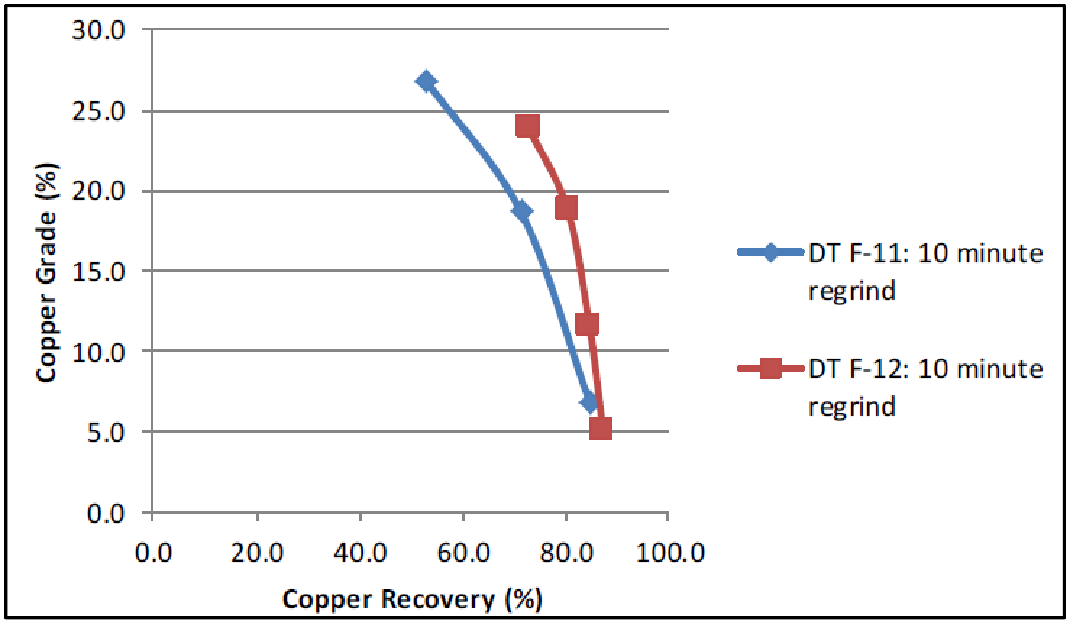
Two cleaner flotation tests were conducted on the Da Tambuk composite with the rougher flotation conditions taken from Test DT F-10. The cleaner flotation conditions are summarized below:

- Test DT F-11: regrinding on copper rougher concentrate for 10 minutes to 80% passing 27 µm, two stages of copper cleaning at pH 11, 1 g/t of F1234 collector added in the first copper cleaner flotation.

- Test DT F-12: regrinding on copper rougher concentrate for 5 minutes, three stages of copper cleaning at pH 11.5, 11 and 11 respectively, 1.5 g/t of F1234 collector added in the first copper cleaner flotation.

The results for these two tests are summarized in Figure 13.6.

Figure 13.6 Cleaner Flotation Test Results - Da Tambuk Composite




Both tests produced copper concentrate grades in excess of 24% copper with high gold grades of between 660 to 860 g/t gold. Copper recovery was higher in Test DT F-12 where a coarser regrind size and slightly higher collector dosage were employed in the cleaner flotation. Test DT F-12 produced a copper concentrate grading 24% copper and 855 g/t gold at a copper recovery of 72.7% and a gold recovery of 57.4%.

Although the copper recovery and concentrate grade results are positive, the gold recovery is low.

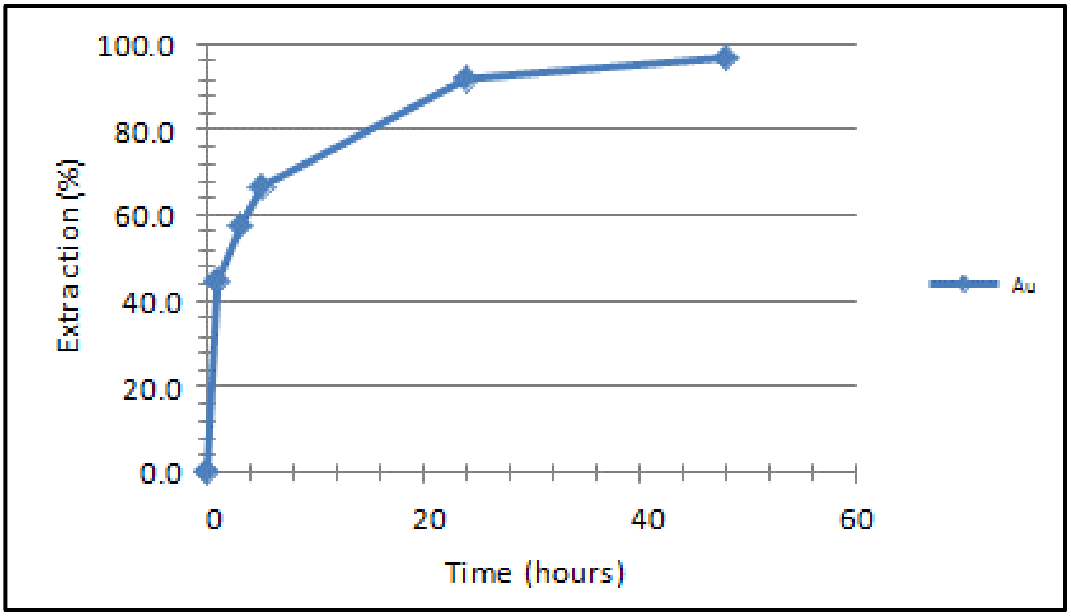
## 13.7 PYRITE SCAVENGER CONCENTRATE CYANIDATION

A blend of the pyrite scavenger flotation concentrates from Tests DT F-5 to DT F-9 was also subjected to an intense cyanide leach using the bottle roll test procedure. The following summarizes key aspects of the test:

- cyanide concentration: 5.0 g/L
- pulp density: 35% w/w solids
- slurry pH: higher than 10.5 with lime
- leach retention time: 48 hours.

As shown in Figure 13.7, the cyanide leach test produced a gold extraction of 96.6% from the pyrite scavenger concentrate.

**Figure 13.7 Cyanide Leach Kinetics – Pyrite Scavenger Concentrate**




## 13.8 FLOTATION CONCENTRATE QUALITY ANALYSIS

The third cleaner flotation concentrate from Test DT F-12 was submitted for multi-elemental analysis using ICP procedure and mercury analysis using cold vapour procedure. The results are summarized in Table 13.5.

### Table 13.5 Multi-element Assay – Flotation Concentrate (Test DT F-12)

| Element | Unit | Content | Element | Unit | Content | Element | Unit | Content |
|---|---|---|---|---|---|---|---|---|
| Ti | % | <0.001 | Ga | ppm | 0.3 | Hg | ppm | 21 |
| S | % | 6 | Ge | ppm | 0.8 | Sm | ppm | 0.6 |
| P | % | <0.001 | As | ppm | 126 | Se | ppm | 168 |
| Li | ppm | 2.7 | Rb | ppm | 0.4 | Eu | ppm | 0.1 |
| Be | ppm | <0.1 | Sr | ppm | 6.2 | Gd | ppm | 0.4 |
| B | ppm | <1 | Y | ppm | 0.4 | Tb | ppm | <0.1 |
| Na | % | <0.001 | Zr | ppm | 2.3 | Dy | ppm | 0.1 |
| Mg | % | 0.1 | Nb | ppm | <0.1 | Ho | ppm | <0.1 |
| Al | % | 0.1 | Mo | ppm | 5.6 | Er | ppm | <0.1 |
| K | % | <0.01 | Ag | ppm | 89.8 | Tm | ppm | <0.1 |
| Bi | ppm | 10.5 | In | ppm | 22.1 | Yb | ppm | <0.1 |
| Ca | % | 0.7 | Sn | ppm | 1.1 | Lu | ppm | <0.1 |
| Sc | ppm | 0.2 | Sb | ppm | 15.2 | Hf | ppm | <0.1 |
| V | ppm | 2 | Te | ppm | 86.9 | Ta | ppm | <0.05 |
| Cr | ppm | <1 | Cs | ppm | <0.02 | W | ppm | <0.1 |
| Mn | ppm | 37 | Ba | ppm | 5.9 | Re | ppm | <0.001 |
| Fe | % | 18.9 | La | ppm | 2.3 | Au | ppm | >10 |
| Co | ppm | 21.8 | Ce | ppm | 5.8 | Tl | ppm | 0.1 |
| Ni | ppm | 9.4 | Cd | ppm | 203 | Pb | ppm | >5,000 |
| Cu | ppm | >10,000 | Pr | ppm | 0.7 | Th | ppm | 0.6 |
| Zn | ppm | >5,000 | Nd | ppm | 2.9 | U | ppm | 0.1 |

The assay from the concentrate analysis shows:

- The third cleaner flotation concentrate contains approximately 90 g/t silver that may be payable.
- Arsenic, antimony, and cadmium contents in the concentrate are low.
- Mercury content is 21 ppm.

Silica content of the concentrate is not available, it should be assayed.

The arsenic, cadmium and antimony contents appear to be lower than the thresholds that may incur smelter penalties. The mercury content may be slightly higher than the penalty thresholds set up by some of the smelters. Silica, lead and zinc contents should be assayed to confirm whether they exceed the penalty thresholds.

Further test work should be conducted on more representative samples, including variability samples, to optimize process conditions and confirm the metallurgical performances. The recommended test work is provided in Section 26.0.

# 14.0 MINERAL RESOURCE ESTIMATES

## 14.1 KEY ASSUMPTIONS/BASIS OF ESTIMATE

Fladgate reviewed the Mineral Resource data for Da Tambuk. The drillholes and channel samples collected from trenches used to estimate mineral resources are shown below in Table 14.1. Fladgate removed several low-confidence (due to magnetic host rocks) downhole survey measurements from the database. Fladgate considers the collar, down hole survey, assay, and lithology data to be adequate to support mineral resource estimation.

There are a total of 84 drillholes (for a total of 15,295.9 m) and 45 trenches (for a total of 2,808 m) within the Da Tambuk database used to support Mineral Resource estimation. Drill holes have intercepted mineralization at depths of up to 200 m below surface at Da Tambuk.

The drill database was provided to Fladgate in a Microsoft® Access database and in Microsoft® Excel files. Coordinates are in a local grid system set-up by EAM. The database cut-off date for Mineral Resource estimate purposes was April 13, 2016. Fladgate imported the collar, survey, lithology and assay data into MineSight®, a commercial mining software program.

Topographic contour lines were based on a surface supplied by EAM with contour lines spaced 2 m apart. The topography is based upon GeoEye images collected at a resolution of 50 cm.

Fladgate compared the drill hole collars with the topographic surface and found only minor differences of less than 1 m in elevation between the surveyed drill hole collars and the topography. No corrections were made to the drill hole collar elevations.

An additional infill diamond drill program of four drillholes was conducted at Da Tambuk in 2016 subsequent to the mineral resource estimate. The program was designed to upgrade the existing resources defined. Da Tambuk has a total of 28 diamond drillholes completed for a total of 4,185 m of core drilled. As of the date of this study the most recent drill results are being processed to update the existing Mineral Resource. Fladgate reviewed the results from the additional drilling in 2016. The drillholes generally intercepted similar grades and thicknesses to those in the 2015 and early-2016 drilling. The Mineral Resource estimate would not be materially affected by the inclusion of the additional drillholes.

The gold-copper mineralization at Da Tambuk is hosted by intensely deformed and altered sericite-altered schists and mafic meta-volcanic rocks which form prominent northeast trending ridges.

At Da Tambuk, mineralization occurs in two sub-parallel zones with a strike length of 650 m in a northeast-southwest direction, a vertical extent of 200 m, and horizontal widths up to 50 m. Mineralization is enriched in gold relative to copper with a gold:copper ratio (gold grams per tonne to copper percent) of 24.7 to 1.

**Table 14.1 Adyabo Project Data Types used to Support Mineral Resource Estimation**

| Area | Number Holes | Drillhole ID | Total Metres | Number Trenches | Total Metres | Trench ID |
|---|---|---|---|---|---|---|
| Da Tambuk | 11 | ADD001-ADD011 | 1,948.5 | 7 | 658 | ADT004-ADT005 |
| | | | | | | ADT011-ADT015 |
| | 13 | ADD012-ADD024 | 1,722.1 | 6 | 359 | ADT018-ADT023 |
| **Total** | **84** | | **15,295.8** | **45** | **2,808** | |

## 14.2 DA TAMBUK MINERAL RESOURCE ESTIMATE

### 14.2.1 WIREFRAME MODELS AND MINERALIZATION DA TAMBUK

EAM provided Fladgate with sectional interpretations of the mineralization based on copper and gold grades. Fladgate created wireframe models of the mineralized zones using EAM's drillhole intercepts with Minesight's implicit modeller. Minesight is an industry standard integrated LOM software program, owned by Hexagon Mining.

Fladgate reviewed the wireframe models and found the wireframe boundaries were correctly snapped to the drill hole intercepts. Fladgate inspected drill holes displaying gold and copper grades. No significant zones of mineralization fall outside of the wireframes.

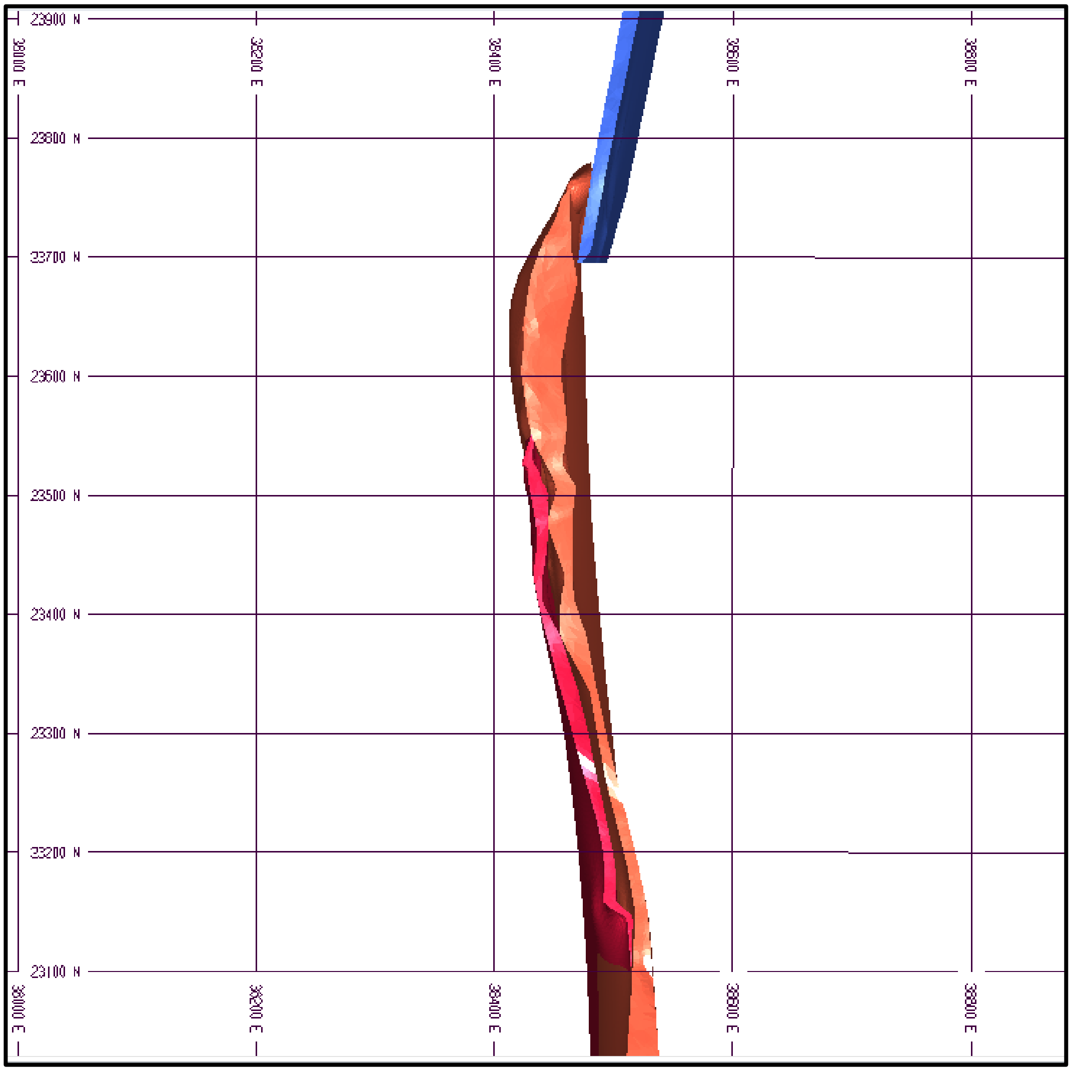
Fladgate coded each zone separately, as shown in in Table 14.2.

**Table 14.2 Da Tambuk Domain Codes**

| Domain | Code |
|---|---|
| Zone 100 | 100 |
| Zone 150 | 150 |
| Zone 200 | 200 |

The wireframe models used to constrain mineral resource estimation are shown below in Figure 14.1. Fladgate created partial items and stored the percentage of each block falling within the wireframes.

**Figure 14.1 Horizontal Projection of Mineralization Wireframes, Da Tambuk**




Note: Zone 100 is shown in red. Zone 150 is shown in orange. Zone 200 is shown in light blue.

### 14.2.2 Exploratory Data Analysis (EDA)

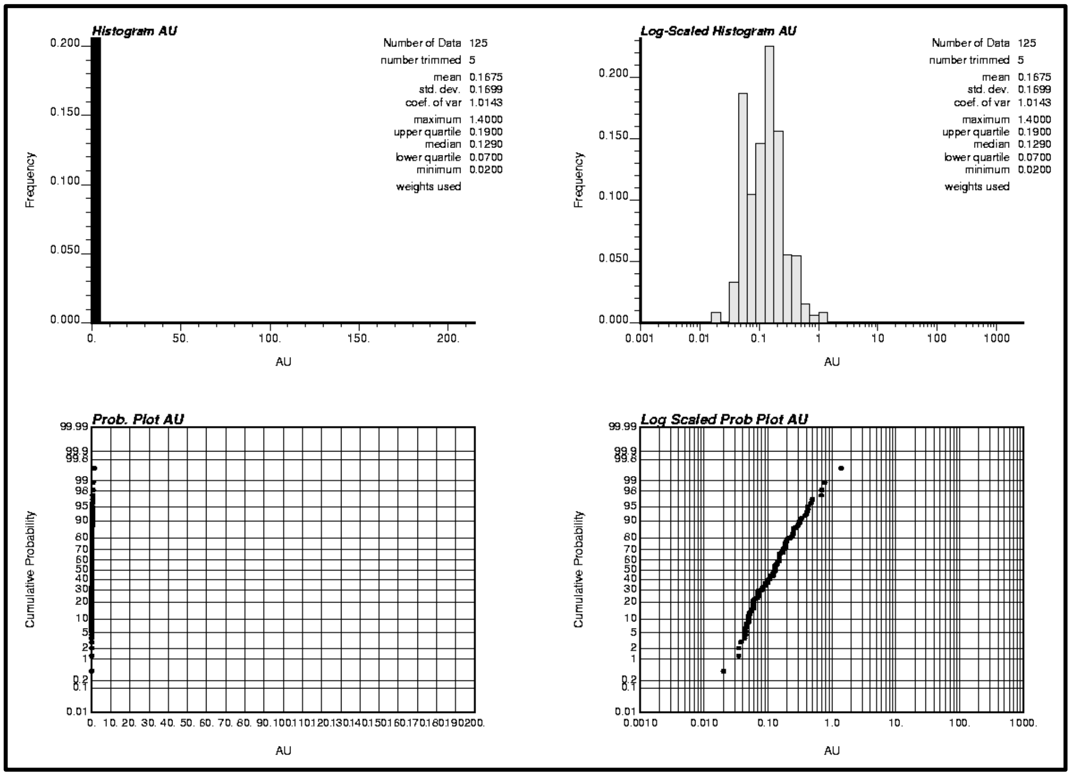
Exploratory data analysis (EDA) comprised basic statistical evaluation of the assays and composites for gold, copper, silver, and sample length.

### 14.2.3 Assays

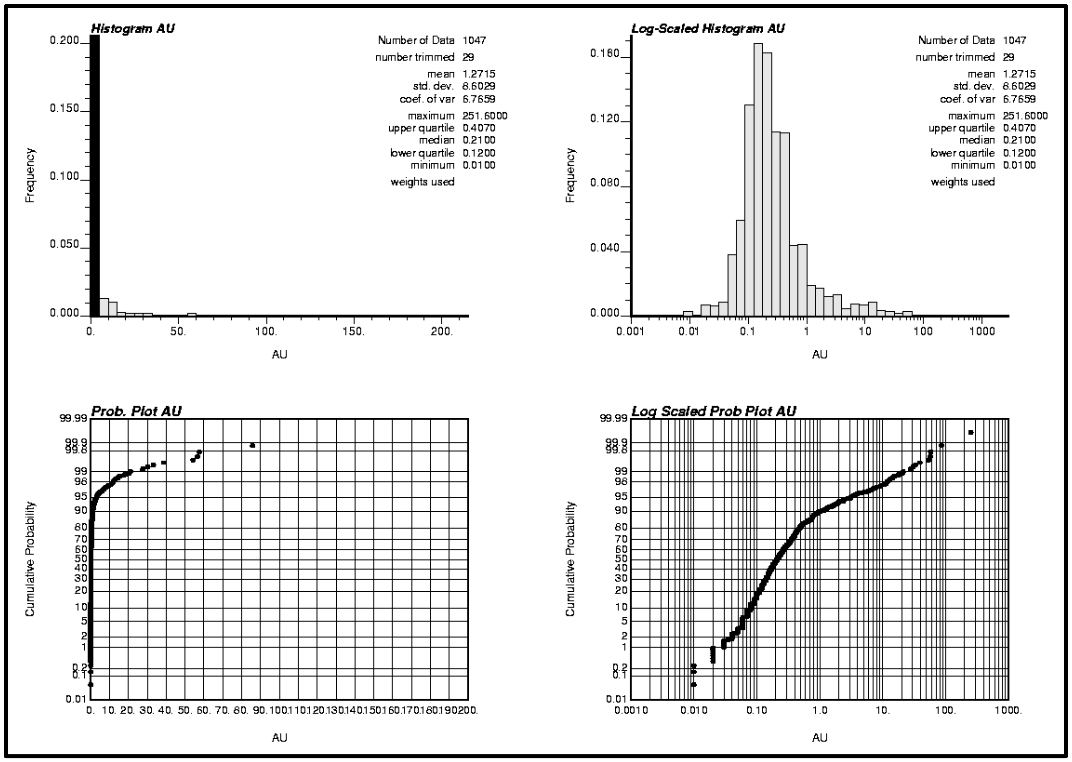
*Histograms and Probability Plots*

Log-scaled histograms and probability plots for copper, gold, and silver within Zone 150 show evidence for mixed populations. The log-scaled histogram for Zone 150 shows the presence of an included higher-grade population above a threshold of approximately 1 g/t gold, comprising 10% of the samples. Fladgate concludes that this amount of included higher-grade material warrants further domaining. The gold histograms and probability plots for Zones 100, 150 and 200 are shown below in Figure 14.2, Figure 14.3, and Figure 14.4.

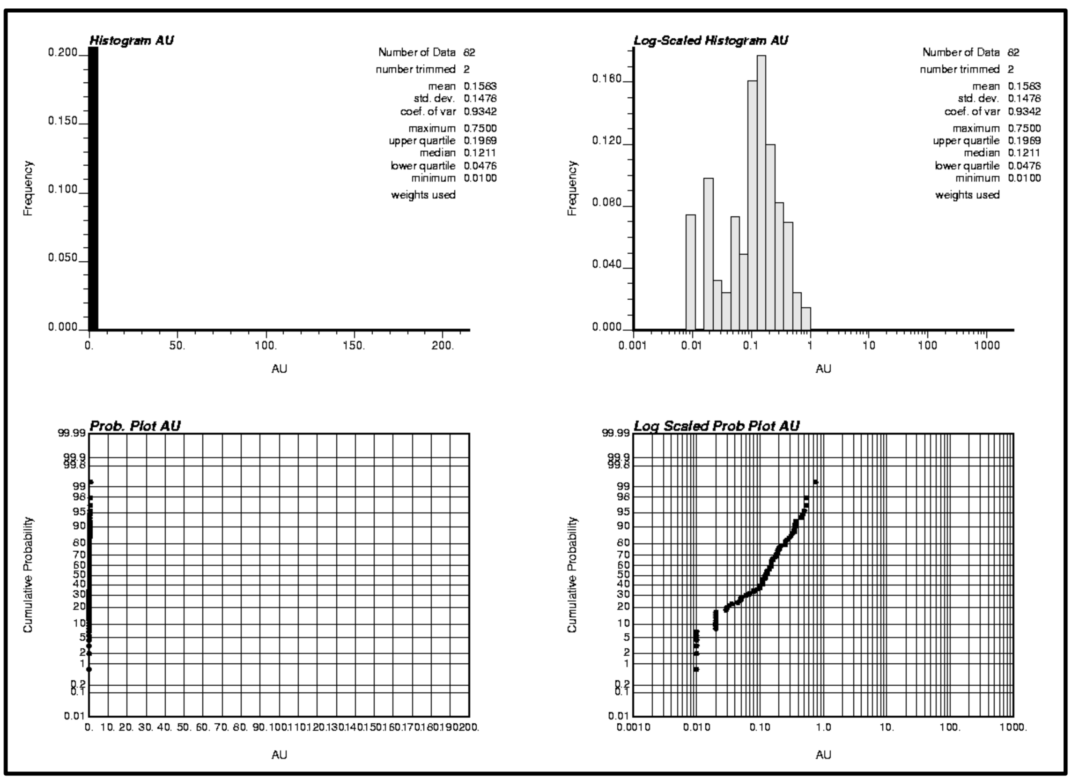
**Figure 14.2 Zone 100 Histograms and Probability Plots, Assays**



## Figure 14.3 Zone 150 Histograms and Probability Plots, Assays




## Figure 14.4 Zone 200 Histograms and Probability Plots, Assays



### 14.2.4 GRADE CAPPING/OUTLIER RESTRICTIONS

Fladgate evaluated length-weighted, normal-scaled, and log-scaled histograms and probability plots of the assays to define grade outliers for gold, copper, and silver within each of the domains separately.

The capping grade thresholds and the amount of metal removed within the domains are shown below in Table 14.3 and Table 14.4. Capping was completed on the assays before compositing.

Fladgate's selected capping threshold for Zone 150 is somewhat higher than would typically be selected (based on the histograms and probability plots) because the high grades occur spatially clustered in one portion of the deposit.

### 14.2.5 ASSAY STATISTICS

Fladgate tabulated summary length-weighted statistics for gold and silver within each domain. The summary statistics are shown below in Table 14.3, Table 14.4 and Table 14.5. The statistics show that Zone 150 has significantly higher means and coefficients of variation (CV) for gold, copper, and silver than those in Zones 100 and 200.

**Table 14.3 Length Weighted Assay Statistics for Gold within Each Domain**

| Domain | Number | Minimum | Maximum | Mean (g/t) | CV | Capping Threshold (g/t) | Capped Mean (g/t) | Capped CV | Metal (%) | Number of Assays Capped |
|---|---|---|---|---|---|---|---|---|---|---|
| Zone 100 | 125 | 0.02 | 1.40 | 0.17 | 1.01 | 0.8 | 0.16 | 0.86 | -3.0% | 1 |
| Zone 150 | 1047 | 0.01 | 251.60 | 1.27 | 6.77 | 55 | 1.08 | 4.36 | -14.9% | 4 |
| Zone 200 | 82 | 0.01 | 0.75 | 0.16 | 0.93 | _ | 0.16 | 0.93 | 0.0% | 0 |

**Table 14.4 Length Weighted Assay Statistics for Copper within Each Domain**

| Domain | Number | Minimum | Maximum | Mean (%) | CV | Capping Threshold (%) | Capped Mean (%) | Capped CV | Metal (%) | Number of Assays Capped |
|---|---|---|---|---|---|---|---|---|---|---|
| Zone 100 | 125 | 0.00 | 0.17 | 0.02 | 1.37 | _ | 0.02 | 1.37 | 0% | 0 |
| Zone 150 | 1060 | 0.00 | 1.97 | 0.05 | 2.98 | _ | 0.05 | 2.98 | 0% | 0 |
| Zone 200 | 82 | 0.00 | 0.14 | 0.02 | 1.06 | _ | 0.02 | 1.06 | 0% | 0 |

**Table 14.5 Length Weighted Assay Statistics for Silver within Each Domain**

| Domain | Number | Minimum | Maximum | Mean (g/t) | CV | Capping Threshold (g/t) | Capped Mean (g/t) | Capped CV | Metal (%) | Number of Assays Capped |
|---|---|---|---|---|---|---|---|---|---|---|
| Zone 100 | 66 | 0.0 | 2.0 | 0.1 | 5.8 | _ | 0.1 | 5.8 | | |
| Zone 150 | 821 | 0.0 | 69.4 | 1.4 | 2.6 | 20 | 1.3 | 2.1 | 5% | 2 |
| Zone 200 | 54 | 0.0 | 6.9 | 1.3 | 1.2 | _ | 1.3 | 1.2 | 0% | 0 |

The CV values of the capped gold assays within Zone 150 are generally over 2. Fladgate concluded that further domaining of the gold grades in Zone 150 is warranted. Further domaining of the gold grades and low copper and silver grades in Zones 100 and 200 is not warranted.

### 14.2.6 COMPOSITES

To normalize the weight of influence of each sample, Fladgate regularized the assay intervals by compositing the drill hole data into 2 m lengths using the mineralization zone domain boundaries to break the composites. The original samples are mostly 1 m in length up to a maximum of 1.3 m; therefore, a 2 m composite length minimizes the amount of sample splitting.

Summaries of the 2 m composite statistics are shown below in, Table 14.6, Table 14.7 and Table 14.8.

Fladgate notes that the length-weighted mean gold and copper grades of 2 m length composites are very similar to those of the assays; therefore, Fladgate is confident that the compositing process is working as intended. The mean length-weighted silver grades of the composites are somewhat different to those of the assays. This is a result of missing assays within the database (the length used to calculate length-weighted statistics is the downhole composite interval length rather than the sum of the assay lengths within the composite). Except for gold within Zone 150, the capped CV values of the composites are low (less than 1).

Capped gold composites within Zone 150 have a very high CV value of 3.52. This CV value indicates that further domaining is warranted.

Gold histograms and probability plots for Zone 100, Zone 150 and Zone 200 are shown in Figure 14.5, Figure 14.6 and Figure 14.7.

**Table 14.6 Length Weighted 2 m Composite Statistics, Gold**

| Domain | Number | Minimum (g/t) | Maximum (g/t) | Mean (g/t) | CV | Capped Mean (g/t) | Capped CV | Capped Assay Mean (g/t) |
|---|---|---|---|---|---|---|---|---|
| Zone 100 | 62 | 0.04 | 0.99 | 0.17 | 0.86 | 0.16 | 0.73 | 0.16 |
| Zone 150 | 518 | 0.02 | 101.53 | 1.27 | 4.77 | 1.08 | 3.52 | 1.08 |
| Zone 200 | 42 | 0.01 | 0.45 | 0.16 | 0.75 | 0.16 | 0.75 | 0.16 |

**Table 14.7 Length Weighted 2m Composite Statistics, Copper**

| Domain | Number | Minimum (%) | Maximum (%) | Mean (%) | CV | Capped Mean (%) | Capped CV | Capped Assay Mean (%) |
|---|---|---|---|---|---|---|---|---|
| Zone 100 | 62 | 0.00 | 0.13 | 0.02 | 1.12 | 0.02 | 1.12 | 0.02 |
| Zone 150 | 518 | 0.00 | 1.10 | 0.05 | 2.23 | 0.05 | 2.23 | 0.05 |
| Zone 200 | 42 | 0.00 | 0.09 | 0.02 | 0.88 | 0.02 | 0.88 | 0.02 |

**Table 14.8 Length Weighted 2m Composite Statistics, Silver**

| Domain | Number | Minimum (g/t) | Maximum (g/t) | Mean (g/t) | CV | Capped Mean (g/t) | Capped CV | Capped Assay Mean (g/t) |
|---|---|---|---|---|---|---|---|---|
| Zone 100 | 31 | 0.0 | 1.0 | 0.1 | 3.8 | 0.1 | 3.8 | 0.1 |
| Zone 150 | 395 | 0.0 | 28.5 | 1.2 | 2.1 | 1.1 | 1.8 | 1.3 |
| Zone 200 | 28 | 0.0 | 5.3 | 1.3 | 1.0 | 1.3 | 1.0 | 1.3 |

**Figure 14.5 Da Tambuk Zone 100 Histograms and Probability Plots, Capped Composites**

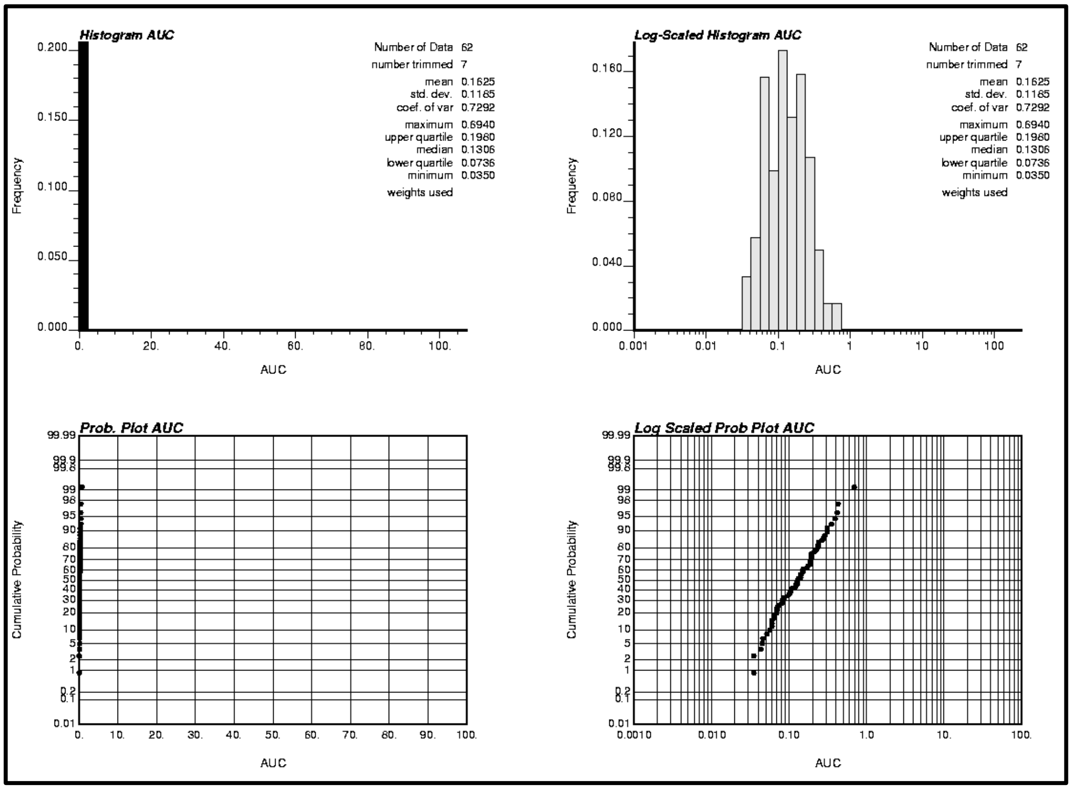
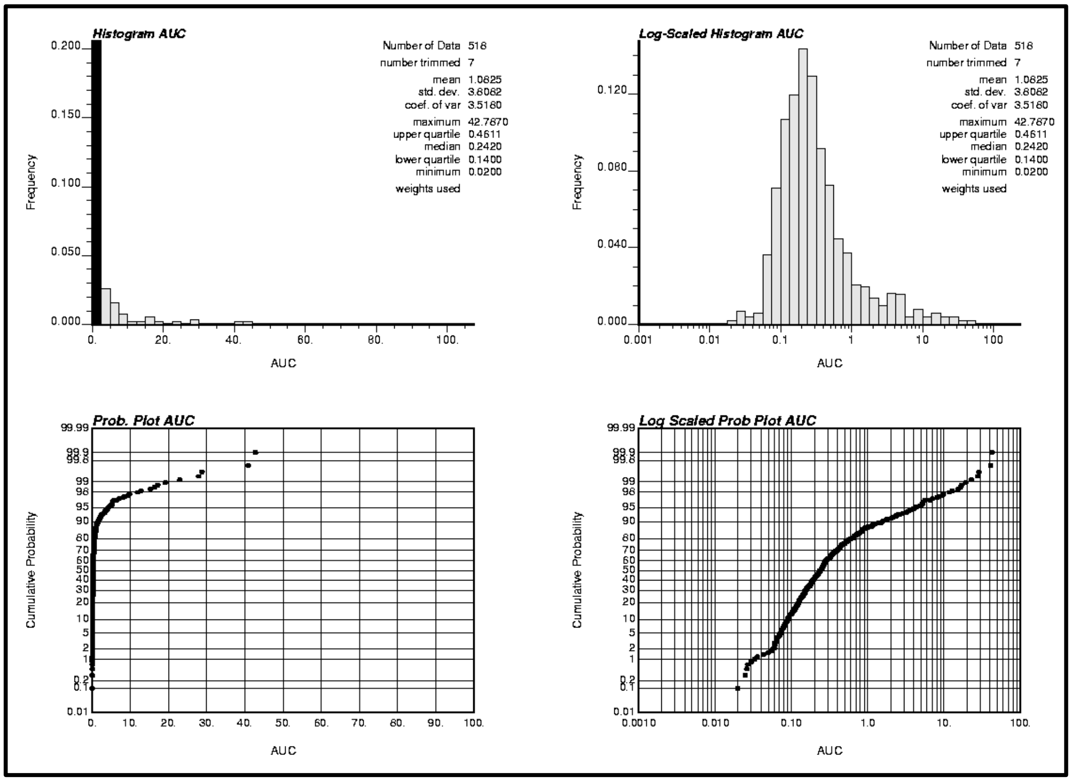
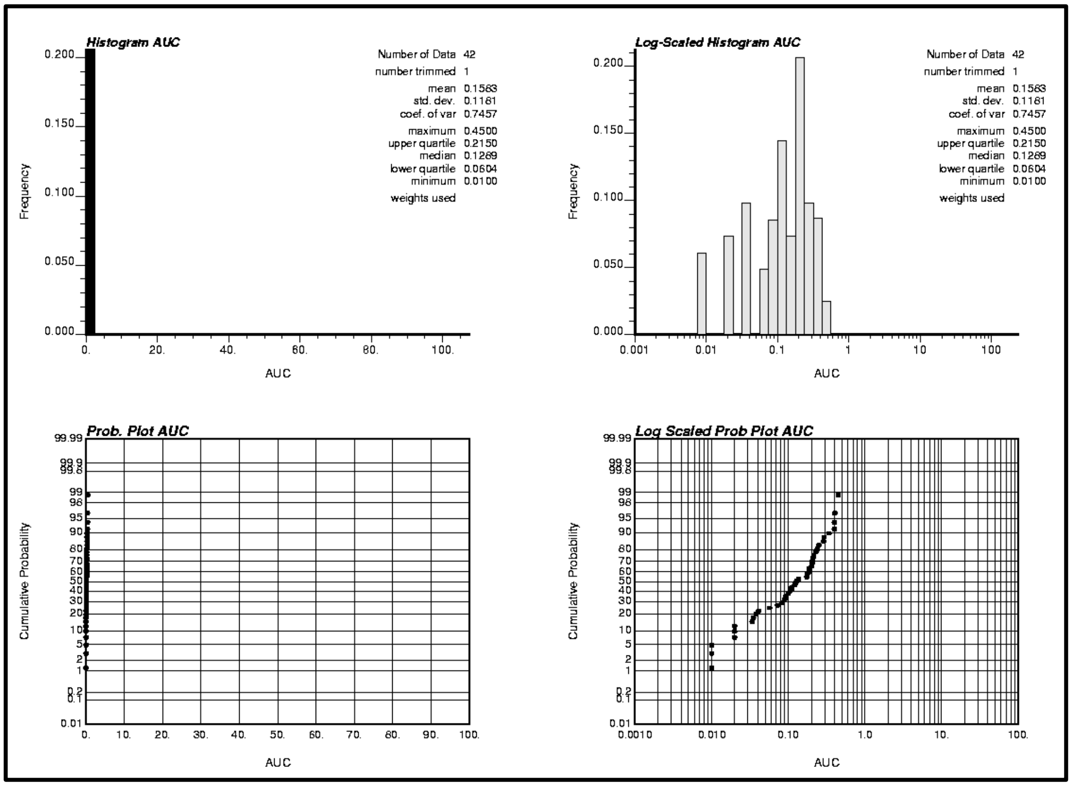


**Figure 14.6 Da Tambuk Zone 150 Histograms and Probability Plots, Capped Composites**



### Figure 14.7 Da Tambuk Zone 200 Histograms and Probability Plots, Capped Composites

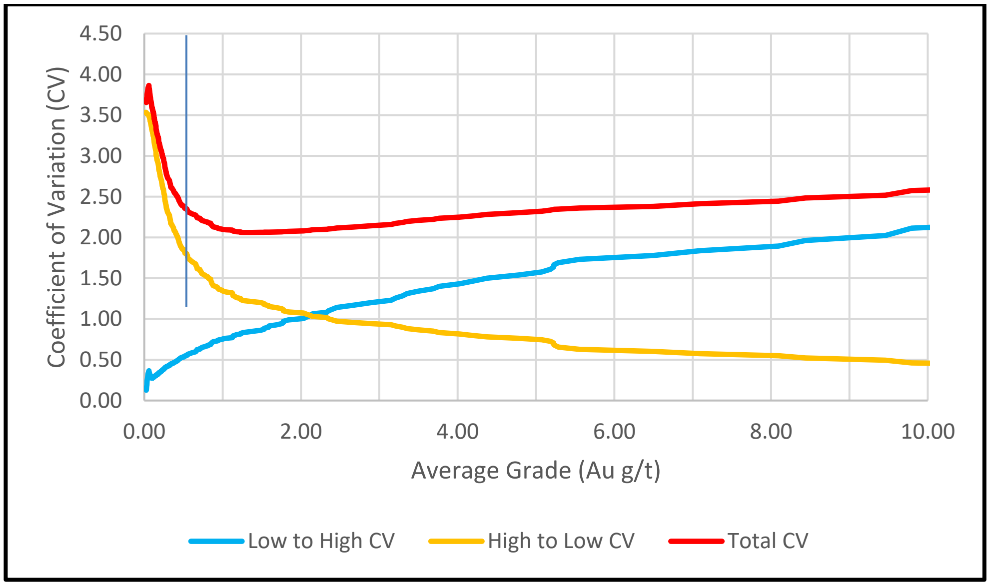



## 14.2.7 INDICATOR DOMAINING

As a result of the multiple gold composite populations and high CV within Zone 150 identified by EDA, Fladgate created a probabilistic indicator model.

The indicator grade threshold was selected by inspecting the probability plot of the composites for inflection points and by minimizing the total CV of the grades above and below the threshold. A threshold of 1 g/t was selected, which corresponds to an inflection point in the log-scaled probability plot of the capped gold composites (shown in Figure 14.8).

Figure 14.8 Plot of CV against Average Gold Grade, Zone 150




Fladgate coded the composites with a value of 1 if the gold grade was ≥1 g/t gold and a value of 0 if the gold grade was below 1 g/t. The composite indicator values were used to estimate block indicator values using inverse distance weighted to the third power ($IDW^3$). A NN model was estimated and assumed to represent an unbiased estimate of the proportion of blocks above the grade threshold.

A threshold indicator value of 0.36 was selected in the $IDW^3$ model such that a close approximation of the number of blocks with an indicator value of one in the NN model is achieved (shown in Table 14.9).

Blocks were coded above and below this indicator threshold. A limited amount of dilution was introduced by creating a transition zone with a width of a single block on either side of the boundary between the lower-grade and higher-grade subdomains. The composites were then back-tagged with the codes from the blocks.

Summary statistics of the coded composites are shown in Table 14.10. Fladgate notes that the CV of the low-grade composites is highly affected by the misclassification of two high grade composites. This composite misclassification was not adjusted. Overall, the indicator coding is successful in separating low grade mineralization from higher grade mineralization.

Table 14.9 Indicator Block Domaining Results, Zone 150

| Estimator | Global Mean | Number of Blocks |
|---|---|---|
| $IDW^3$ | 0.076 | 5,074 |
| NN | 0.068 | 5,151 |
| Relative Difference | 11.4% | -1.5% |

**Table 14.10 Composite Subdomaining Results, Zone 150**

| Gold | Number | Min | Max | Mean | SD | CV |
|---|---|---|---|---|---|---|
| Low Grade | 448 | 0.02 | 40.88 | 0.40 | 1.95 | 4.91 |
| Higher Grade | 70 | 0.12 | 42.79 | 5.35 | 7.79 | 1.46 |

### 14.2.8 VARIOGRAPHY

Fladgate constructed down-hole and directional correlograms for gold and copper grades within the Zone 150 domain. Fladgate used a single spherical model, a nested exponential model, and a coarse effect to fit the experimental correlograms. Table 14.11 shows the correlogram models.

Fladgate notes that the gold variogram shows a moderate coarse gold effect with short range structures.

### Table 14.11 Variogram Models, Da Tambuk

| Grade Element | Coarse Gold | Sill | | Structure Type | | Ranges First Structure | | | Ranges Second Structure | | | Rotations | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Effect | 1st Structure | 2nd Structure | First | Second | Y | X | Z | Y | X | Z | Z | X | Y |
| Au | 0.413 | 0.401 | 0.186 | Spherical | Exponential | 8.0 | 3.6 | 2.5 | 70 | 60 | 10 | 0 | 0 | 0 |
| Cu | 0.300 | 0.277 | 0.423 | Spherical | Exponential | 5 | 5 | 5 | 50.7 | 30.0 | 30.0 | 0 | 0 | 0 |

Note: No rotations are given because the interpolation plan uses distances in the plane of the wireframe.

### 14.2.9 ESTIMATION/INTERPOLATION METHODS

The block model consists of regular blocks (5 m along strike by 2 m across strike by 5 m vertically). The block size was chosen to reflect geological contacts reasonably well and to support selective mining scenarios.

Fladgate used an OK grade interpolation method in two passes using Minesight's dynamic unfolding (DU) module to account for significant changes in the orientation of the mineralization wireframe. The DU module uses input surfaces to calculate non-linear distances between composites and blocks to composites. Search distances used in grade estimation are in metres along the strike (y-axis), down-dip (x-axis) and perpendicular to dip (z-axis) orientations of the wireframe.

Grade estimation used a composite and block matching scheme based on the domain codes. For example, composites coded to the Zone 150 were only used to estimate blocks falling within Zone 150. The same grade estimation plan was used for gold, copper, and silver.

In Zone 150, the indicator subdomain was used as a firm boundary, using the composite sharing schemes shown in Table 14.12 and in Table 14.13. For example, in the first estimation pass, blocks coded as 1 were interpolated using only composites with the same code. Blocks coded 5 were interpolated using composites coded 1, 5 and 8.

**Table 14.12 Composite and Block Sharing Scheme, Pass 1**

| | Composite Codes | | | |
|---|---|---|---|---|
| Block Codes | 1 | 5 | 8 | 10 |
| Low Grade (1) | x | | | |
| Low Grade Transition (5) | x | x | x | |
| High Grade Transition (8) | | x | x | x |
| High Grade (10) | | | x | x |

**Table 14.13 Composite and Block Sharing Scheme, Pass 2**

| | Composite Codes | | | |
|---|---|---|---|---|
| Block Codes | 1 | 5 | 8 | 10 |
| Low Grade (1) | x | | | |
| Low Grade Transition (5) | x | x | | |
| High Grade Transition (8) | | | x | x |
| High Grade (10) | | | | x |

Table 14.14 and Table 14.15 show the composite restrictions and search distances for the estimation domains. A slightly longer search distance was selected in the horizontal strike direction of the wireframe based on the variogram and visual inspection of a long-

section along the strike of the deposit that shows a sub-horizontal plunge to the higher-grade mineralization.

**Table 14.14 Grade Model Interpolation Plan, Pass 1**

| | Search Ellipse Dimensions | | | Composite Restrictions | | | Number of Holes | |
|---|---|---|---|---|---|---|---|---|
| | Pass 1 | | | | | | | |
| Domain | X-Axis | Y-Axis | Z-Axis | Minimum | Maximum | Maximum per Hole | Minimum | Maximum |
| Zone 100 | 40 | 50 | 10 | 3 | 8 | 2 | 2 | 4 |
| Zone 150 | 40 | 50 | 10 | 3 | 8 | 2 | 2 | 4 |
| Zone 200 | 40 | 50 | 10 | 3 | 8 | 2 | 2 | 4 |

**Table 14.15 Grade Model Interpolation Plan, Pass 2**

| | Search Ellipse Dimensions | | | Composite Restrictions | | | Number of Holes | |
|---|---|---|---|---|---|---|---|---|
| | Pass 1 | | | | | | | |
| Domain | X-Axis | Y-Axis | Z-Axis | Minimum | Maximum | Maximum per Hole | Minimum | Maximum |
| Zone 100 | 80 | 100 | 20 | 1 | 8 | 2 | 1 | 4 |
| Zone 150 | 80 | 100 | 20 | 1 | 8 | 3 | 1 | 4 |
| Zone 200 | 80 | 100 | 20 | 1 | 8 | 2 | 1 | 4 |

Note: Search ellipse orientations are given using the LRR rotation convention as used in GSLIB

### 14.2.10 Density Assignment

A total of 559 SG determinations were performed on drill core samples collected from material within the mineralized zones at Da Tambuk. The determinations were performed at site using unsealed immersion technique to measure the weight of each sample in air and in water. Fladgate assigned an average SG of 2.83 to all blocks within the mineralized zones. The SG values were used directly as the dry bulk density to report the tonnage estimates of the Mineral Resource.

The rock types intercepted in the drillholes are generally not porous; therefore, the amount of porosity is not expected to cause a large difference between the SG and bulk density. However, Fladgate recommends that at least 10% of the SG determinations are repeated using a wax-sealed immersion method of SG measurement in a commercial laboratory.

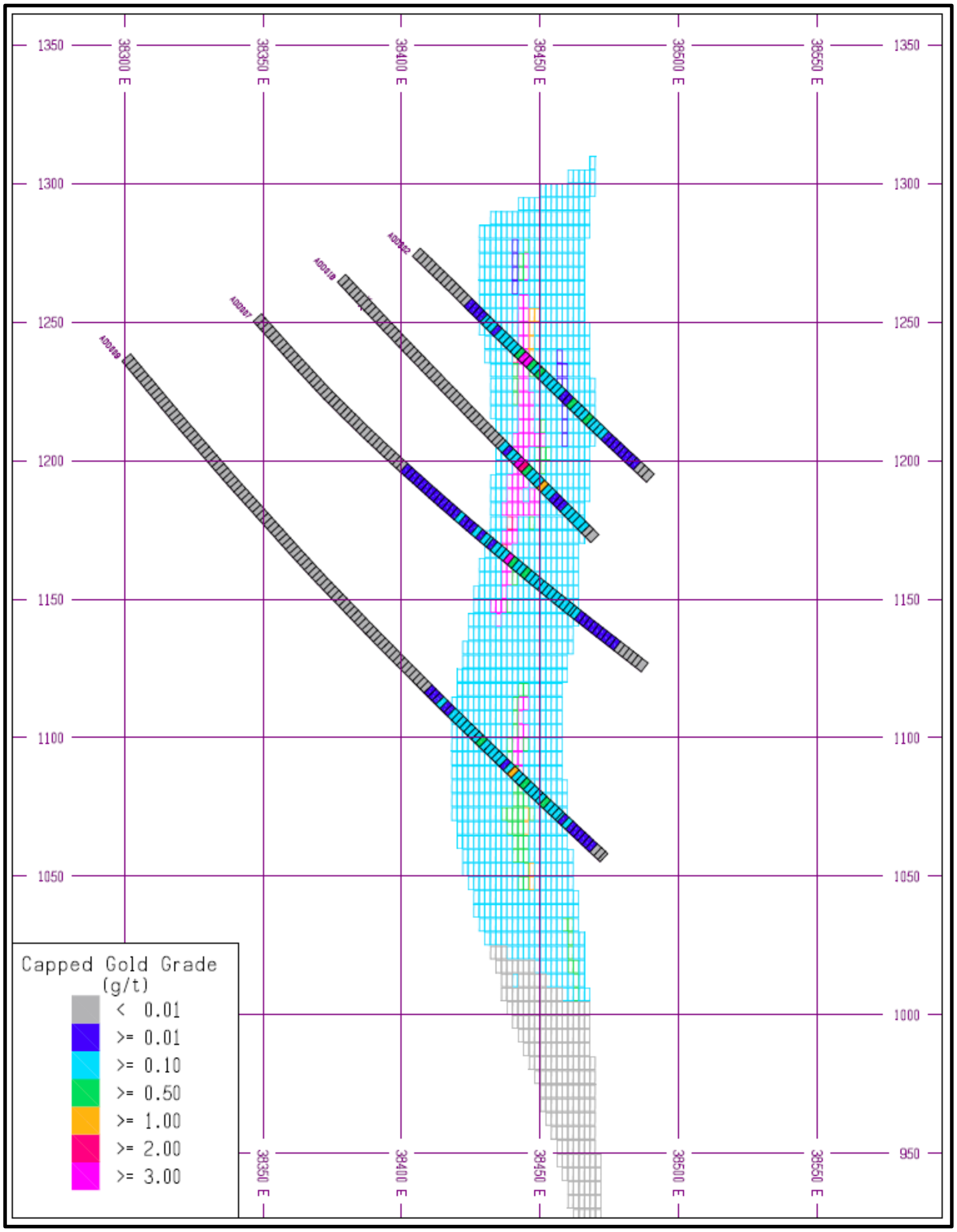
### 14.2.11 Block Model Validation

Fladgate validated the Da Tambuk block model to ensure appropriate honouring of the input data. NN grade models were interpolated from 2 m composites to validate the OK grade models.

### VISUAL INSPECTION

A visual inspection of block grade versus composited data in section and plan view was conducted and showed good reproduction of the data by the model. As expected from the firm boundaries used in the grade interpolation plan, a limited amount of smoothing is observed in Zone 150. An east-west oriented cross-section is shown in Figure 14.9.

**Figure 14.9 East-West Cross-Section, 23,680 N**



### METAL REMOVED BY CAPPING

Fladgate evaluated the impact of capping by estimating uncapped and capped grade models. The capped models show differences of 3.4% and 12.3% in the gold metal contents in Zone 100 and Zone 150 respectively. The amounts of metal removed by capping in the models are consistent with the amounts calculated during the grade capping study on the assays.

### GLOBAL BIAS CHECKS

A comparison between the OK and NN estimates was completed on classified blocks to check for global bias in the grade estimates. Differences were generally within acceptable levels (less than 5% for the Indicated category and less than 10% for the Inferred category). Summary statistics are shown in Table 14.16, Table 14.17, Table 14.18 and Table 14.19.

**Table 14.16 NN and OK Model Statistics Comparison, Indicated Blocks**

| | NN Blocks Capped | | OK Blocks Capped | | % Differences |
|---|---|---|---|---|---|
| Grade | Mean | Number | Mean | Number | Mean (IDW$^3$-NN) |
| Gold (g/t) | 1.62 | 19,754 | 1.55 | 19,754 | -4.2 |
| Copper (%) | 0.05 | 19,754 | 0.05 | 19,754 | 0.0 |
| Silver (g/t) | 0.17 | 9,645 | 0.16 | 9,645 | -0.6 |

**Table 14.17 2 m Composite, NN and OK Model Statistics Comparison, Gold**

| | | 2 m Capped Composites | | NN Blocks Capped | | OK Blocks Capped | | % Differences | |
|---|---|---|---|---|---|---|---|---|---|
| Domain | Code | Mean Au (g/t) | Number | Mean Au (g/t) | Number | Mean Au (g/t) | Number | Mean (Composites - NN) | Mean (IDW$^3$-NN) |
| Zone 100 | 100 | 0.16 | 62 | 0.17 | 10,201 | 0.17 | 10,201 | 5.6 | -0.9 |
| Zone 150 | 150 | 1.08 | 518 | 0.75 | 59,337 | 0.75 | 59,335 | -31.1 | 0.0 |
| Zone 200 | 200 | 0.16 | 42 | 0.17 | 9,645 | 0.16 | 9,645 | 16.4 | 9.7 |

**Table 14.18 2 m Composite, NN and OK Model Statistics Comparison, Copper**

| | | 2 m Capped Composites | | NN Blocks Capped | | OK Blocks Capped | | % Differences | |
|---|---|---|---|---|---|---|---|---|---|
| Domain | Code | Mean Cu (%) | Number | Mean Cu (%) | Number | Mean Cu (%) | Number | Mean (Composites - NN) | Mean (IDW$^3$-NN) |
| Zone 100 | 100 | 0.02 | 62 | 0.02 | 10,201 | 0.02 | 10,201 | -5.8 | -4.0 |
| Zone 150 | 150 | 0.05 | 518 | 0.04 | 58,400 | 0.04 | 58,400 | -21.4 | 3.0 |
| Zone 200 | 200 | 0.02 | 42 | 0.02 | 9,645 | 0.02 | 9,645 | 10.9 | 3.0 |

**Table 14.19 2 m Composite, NN and OK Model Statistics Comparison, Silver**

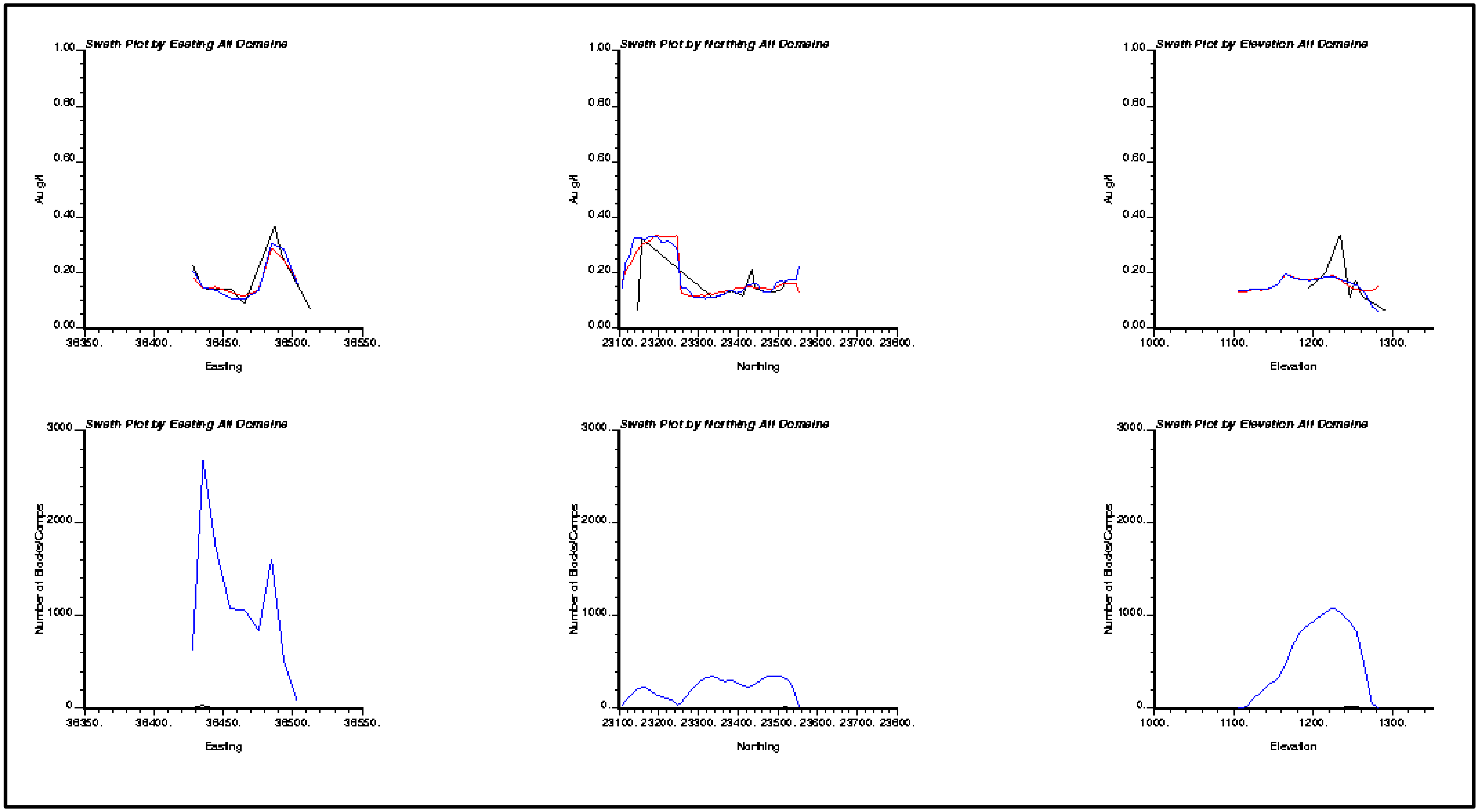
| | | 2 m Capped Composites | | NN Blocks Capped | | OK Blocks Capped | | % Differences | |
|---|---|---|---|---|---|---|---|---|---|
| Domain | Code | Mean Ag (g/t) | Number | Mean Ag (g/t) | Number | Mean Ag (g/t) | Number | Mean (Composites - NN) | Mean (IDW$^3$-NN) |
| Zone 100 | 100 | 0.1 | 31 | 0.1 | 6,894 | 0.1 | 6,894 | 74.5 | 59.0 |
| Zone 150 | 150 | 1.2 | 395 | 0.9 | 47,143 | 0.9 | 47,143 | 31.2 | 0.7 |
| Zone 200 | 200 | 1.3 | 28 | 1.2 | 8,396 | 1.2 | 8,396 | 9.1 | -3.3 |

### 14.2.12 Local Bias Checks

Fladgate performed a check for local bias by plotting the average gold and copper grades of composites, NN, and OK models in swaths oriented along the model northings, eastings and elevations.

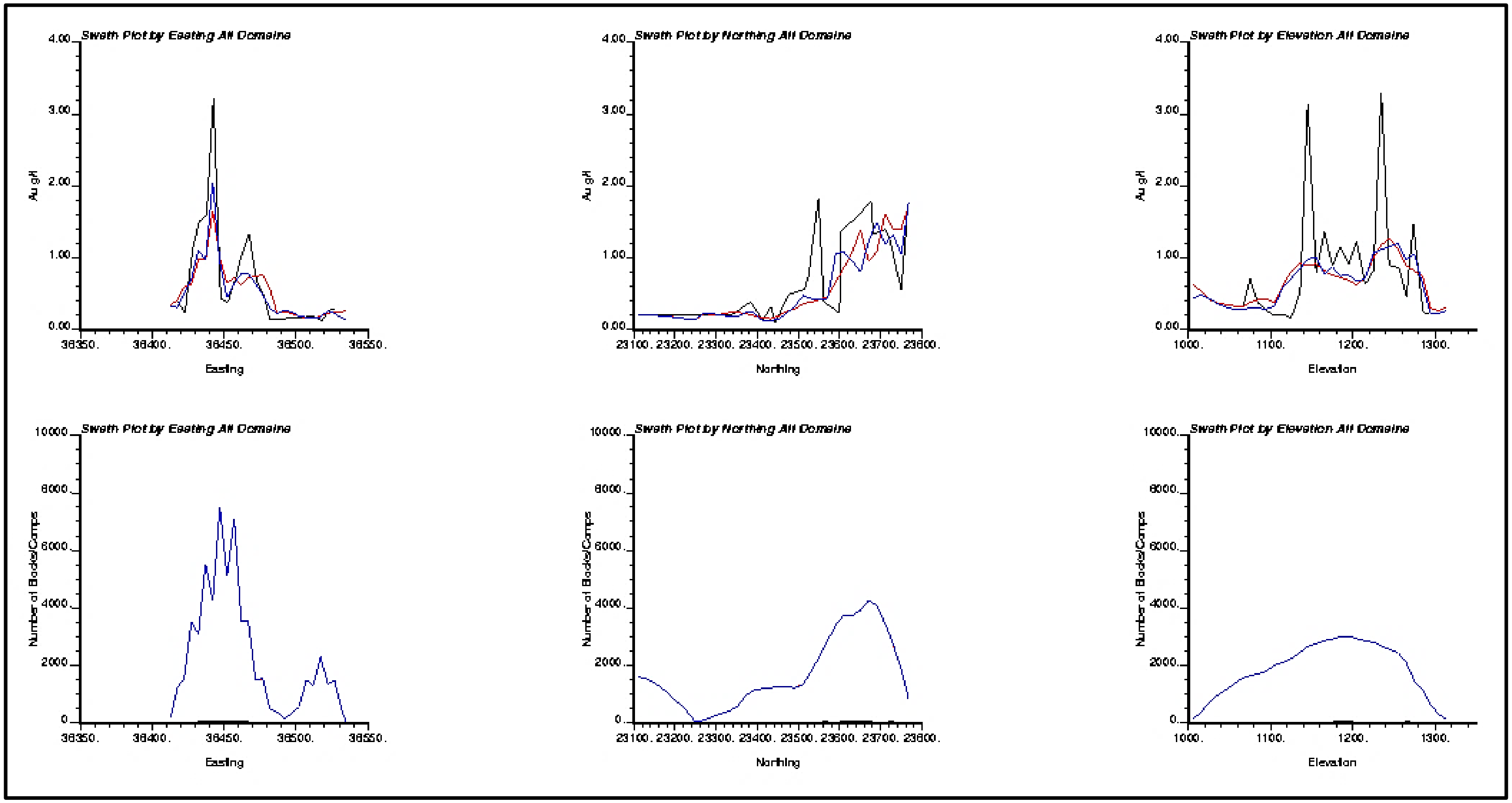
Fladgate reviewed the swath plots and found only minor discrepancies between the NN and OK model grades. In areas with significant extrapolation beyond the drill holes, the swath plots indicate less agreement for all variables. The gold swath plots for the Zone 100, Zone 150, and Zone 200 are shown below in Figure 14.10, Figure 14.11 and Figure 14.12.

**Figure 14.10 Gold Swath Plots by Easting, Northing and Elevation for Zone 100**



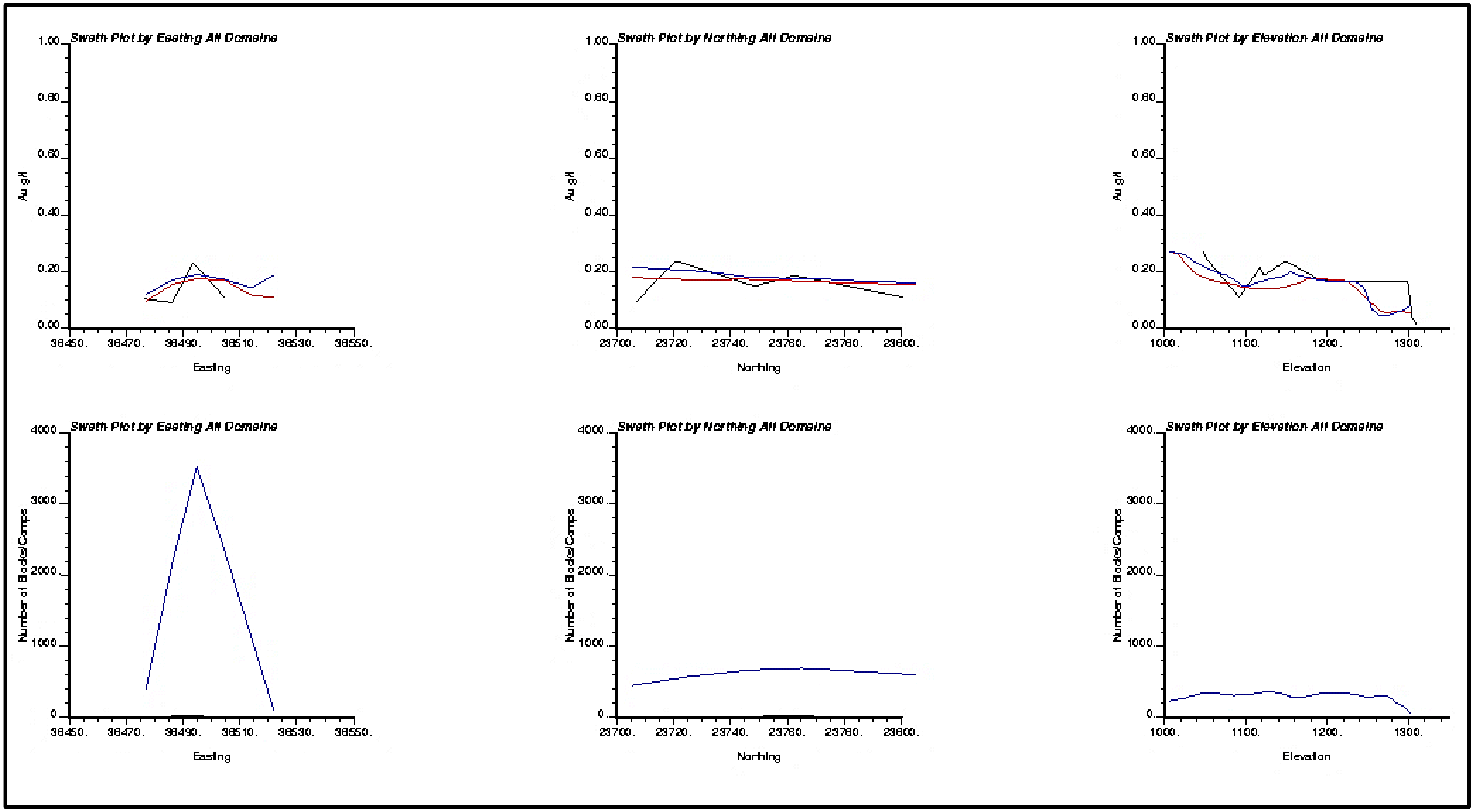

Note: Upper Swath plots show the grades, lower swath plots show number of blocks or composites. Red line represents IDW³ model. Blue line represents NN model. Black line represents Composites.

## Figure 14.11 Gold Swath Plots by Easting, Northing and Elevation for Zone 150




Note: Upper Swath plots show the grades, lower swath plots show number of blocks or composites. Red line represents $IDW^3$ model. Blue line represents NN model. Black line represents Composites.

## Figure 14.12 Gold Swath Plots by Easting, Northing and Elevation for Zone 200

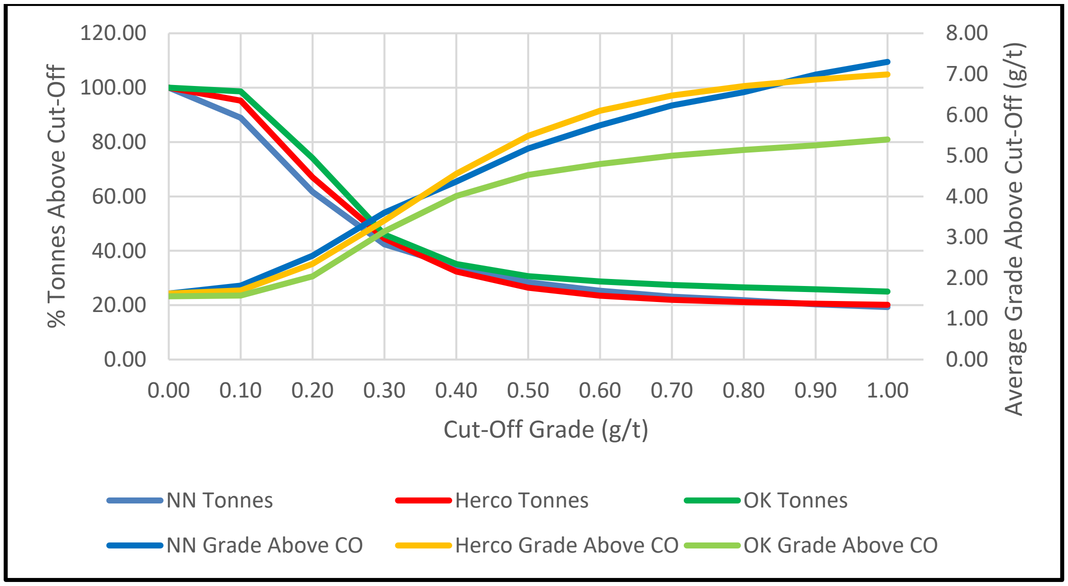



Note: Upper Swath plots show the grades, lower swath plots show number of blocks or composites. Red line represents IDW³ model. Blue line represents NN model. Black line represents Composites

### Grade Smoothing Checks

Fladgate checked grade smoothing (model selectivity) for potential open pit mining using a global change-of-support correction (a discrete Gaussian model or DGM) to the NN model. The check was completed for gold in the oxide and transition domains for gold. The results show that the amount of smoothing is acceptable for a block size of 2 m by 5 m by 5 m around the cut-off grades of interest and are generally less than 5%. A grade-tonnage curve comparing the OK model to the reference discrete Gaussian model is shown below in Figure 14.13.

**Figure 14.13 Grade-Tonnage Curve Comparison of OK Model with NN and DGM Models**



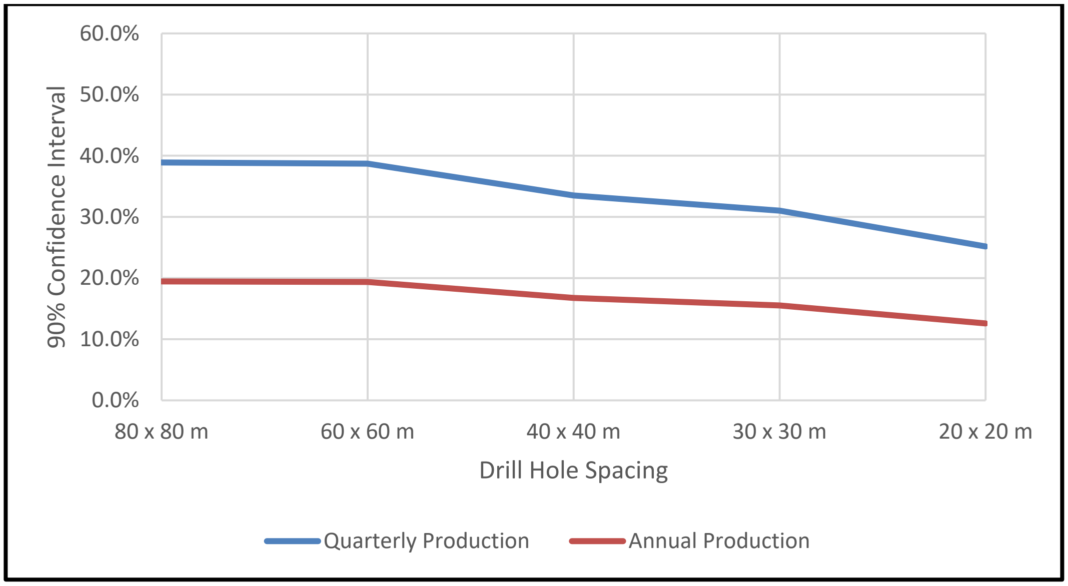

## 14.2.13 Classification of Mineral Resources

Fladgate classified blocks with a maximum distance of 100 m to the closest composite to the Inferred category.

Fladgate reviewed the geological model, data quality, geological continuity and metallurgical characteristics for classification of Mineral Resources. The mineralized zone wireframes were supported by drilling with a spacing of between 40 m and 80 m. This drill spacing was sufficient to assume that the mineralization is continuous between drillholes. A 100 m maximum distance to the closest composite permits a reasonable local estimate of grades (as demonstrated by model validation).

Fladgate analyzed confidence limits using quarterly panels of production for a 4,500 t/d open pit mine operation. The accuracy of grade estimates was then scaled to annual production. Accuracy of ±15% or better at a 90% confidence limit on annual production was used as the criteria to select a drillhole spacing to be used to classify Indicated Mineral Resources. The results (Figure 14.14) show that a drillhole spacing of 40 m (along the easting) by 40 m (along the northing) is sufficient to classify Indicated Mineral Resources

**Figure 14.14 Drillhole Spacing Study Results**




Fladgate analyzed the classification categories using conditional simulation of grades within Zone 150. The results of the conditional simulation show that the blocks classified as Indicated have a mean 90% confidence limit of ±23% with a minimum of ±16% and a maximum of ±59.5%. Although the mean confidence limit is somewhat wider than the criteria of a 90% confidence limit of ±15% or better, Fladgate is of the opinion that the continuity of grade observed on section is sufficient to classify material to the Indicated category.

Fladgate compared the updated Mineral Resource model within the area infill drilled to 40 m by 40 m spacing. The results of the comparison are shown in Table 14.20. At this stage of project development, the annual production throughput rate is not known but can be projected from the general size of the mineral resources. The differences in estimated tonnage and grade observed are relatively large; however, the tonnage represents approximately only a third to a half of annual production. Therefore, the difference in the estimated tonnage and grade of an annual production increment would be lower than the difference observed in the area of infill drilling.

Fladgate believes that the results support the classification of Indicated Mineral Resources.

**Table 14.20 Da Tambuk Model Comparison, Area of Infill Drilling**

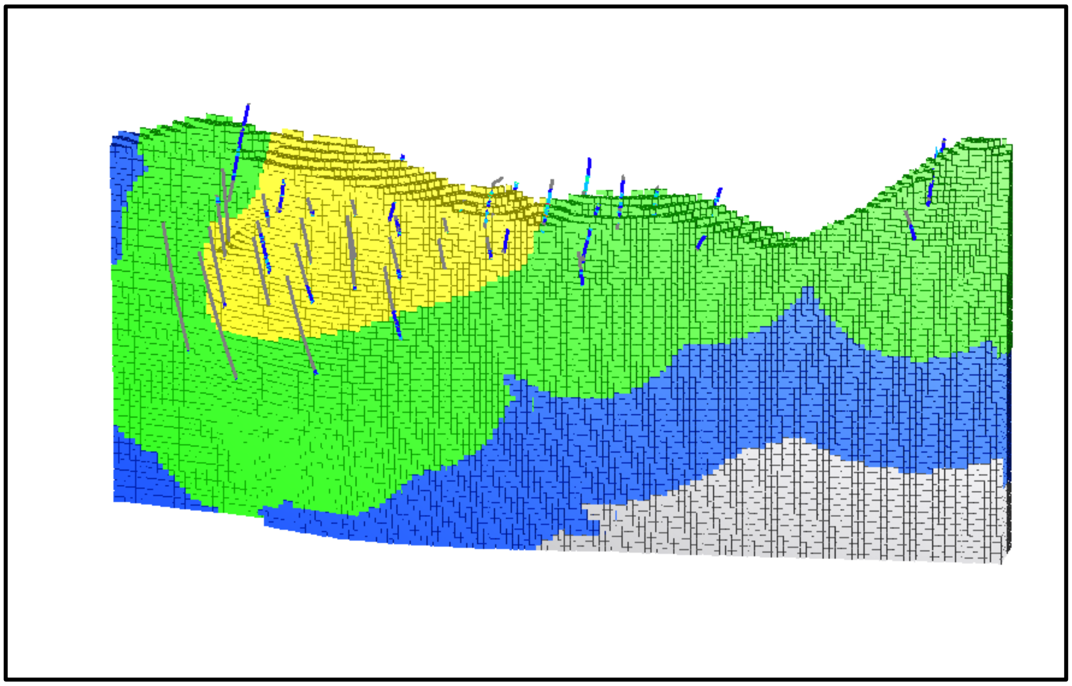
| | NSR Cut-off (US$/t) | Tonnes | Gold Grade (Au g/t) | Copper Grade (Cu %) | Silver Grade (Ag g/t) | Gold (tr oz) | Copper (Mlb) | Silver (tr oz) |
|---|---|---|---|---|---|---|---|---|
| Indicated 2016 Model | 23.9 | 651,648 | 4.39 | 0.11 | 2.2 | 91,891 | 1.51 | 46,888 |
| Inferred 2016 Model | 23.9 | 6,712 | 2.19 | 0.09 | 0.5 | 472 | 0.01 | 113 |
| Combined 2016 Model | 23.9 | 658,360 | 4.36 | 0.10 | 2.2 | 92,363 | 1.5 | 47,002 |
| Inferred 2015 Model | 23.9 | 545,142 | 7.17 | 0.13 | 1.5 | 125,737 | 1.6 | 26,851 |
| % Difference | - | 20.8% | -39.2% | -20.0% | 44.9% | -26.5% | -3.4% | 75.0% |

Fladgate classified blocks to the Indicated category using the following criteria:

- A maximum distance to the closest hole of 40 m.
- A maximum average distance from two holes of 31 m (approximately half the diagonal distance within a 40 m by 40 m grid with a 10% contingency).

A three-dimensional view of the resulting Mineral Resource classification is shown in Figure 14.15.

**Figure 14.15 Da Tambuk Mineral Resource Classification**



### 14.2.14 MARGINAL CUT-OFF GRADE CALCULATION

Fladgate estimated marginal cut-off dollar values of US$63.90/t for underground mining based on the total costs shown in Table 14.21. The marginal cut-off is based on the generally accepted practice that mined material above the marginal cut-off grade will lose less money if it is sent to the mill rather than if it is sent to the waste dump. It is considered for further processing if it contains a value that is greater than the costs to process it. The assumed metallurgical recoveries are shown in Table 14.22.

Fladgate calculated dollar values for the blocks using the metal prices and process recoveries and used a dollar value cut-off grade of US$63.90/t for reporting Mineral Resources potentially amenable to underground mining methods.

**Table 14.21 Fladgate Mining Costs and Ore-Based Costs used for NSR Calculations**

| | Unit | Value (US$) |
|---|---|---|
| **Mining Costs** | | |
| Underground Mining Cost | US$/t mined | 40.0 |
| **Ore Based Costs** | | |
| Process Cost | US$/t ore | 17.9 |
| G&A Cost | US$/t ore | 6.0 |
| Total Mineralized Material Based Costs | US$/t milled | 63.9 |

**Table 14.22 Metallurgical Recovery Assumptions for Mineral Resource Constraints**

| | Metallurgical Recoveries | | |
|---|---|---|---|
| | Gold (%) | Copper (%) | Silver (%) |
| Da Tambuk | 93.0 | 0.0 | 50.0 |

### 14.2.15 MINERAL RESOURCE STATEMENT FOR DA TAMBUK

Mineral Resources for the project were classified under the 2014 CIM Definition Standards for Mineral Resources and Mineral Reserves by application of a cut-off grade that incorporated mining and metallurgical recovery parameters. Mineral Resources potentially mineable by underground mining methods are constrained to blocks with sufficient value to cover the underground marginal cut-off grade based on commodity prices, metallurgical recoveries, and operating costs. Isolated blocks have been removed from the underground mineral resource estimate.

The Qualified Person for the Mineral Resource estimate is David G. Thomas, P. Geo. The Indicated Mineral Resources is shown in Table 14.23 and the Inferred Mineral Resource is shown subdivided in Table 14.24.

**Table 14.23 Da Tambuk Project Indicated Mineral Resource Estimate David Thomas, P. Geo. (Effective Date: April 30, 2018)**

| Area | Cut-off (US$/t) | Tonnes | Gold (g/t) | Copper (%) | Silver (g/t) | Gold Equivalent (g/t) | Gold Metal (tr oz) | Copper Metal (Mlb) | Silver Metal (tr oz) | Gold Equivalent Metal (tr oz) |
|---|---|---|---|---|---|---|---|---|---|---|
| Da Tambuk | 23.9 | 775,000 | 4.51 | 0.11 | 2.4 | 4.65 | 112,000 | 1.9 | 59,000 | 116,000 |

**Table 14.24 Da Tambuk Project Inferred Mineral Resource Estimate David Thomas, P. Geo. (Effective Date: April 30, 2018)**

| Area | Cut-off (US$/t) | Tonnes | Gold (g/t) | Copper (%) | Silver (g/t) | Gold Equivalent (g/t) | Gold Metal (tr oz) | Copper Metal (Mlb) | Silver Metal (tr oz) | Gold Equivalent Metal (tr oz) |
|---|---|---|---|---|---|---|---|---|---|---|
| Da Tambuk | 23.9 | 110,000 | 4.04 | 0.06 | 2.93 | 4.13 | 14,000 | 0.2 | 10,000 | 15,000 |

Notes: Fladgate reviewed EAM's QA/QC programs on the Mineral Resources data. Fladgate concludes that the collar, survey, assay, and lithology data are adequate to support Mineral Resources estimation.
Domains were modelled in 3D to separate mineralised rock types from surrounding waste rock. The domains were modelled based on copper and gold grades.
Raw drillhole assays were composited to 2 m lengths broken at domain boundaries.
Capping of high grades was considered necessary and was completed for each domain on assays prior to compositing.
Block grades for gold and silver were estimated from the composites using an inverse distance weighted (power of three) interpolation method into 5 m (along strike) by 2 m (across strike) by 5 m (vertical) blocks coded by domain.
Dry bulk density varied by deposit area. The dry bulk densities are based on 259 specific gravity measurements at Da Tambuk, 1,665 specific gravity measurements at Mato Bula and 231 specific gravity measurements at Mato Bula North.
Blocks were classified as Indicated and Inferred in accordance with CIM Definition Standards 2014. Inferred resources are classified on the basis of blocks falling within the mineralised domain wireframes (i.e. reasonable assumption of grade/geological continuity) with a maximum distance of 100 m to the closest composite. Indicated mineral resources are classified based on distances to drill holes which approximate a 40 x 40 m drill hole spacing.
The Mineral Resource estimate is constrained within a wireframe model using a US$63.90/t minimum block value. Isolated blocks were removed from the wireframe. Metal prices of US$1,400/tr oz, US$3.20/lb and US$20.0/tr oz were used for gold, copper and silver respectively. Metallurgical recoveries of 93% for gold, 72% for copper and 50% for silver were applied at Da Tambuk.
An underground US$ per tonne cut-off was estimated based on a total process and G&A operating cost of US$23.9/t of ore mined. An additional mining cost of US$40/t was assumed for reporting underground Mineral Resources.
The contained gold, copper and silver figures shown are in situ. No assurance can be given that the estimated quantities will be produced. All figures have been rounded to reflect accuracy and to comply with securities regulatory requirements. Summations within the tables may not agree due to rounding.
Mineral Resources which are not Mineral Reserves do not have demonstrated economic viability. The estimate of Mineral Resources may be materially affected by environmental, permitting, legal, title, taxation, socio-political, marketing, or other relevant issues.
The quantity and grade of reported inferred resources in this estimation are conceptual in nature and there has been insufficient exploration to define these Inferred resources as an Indicated or Measured Mineral Resource and it is uncertain if further exploration will result in upgrading them to an Indicated or Measured Mineral Resource category.

### 14.2.16 FACTORS THAT MAY AFFECT THE MINERAL RESOURCE ESTIMATE

Areas of uncertainty that may materially impact the Mineral Resource estimates include:

- long-term commodity price assumptions
- long-term exchange rate assumptions
- operating cost assumptions used
- metal recovery assumptions used
- changes to the tonnage and grade estimates as a result of new assay and bulk density information
- future tonnage and grade estimates may vary significantly as more drilling is completed
- changes to the metallurgical recovery assumptions as a result of new metallurgical test work
- any changes to the slope angle of the pit wall as a result of geotechnical information would affect the pit shell used to constrain the Mineral Resources (note the results of this PEA concluded that underground mining of the resource was appropriate).

# 15.0 MINERAL RESERVE ESTIMATES

A Mineral Reserve is the economically mineable part of a Measured or Indicated Mineral Resource and has not been estimated for Da Tambuk as part of this PEA.

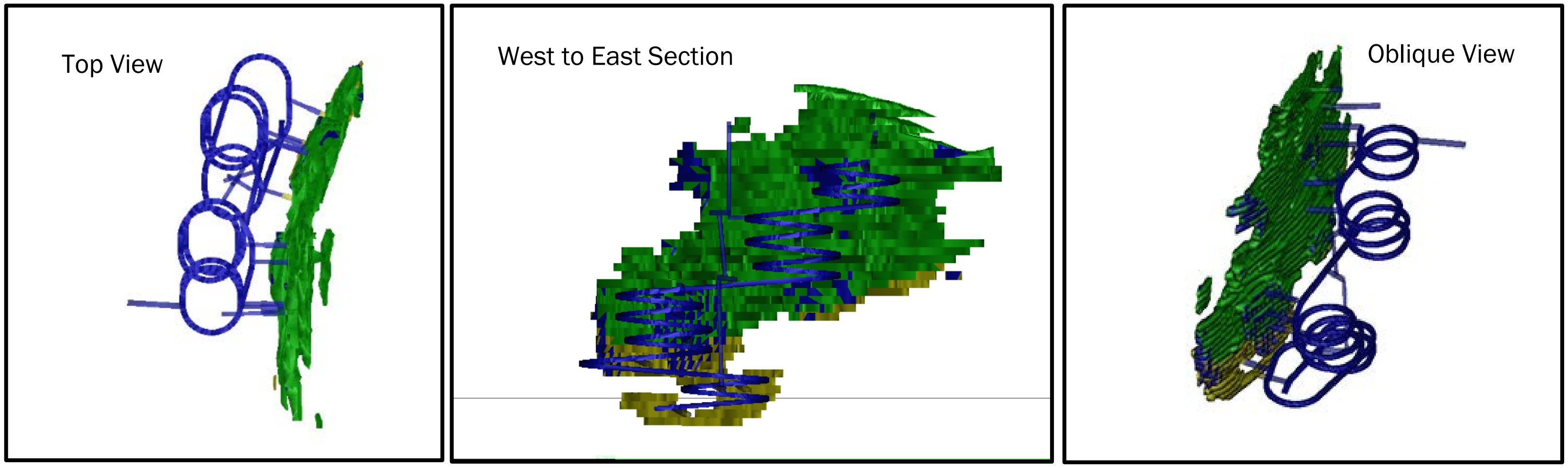
# 16.0 MINING METHODS

The Da Tambuk operation has been planned as an underground mining operation to produce 550 t/day of mill feed.

An evaluation of the mineable resources for Da Tambuk resulted in a total of 650 kt, planned for a LOM of four years. Not all reported resources are included in the mine plan as deductions have been made for low grade, underground pillars, crown pillars, while some isolated mineralised zones have not been included in the underground mining plan.

Figure 16.1 shows the mine plan included in the PEA. The shapes shown below include planned dilution. Subsequent additional unplanned dilution and deductions for pillars resulted in 650 kt of mill feed included in the economic assessment.

**Figure 16.1 Underground Mine Plan Showing Potential Stope Shapes, Main Ramp and Ventilation Raise**




Note: green = Indicated, yellow = Inferred, blue is development and/or waste

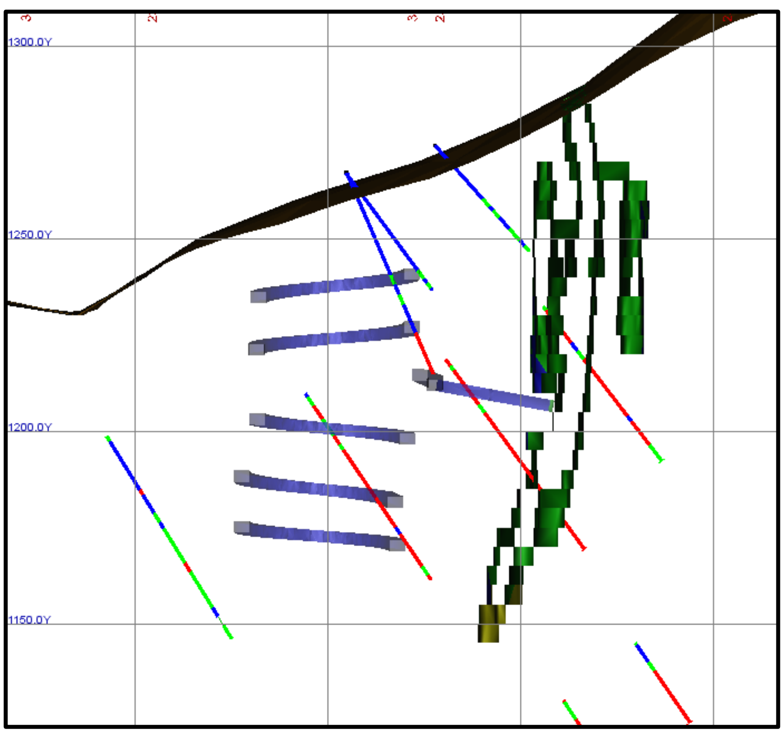
The tonnes planned for mining and processing include planned dilution of 25% (low grade and barren waste) resulting from mining shapes and an additional 10% dilution from either unplanned sources or loading of the surface of the backfill, in cut-and-fill stopes.

The mining depth is planned to be to a maximum of 150 m. Underground working will be accessed through a main underground ramp supported by ventilation shafts or raises to surface. The mine plan considers trackless mining machinery, most of which will be powered by fuel (diesel) with some equipment powered electrically (such as drilling jumbos). Ventilation of underground workings will be provided using a main ventilation fan which will draw air through the workings and multiple auxiliary ventilation fans to force fresh air into working areas.

## 16.1 Geotechnical Assessment

A geotechnical study has not been completed for Da Tambuk. Based on a review of exploration core rock quality designation (RQD), a measure of the degree of jointing of rock in exploration core, the mineralized material and the immediate hanging wall tend to have high RQD (80 to 100). The mineralized zone is steeply dipping and varies in width from 2 to 22 m. Based on this there is no reason to exclude any mining method based on potential ground conditions. However, further work is required to determine expected ground conditions and to ensure that the mining method selected is appropriate.

**Figure 16.2 Exploration Drilling Showing RQD Data Along the Drillhole Trace**




Note: Areas planned for stoping appear to have RQD above 50 (shown in green), with much of the rock at RQD above 80 (shown in red). Closer to surface the rock has RQD below 50 (shown in blue)

### 16.1.1 Underground Water Management

For the PEA, it has been assumed that groundwater will be encountered during mining. Groundwater entering the workings will be directed towards underground sumps, then clarified for re-use in underground mining or pumped to surface for disposal.

## 16.2 Mine Plan Mineral Resource Estimate

The resources reported for Da Tambuk were evaluated for mining through a combination of applying a cut-off grade and preparing minable shapes. The criteria for the mine plan includes the following aspects:

- cut-off grade of 2.2 g/t for gold
- minimum mining width of 2 m.

A summary of the Mineral Resources planned for mining is included in Table 16.1.

**Table 16.1 Summary of Da Tambuk Mineral Resource Falling within the Underground Mine Plan**

| Item | Unit | Quantity |
|---|---|---|
| Diluted Tonnes Mined and Fed into Process | t | 650,415 |
| Gold Grade (Mill Head Grade) | g/t | 4.88 |
| Silver Grade (Mill Head Grade) | g/t | 2.27 |
| LOM | years | 4 |
| Annual Throughput | t | 200,000 |
| Daily Throughput | t/d | 550 |

Table 16.1 above includes dilution of either low-grade or barren rock, mined with the mineralized rock.

## 16.3 Mining Method Selection

### 16.3.1 Open Pit Evaluation

Preliminary engineering was conducted to select the mining methods appropriate for the Da Tambuk deposit. Initial assessment focussed on open pit mining, however the topography and steeply dipping orientation of the mineralization clearly resulted in a high waste stripping ratio of 10 to 1, rendering open pit mining uneconomic.

#### *Whittle Optimization*

The Da Tambuk project was originally envisaged as an open pit mine and as a result was run through several scenarios using an industry wide accepted open pit optimization software (GEOVIA Whittle™). The results from the optimization exercise, however, did not provide positive economic results. Given the nature of the orebody and the overlying topography, the open pit yields a relatively large stripping ratio of 10:1 and that so with a somewhat aggressive (steep) overall pit slope of 49°.

Table 16.2 shows the inputs used to develop a series of nested pit shells in Whittle™. The software generates a series of nested pit shells using a range of commodity selling prices, in this case the gold price

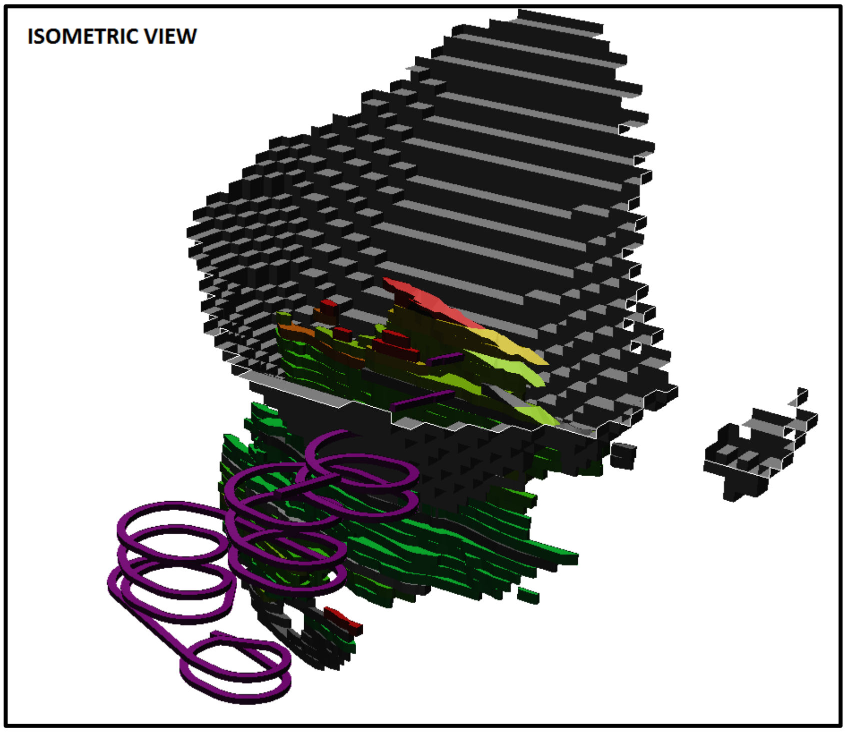
**Table 16.2 Whittle Optimization Inputs**

| Item | Input | Unit |
|---|---|---|
| **Mining** | | |
| Mining Cost | 3.56 | US$/t |
| Recovery | 98 | % |
| Dilution | 5 | % |
| **Processing + G&A** | | |
| Recovery | 93 | % |
| Process + G&A Cost | 26.96 | US$/t |
| **Selling Price** | | |
| Au Price | 1134.25 | US$/tr oz |
| **Capital Cost** | | |
| Initial Capital | 30 | US$ million |

### *WHITTLE™ OPTIMIZATION RESULTS*

Figure 16.1 shows the resulting Whittle™ shell with the most optimal results. Figure 16.1 is shown along with the current underground mine design plan and can be seen considerable waste mining would be required to extract a small portion of the mineralized zone. The gray shell is the Whittle™ shell, while the purple is the underground mine workings, and the other colors represent the orebody.

Figure 16.3 Isometric View of Whittle Pit Shell and Underground Design




## 16.4 UNDERGROUND MINE DESIGN

Once it was confirmed that open pit mining was not economically viable, Tetra Tech competed an assessment of underground mining potential.

The preliminary information on geotechnical conditions and the nature of the mineralisation, provided a basis for numerous potential mining methods including:

- cut-and-fill
- drift-and-fill
- sublevel stoping
- long-hole stoping
- sublevel caving
- shrinkage stoping

For the purpose of completing the PEA, Tetra Tech selected cut and fill mining and sublevel stoping. Cut-and-fill mining would be carried out in areas with irregular mineralized shapes, with sublevel stoping done in wider areas and where ground conditions permit.

The concept for cut and fill mining would be the use of attach ramps into the mineralization, mining out each sublevel to the extents of planned stopes, with subsequent lifts using uppers and/or benching downwards.

The underground operations will be accessed through a 3 m by 3 m spiral access ramp. The main ramp will commence at an elevation of 1,239.5 m and descend to an elevation of 1,091 mamsl. Stopes will be accessed through 30 m long crosscuts into the mineralization.

The mine has been designed with the following criteria:

- minimum (cut-off) gold grade included in mine plan of 2.2 g/t
- crown pillar of 10 m left against surface
- minimum mining width of 2 m
- main ramp tunnel dimensions 3 m high by 3 m wide
- cross cut tunnel dimensions 2.5 m high by 2.5 m wide
- maximum grade of ramps 15%
- maximum grade of crosscuts –15% (for attack ramps)
- vertical spacing of levels of 15 m
- ventilation shaft diameter of 3 m
- maximum height of cut-and-fill lift of 5 m
- maximum height of sublevel stoping panel of 15 m.

**Table 16.3 Mine Plan Results**

| Item | Amount (kt) | Amount (Au g/t) |
|---|---|---|
| Undiluted Tonnes Selected for Mining | 515 | 6.8 |
| Internal Mineralized and Barren Dilution Carried in Mineable Shapes | 174 | 1.0 |
| Stope Shape Tonnage Selected for Mining | 689 | 5.3 |
| Deductions for Pillars | 80 | 5 |
| Planned Stopes | 609 | 5.4 |
| Unplanned Dilution 10% | 61 | 0 |
| Mining Losses 3.5% | 21 | 0 |
| Total Mill Feed Tonnes | 650 | 4.88 |

**Table 16.4 Breakdown of Tonnages into Mineral Resource Categories**

| Resource Category | Percentage (%) |
|---|---|
| Inferred | 12 |
| Indicated | 88 |

## 16.5 UNDERGROUND MINING METHODS

The selected mining methods are described below. A combination of cut-and-fill mining and sublevel stoping was considered for the underground operations. Cut-and-fill will be used to mine areas with irregular mining shapes that would be unsuitable for sublevel stoping, which is a bulk mining method.

Cut-and-fill requires placing waste rock or tailings into mined out excavations for use of both as ground support and as a working platform for subsequent mining cuts.

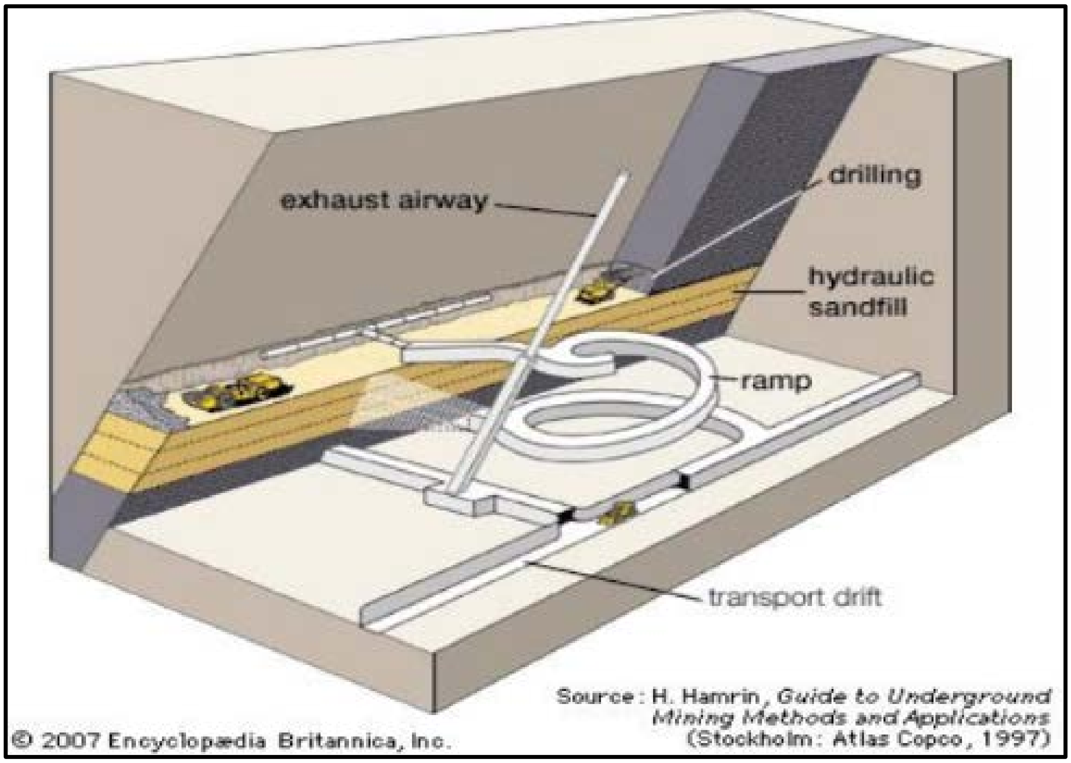
Sublevel stoping does not necessarily require backfill. The method involves blasting large voids underground that become non-entry stopes. The method requires using remote control mucking equipment, which is standard practice in modern underground mining.

### 16.5.1 CUT-AND-FILL MINING

The proposed cut-and-fill mining is illustrated in Figure 16.4 and involves the following steps:

1. An attack ramp is driven off the main access ramp at a grade of -15% into the mineralization.
2. The first cut is excavated by driving along the vein to the width of the vein. This may be done in stages to allow partial backfilling of mined-out areas.
3. If the mineralization is narrow, blast holes will be drilled upwards into the next cut and “slashing” the rock down into the first cut. If the mineralization is wide or if rock stability is not adequate for large spans, then the first cut will be backfilled immediately after mining. For both options, this step involves backfilling the mined-out void with rock, tailings, cemented rock, or cemented tailings.
4. The attack ramp is slashed to raise the access to the next cut elevation.
5. Steps 1 to 4 are repeated until the stope height is mined out. Depending on the situation, a sill or crown pillar is left between stopes as regional support and to support the backfill.

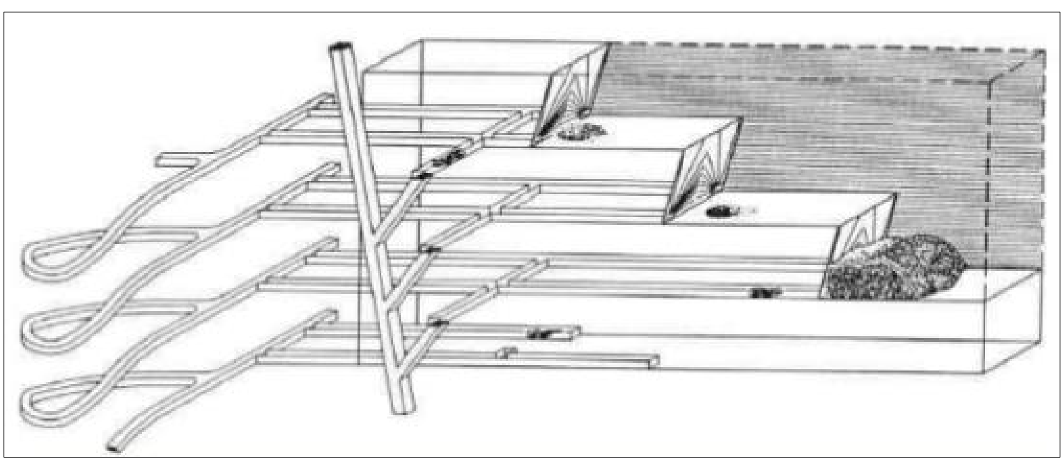
**Figure 16.4 Cut-and-fill Mining Practice as planned for Da Tambuk**




### 16.5.2 SUBLEVEL STOPING

Sublevel stoping generally involves establishing a system of stope access tunnels for drilling blastholes and for loading blasted ore. Blasthole drilling drifts are driven into the mineralization to allow access for longhole drilling equipment. Drawpoints are then developed at a lower level to enable mucking of blasted ore. This is illustrated in Figure 16.5.

**Figure 16.5 Sublevel Stoping Method (Underhand Method) planned for Da Tambuk**



Sublevel stoping is undertaken in overhand and underhand configurations. Overhand configurations involve advancing lower panels of a stope to be mined out first, after which the upper panels are mined out, dropping the rock to drawpoints located at the lowest point of the stope.

With underhand configurations, the stope is mined out from the top to the bottom, with blasted rock being mucked from each level. Blastholes are drilled upwards from the sill drives, with rock mucked from the same drive used for drilling.

In the case of Da Tambuk, underhand sublevel stoping is considered appropriate, since this approach minimizes the length of time between developing stopes and production from stopes.

## 16.6 BACKFILLING UNDERGROUND EXCAVATIONS

The mine plan considers the following combinations of backfill to provide both ground support and working platforms for mining.

### 16.6.1 ROCKFILL

Rockfill will involve using waste rock mined in development areas of the mine or advancing the main ramp placed into the mined-out stopes. This material is not expected to have much use in regional ground support but will be used when backfilling is only needed for providing a working platform for mining upper lifts or cuts.

### 16.6.2 UNCEMENTED HYDRAULIC TAILINGS (SANDFILL)

The mine plan considers backhaul of detoxified tailings from the cyanide detoxification system and deposition in mined-out stopes. Where no additives (such as cement) are used, the backfill is only useful as a working platform during the mining cycle and not for regional support. Tailing backfill is expected to have unsuitable trafficability in underground workings, and as such, when uncemented tailings are used, it will be important to install a stope drainage system to remove water and to place a layer of waste rock over the deposited tailings to create a working trafficable surface.

### 16.6.3 CEMENTED ROCKFILL

The mine plan includes a portion of backfilled waste rock as cemented fill. Cemented fill is considered for areas where mining may take place adjacent to backfilled areas or where backfill plays a role in ground support. The cement is added to rock in the back of haul trucks, then hauled back underground. The cemented rock fill is then tipped into a dedicated muck back where a scooptram will mix the material and place it in the stope being backfilled.

### 16.6.4 Cemented Hydraulic Tailings (Sandfill)

Where rock is not available for backfilling stopes, cemented tailings can be used to backfill stopes. Like cemented rock fill, batches of cemented tailings will be made up and transported underground for placement in mined-out stopes.

### 16.6.5 Backfill as Regional Support

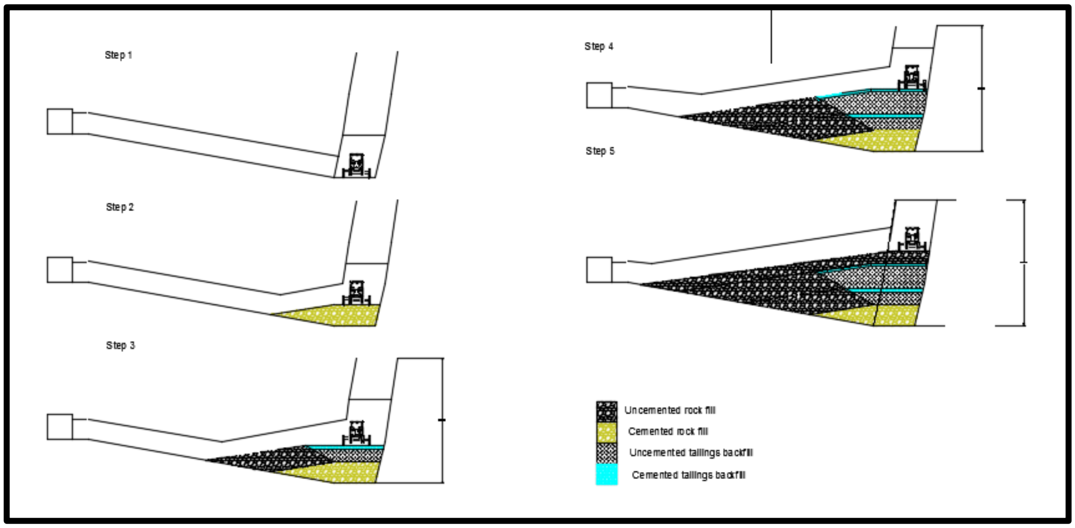
Where suitable, backfill can be used as regional support, where mining of pillars is desired due to grades. This will involve using cemented rockfill and tailings with high percentage cement, which will allow creation of higher strength backfill plugs. This will enable retreat mining of some regional pillars, with pillars left behind as ground support. This is only feasible where the stopes are relatively narrow, since cemented rockfill or tailings will not have strength over large spans.

### 16.6.6 Backfilling of cut and fill stopes

The standard process for mining and backfilling of cut and fill stopes is illustrated in Figure 16.5 and described below.

1. An attack ramp is driven at -15% from the main ramp into the stope to be mined. The first cut is mined by breasting along the mineralization to the lateral extremities of the planned stope.
2. Rockfill or cemented rockfill is placed into the base of the stope. The attack ramp back is slashed to allow mining of the next lift of 2.5 m high. The total height of the stope will be 7.5 m after completion of this step.
3. The attack ramp is slashed again, and the stope is backfilled with cyclone tailings, capped with a layer of cemented tailings as a working surface for mining the next lift of 2.5 m. The total height of the stope will be 10 m after completing this step.
4. Similar to Step 3, the attack ramp is slashed again, and the stope is backfilled with cyclone tailings, capped with a layer of cemented tailings as a working surface for mining the next lift of 2.5 m. The total height of the stope will be 12.5 m after completing this step.
5. As necessary to enable drilling of up-holes for blasting the last lift, waste rock will be placed into the stope above the previous layer of cemented tailings.

**Figure 16.6 Step-by-step Process for Backfilling in Cut and Fill Stopes**




### 16.6.7 BACKFILL DELIVERY

Rockfill, cemented rock fill, and cemented tailings will be prepared outside the stope and placed by underground scooptram.

## 16.7 CUT-OFF GRADE

In delineation of the mine plan, Tetra Tech selected a cut-off grade that when dilution was included, would result in a positive value for the block, in other words a breakeven cut-off grade was used.

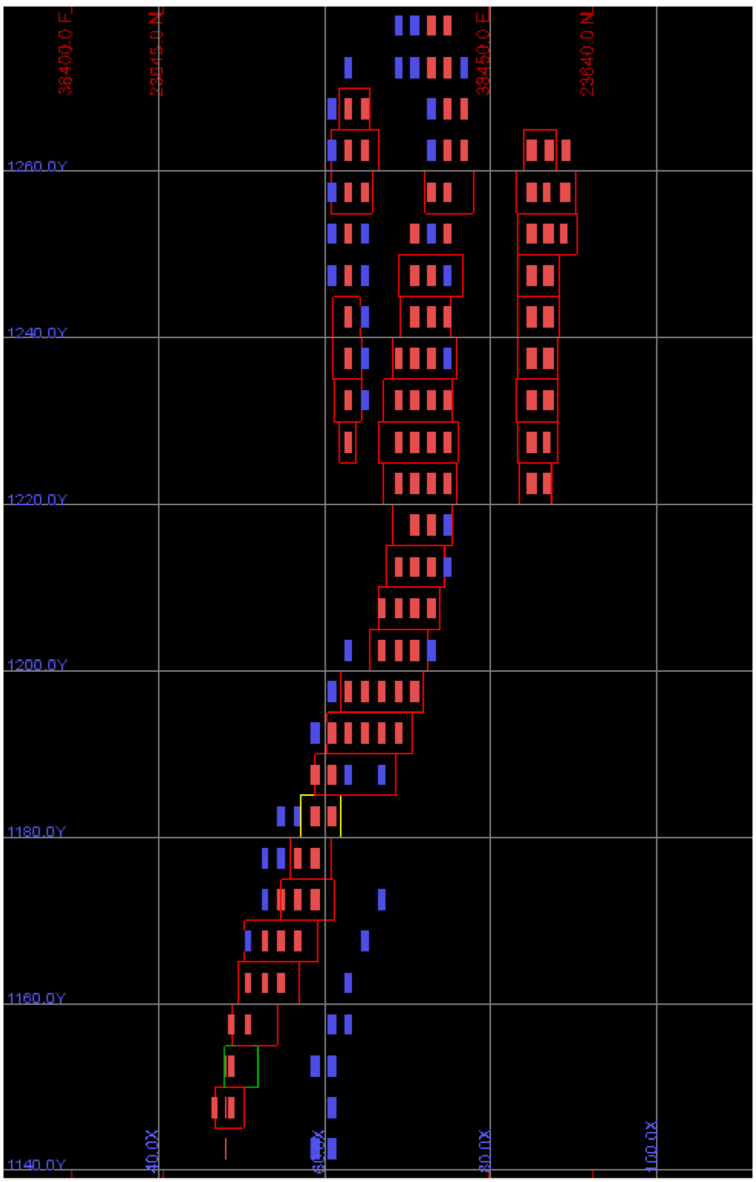
**Table 16.5 Da Tambuk Cut-off Grade Calculation Example**

| Attribute | Symbol | Value applied | Units |
|---|---|---|---|
| Price of Gold | | 1,250 | US$/tr oz |
| Price of Gold | p | 40.19 | US$/g |
| Selling Cost | ps | 3.34 | US$/g |
| Recovery | y | 93 | % |
| Process Cost | h | 22.5 | US$/t |
| Fixed Cost | fc | 2,147,750 | US$/a |
| Opportunity Cost of Capital | F | 5,940,000 | US$/a |
| Production Rate | K | 200,750 | t/a |
| Dilution | d | 15% | % |
| Cut-off Au | gK | 2.2 | g/t |
| Formula to Calculate Cut-off Grade | gK | (h+(fc+F)/K)/(p-ps)/y/(1-d) | g/t |

To generate a mine plan for Da Tambuk, Tetra Tech isolated blocks above cut-off grade of 2.2 g/t gold. A grade shell was then generated from all blocks above the 2.2 g/t Au cut-off. This grade shell represented the portion of the mineralized material that can be economically extracted. As such, this grade shell was then used to create mineable shapes with contiguous mineralization.

Figure 16.7 illustrates the stopes in plan view. Largely, the designed stopes (shown in red outlines) include only material above cut-off, which is represented by the red blocks. There are however areas where material below cut-off (blocks in blue) is included. This is considered planned dilution. The resulting stope must still generate a positive cash flow when all applicable costs are included for the stope to be included in the mine plan.

**Figure 16.7 Plan View of Underground Mine Plan for Da Tambuk (Cut-off of 2.2 g/t Au)**




Note: red blocks – above cut-off, blue blocks – below cut-off

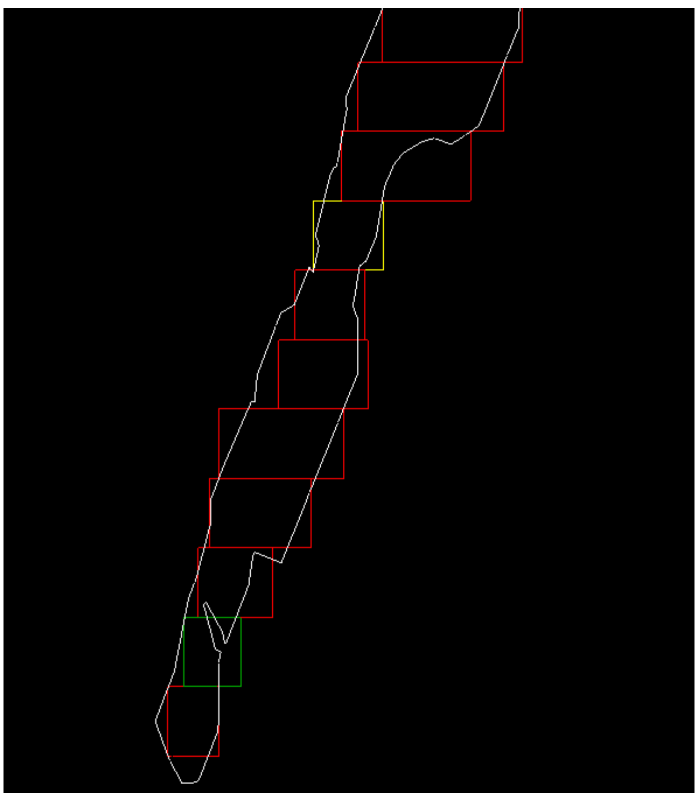
## 16.8 DILUTION AND MINING RECOVERY

Regular mining shapes have been planned around mineralization which has a gold grade of greater than 2.2 g/t. Figure 16.8 shows a section through the mineralization, with planned mining shapes as well as an outline of mineralization above cut-off grade. The mining shapes include planned dilution of material outside the mineralized shape, as well as mining losses.

The average planned dilution is estimated at 25% over the LOM. In addition to planned dilution, dilution from unplanned sources as well as reloading of backfill material, has been included in the mining schedule. The unplanned dilution has been included at an additional 10% of the planned mining tonnes as zero grade.

More detailed stope planning, can be completed once geotechnical conditions are better understood, which could improve stope shapes such that they better follow the mineralization.

**Figure 16.8 Da Tambuk Mining Shapes vs, Mineralization, Showing Dilution and Mining Losses**

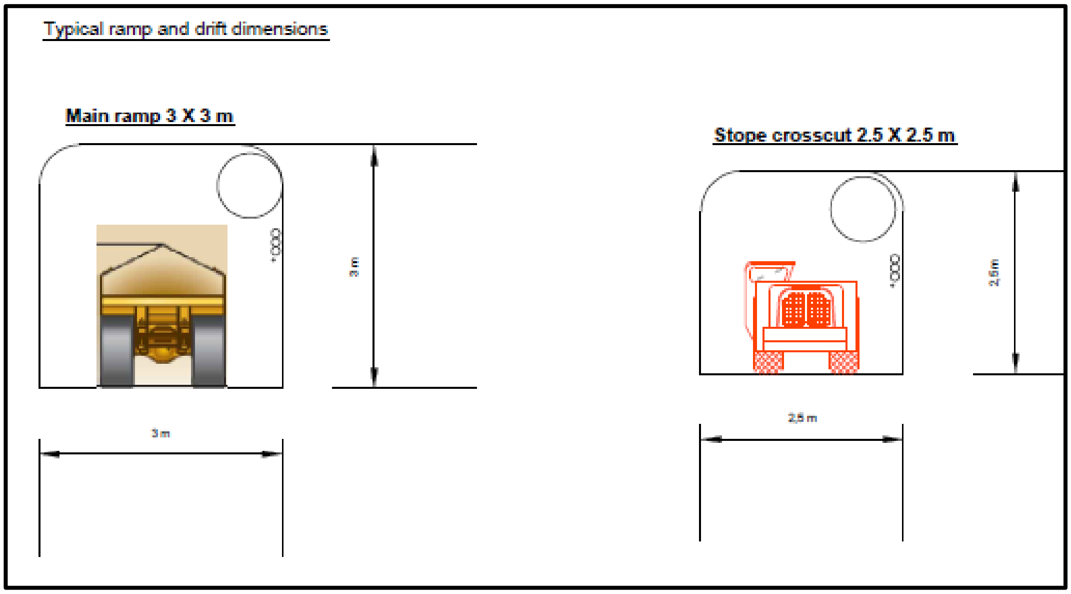


## 16.9 RAMPS AND TUNNELS

Ramps and tunnels were designed based on the size of equipment selected for the operation. The main access ramp was designed to be wide enough for 6 to 12 t haul trucks that are 1.82 m wide. Depending on requirements, stope access crosscuts will be either 2.5 m or 3 m wide. A minimum mining width of 2 m has been applied, which will allow for mucking with a small scooptram that is 1.6 m wide.

Figure 16.9 shows dimensions of the ramp and tunnels for Da Tambuk. Underground drifts and ramps will allow one-way traffic. Passing bays will be excavated at regular intervals to allow trucks to pass.

**Figure 16.9 Ramp and Tunnel Shape and Dimensions for Underground Mining at Da Tambuk**



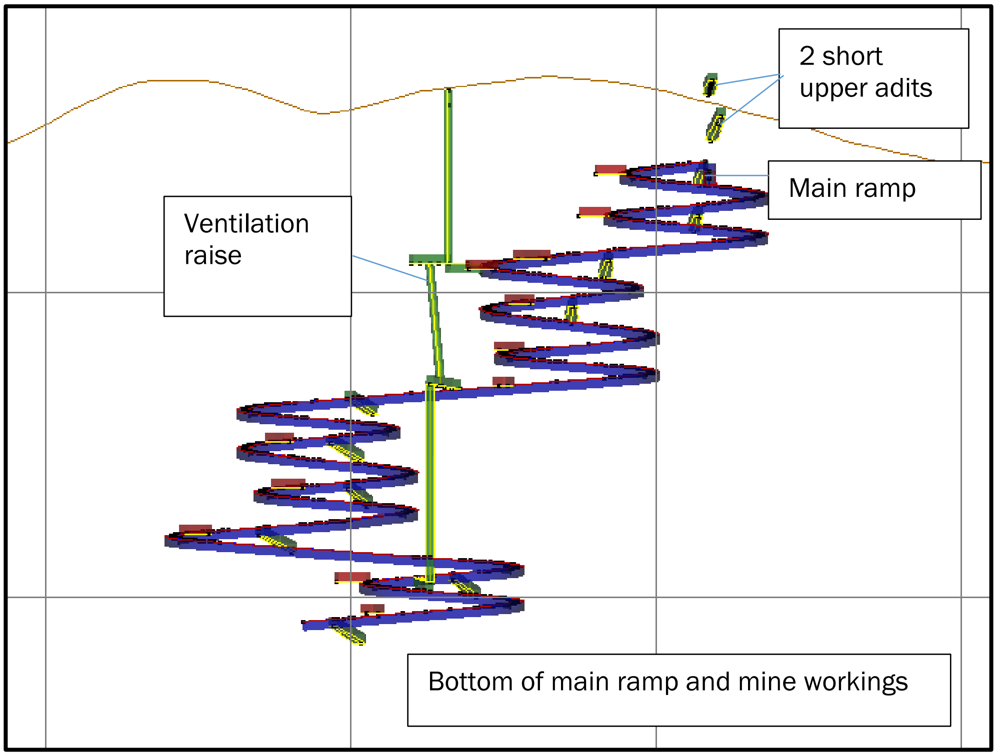

### 16.9.1 UNDERGROUND DEVELOPMENT AND ACCESS

Underground access will be via three adits. Two upper adits at elevations of 1,270 m and 1,258 m., will provide access to shallow mining areas. The main underground ramp that provides access to the remaining mine workings to depth will start at an elevation of 1,240 m. This ramp will continue down 1,700 m to a depth of 1,090 m, driven at a maximum grade of –15%.

A ventilation shaft will be excavated to the base of the mine workings in stages, with the first stage starting at 1,267 m to a depth of 1,210 m. The second stage will be completed to an elevation 1,170 m, with the final stage terminating at 1,107 m.

Figure 16.10 shows the layout for the underground access to the Da Tambuk deposit.

**Figure 16.10 Underground Access for Da Tambuk**




## 16.10 VENTILATION

Ventilation will be carried out through a main ventilation fan, which will draw air through the mine, and auxiliary ventilation systems, which will direct air towards working areas. The main ventilation fan will be installed at the collar of a main ventilation shaft.

The sizing of the ventilation fans was completed based on the air requirement to dilute particulates from diesel-powered mining equipment. An airflow of 0.07 $m^3/s$ was applied for each kW of diesel equipment operating at any point in the mine life. As such, the airflow was estimated based on two scooptrams, three underground trucks, and service equipment. An additional 25% was added for leakages and for personnel comfort. On this basis, the total air required was estimated at 80 $m^3/s$ or 200,000 cfm.

The following design criteria have been used for mine ventilation design:

- total ventilation shaft depth of 157 m
- additional linkages of 40 m as ventilation ways
- a friction factor of 70 for unlined, conventionally blasted ventilation raise
- a friction factor of 27 for a bored ventilation raise
- a friction factor of 20 for ventilation ducting
- 70% efficiency of ventilation fan

- 3 m diameter ventilation raise
- 0.6 to 1 m diameter ducting to bring fresh air into stopes

Figure 16.11 shows results of Ventsim Visual modelling of the Da Tambuk ventilation circuit. The results show that a 125 hp fan will provide adequate ventilation for diluting underground diesel-powered machinery emissions.

Additional engineering and optimization of the ventilation circuit will be done based on detailed design of underground workings, once underground development has started.

Figure 16.12 and Figure 16.13 show the calculations for sizing of the ventilation fans. The main fan was selected as a 125 kp (95 kW) with auxiliary fans selected at 30 hp (20 kW).

The main fan will be mounted onto the top of the ventilation raise collar, which will be prepared with rock stabilization and concrete to form the foundation for the fan. The main fan will work as an extraction fan, drawing air through the mine. This is ideal for hot climates, as the ventilation fan will marginally reduce air pressure underground, which provides a nominal cooling effect. The auxiliary fans will be hung from the roof of tunnels and fitted to ventilation ducts that will blow fresh air from the main ramp into working areas that are off the main ventilation circuit.

**Figure 16.11 Modelled Ventilation Circuit in Ventsim Visual**

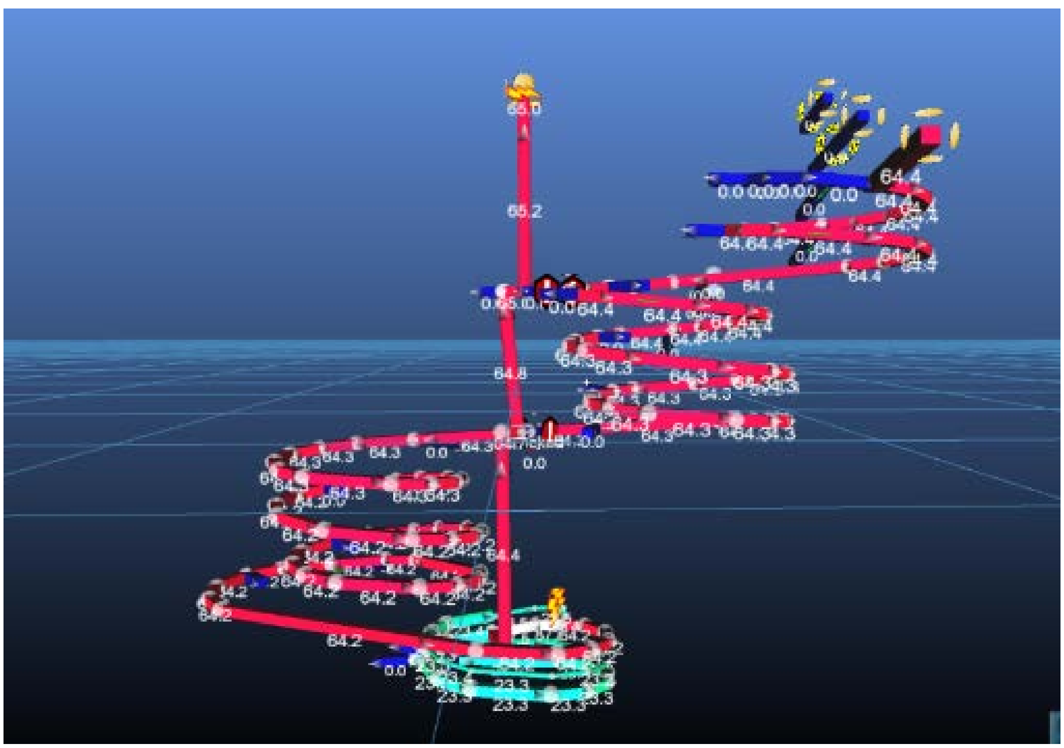
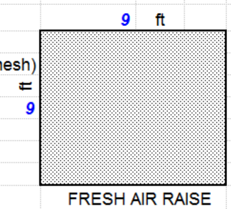


**Figure 16.12 Main Ventilation Raise Fan Sizing Calculation**

**FRESH AIR RAISE HEAD**

| | | | | |
|---|---|---|---|---|
| $P_s$ = | $\frac{KPLQ^2}{5.2a^3}$ | | | |
| K= | | 70 | Friction Factor (untimbered, with rock bolts and mesh) | |
| P= | | 36 | ft | |
| L= | | 656 | ft | |
| A= | | 81 | sq ft | (of unrestricted airway) |
| Q= | | 200,000 | cfm req'd | |
| $P_s$ = | | 2.39 | in. w.g. | |
| $P_v$ = | $(Q/4000A)^2$ = | 0.38 | in w.g. | |
| $P_t$ = | $P_s + P_t$ = | 2.77 | in w.g. | |
| fan HP = | $\frac{QP_t}{6350}$ = | 87.36 | bhp | |
| | @ 70% efficiency = | 125 | bhp | |




or

FAR

**Figure 16.13 Auxiliary Fan Sizing Calculation**

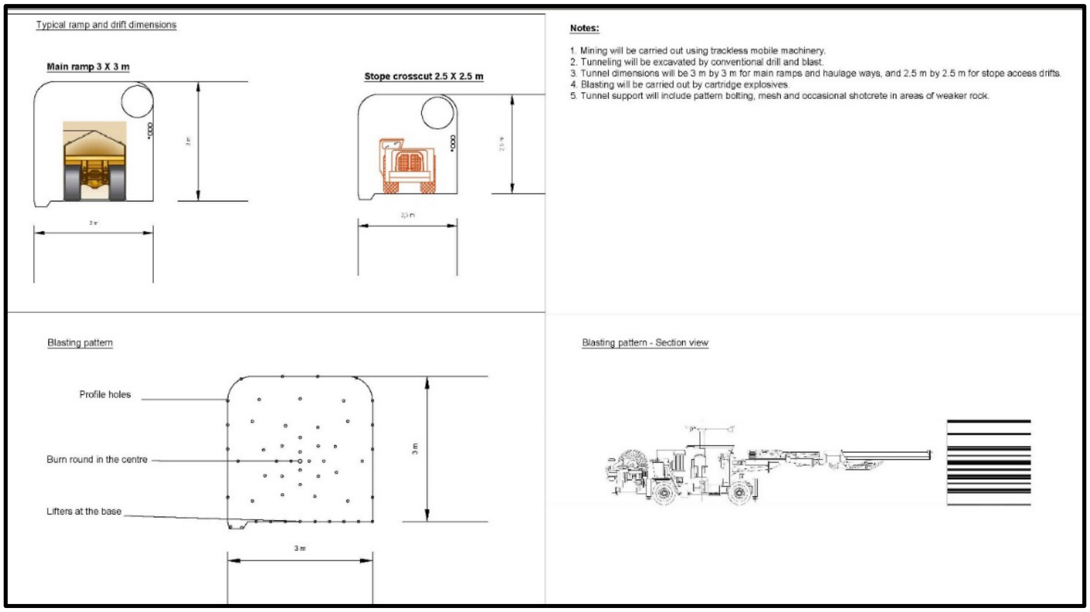
**VENT TUBING HEAD**

| | | | | | |
|---|---|---|---|---|---|
| $P_s$ = | $\frac{KPLQ^2}{5.2a^3}$ | | | | |
| K= | | 20 | Friction Factor (smooth plastic fabric) | | |
| D= | | 48 | inch | = | 4 ft |
| P= | | 12.57 | ft | | |
| L= | | 328 | ft | | |
| A= | | 12.57 | sq ft | | |
| Q= | | 42,000 | cfm req'd each tube | | |
| Coupling loss equivalent = | | | 33 | ft | |
| Exit Loss equivalent = | | | 100 | ft | |
| | Number 90 deg bends = | | 1 | | |
| | Bend loss = | | 50 | | |
| Total theoretical length of tubing = | | | 511 | ft per | |
| $P_s$ = | | | 2.20 | in. w.g. | |
| $P_v$ = | $(Q/4000A)^2$ = | | 0.70 | in w.g. | |
| $P_t$ = | $P_s + P_t$ = | | 2.90 | in w.g. | |
| fan HP = | $\frac{QP_t}{6350}$ = | | 19.15 | bhp | |
| | @ 70% efficiency = | | 27.36 | bhp | |

## 16.11 DRILLING AND BLASTING

Drilling and blasting for Da Tambuk will be carried out using jumbo drilling rigs or handheld jacklegs (jackhammer) to drill blastholes. When developing tunnels or ramps, the holes are drilled into the advancing face as shown in Figure 16.14. After drilling and blasting, the holes will be charged with explosive by a qualified underground blaster. Safe industry standard explosives will be used, which are insensitive, requiring a detonating charge to ignite. The certified blaster will connect the initiation lines to an electric detonator. The electric detonator will be connected to a dedicated blasting cable, so that blasting can be initiated from surface after all personnel have been cleared from the mine.

**Figure 16.14 Da Tambuk Drilling and Blasting**



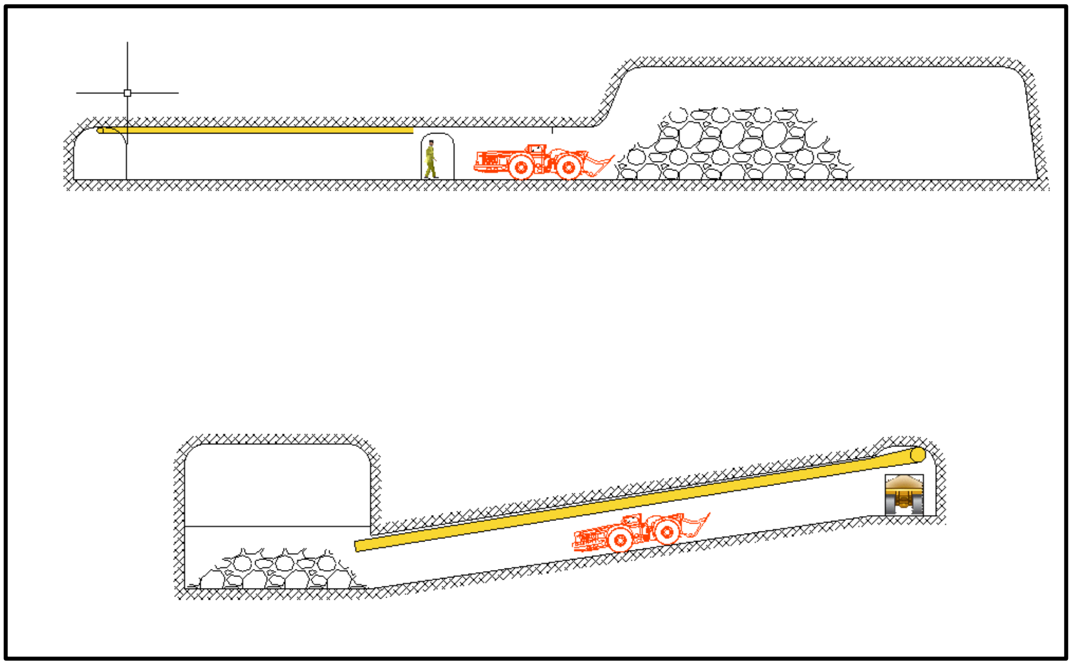

## 16.12 MUCKING AND HAULING

Mucking of stopes and development will be carried out using diesel powered scooptrams. The scooptrams will be selected to enable entry into the stopes to muck out blasted rock. Where mucking is undertaken in open stopes, the scooptrams will be fitted with remote control capabilities, which will enable the operator to operator the machine away from the risk of falling ground or undercutting of blasted rock within the stope.

Figure 16.15 shows a sketch of the mucking and hauling process considered for Da Tambuk.

Haul trucks will operate on the main ramp, with rock delivered from the stope to the haul truck by scooptram. Crosscuts may need to be slashed out to enable the scooptram to load the haul trucks.

**Figure 16.15 Mucking and Hauling of Broken Rock**



## 16.13 MINING EQUIPMENT

Mining equipment requirements were evaluated to be in line with the production schedule. Table 16.6 shows the equipment list for mining.

Due to the small throughput and the requirements to first develop the access ramp down 150 m before production can start, the mining equipment will be purchased in two phases. The first phase will include enough mining equipment to start developing the ramp and complete initial stope development work. Once sufficient development has been done, additional equipment will be required to ramp up to full production.

**Table 16.6 Summary Equipment for Underground Mining at Da Tambuk**

| Type of Equipment | Size | Installed Power | Number | Pre-production | Sustaining |
|---|---|---|---|---|---|
| Jumbo Small | Twin boom 1.6 m wide | 70 | 1 | 1 | 0 |
| Jumbo Small | Twin boom 1.6 m wide | 70 | 1 | 0 | 1 |
| Scoops Small | 4 t 1.6 m wide | 75 | 1 | 1 | 0 |
| Scoops Large | 7 t 2.1 m wide | 150 | 1 | 0 | 1 |
| Trucks | 10 t Trucks | 140 | 3 | 1 | 2 |
| Jacklegs | Air Powered 100 cfm | 100 cfm | 10 | 3 | 7 |
| Shotcreting Systems | Trailer Mounted System | 0 | 1 | 1 | 0 |
| Personnel Carrier | Toyota Land Cruiser with ROPS/FOPS | 150 kW | 2 | 1 | 1 |
| Scissor Lift | Tractor Mounted | 55 kW | 1 | 0 | 1 |
| Rock Duster | Trailer Mounted System | 0 | 1 | 0 | 1 |
| Axial Fans | 125 hp Axial Fan for Surface | 95 kW | 2 | 1 | 1 |
| Auxiliary Fans Large | 30 hp Fans | 20 kW | 3 | 1 | 2 |
| Auxiliary Fans Small | 5 hp Fans | 4 kW | 2 | 2 | 0 |
| Pumps | 30 kW Self-priming | 30 kW | 4 | 1 | 3 |
| Compressor | 500 cfm | 450 kW | 1 | 1 | 0 |
| Bus | 60 Seater | 120 kW | 1 | 1 | 0 |
| Light Vehicles | Toyota 4 x 4 | 150 | 4 | 4 | 0 |

Note: ROPS – rollover protective structure; FOPS – falling object protective structure

## 16.14 ANCILLARY MINING OPERATIONS

To support core mining operations (drilling, blasting, loading, and hauling), TRI will provide mining support operations, including:

- equipment refuelling
- road maintenance
- supervision
- training
- grade control
- geology
- equipment maintenance
- dewatering
- environmental services
- dust suppression.

The cost of the services above was estimated and included in the mine operating cost.

## 16.15 WASTE ROCK STORAGE

The mining methods applied at Da Tambuk require backfilling of rock into the mined-out voids underground. As such, waste rock will be stored temporarily on surface during mining but ultimately stored underground.

The mine plan includes provision of an area to the south of the underground ramp adit where waste rock will be stored, before re-handling for placement underground.

## 16.16 MINING SCHEDULE

Table 16.6 shows the Da Tambuk underground mining schedule. The steep terrain and the surface mineralization outcrops mean initial stopes for mining are accessible within 30 m from surface. Three adits will be developed for part of the early schedule. To access ore below the outcrop, two upper adits at elevations of 1270 and 1258 m. will be developed before the main ramp.

Initially much of the mill feed will be derived from level development of stopes.  As the ramp deepens the crosscut levels will be mined out to the extent possible.  Once sufficient crosscuts are established mining between sublevels will commence either by cut and fill or sublevel stoping.

Prior to backfilling, sublevels will be slashed including drilling uppers and mining out any mineralized pillars on retreat. Miners will move to other stoping areas while backfilling takes place and return only once the backfill is complete and trafficable. Where blasting is done onto the backfill, it is expected that additional dilution from backfill will occur.

Depending on the availability of mill feed, miners may elect to leave mineralized rock in the stopes as temporary backfill to mine above the blasted rock, prior to mucking out the stope. This will reduce the need to muck blasted rock from above backfilled areas.

## Table 16.7 Da Tambuk Mining Schedule

| Mining schedule | Unit | Total | Year | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | -1 | | 1 | | | | 2 | | | | 3 | | | | 4 | | |
| | | | Quarter | | | | | | | | | | | | | | | | |
| | | | -2 | -1 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| Ramp development | m | 2,467 | 72 | 114 | 123 | 140 | 156 | 152 | 170 | 157 | 153 | 143 | 145 | 159 | 588 | 196 | - | - | - |
| Raise development | m | 157 | - | - | - | - | 52 | - | - | 40 | - | - | - | 65 | - | - | - | - | - |
| Crosscut development | m | 210 | - | 30 | 30 | - | 30 | 30 | 30 | 30 | 30 | - | - | - | - | - | - | - | - |
| Other lateral development | m | 370 | 11 | 17 | 18 | 21 | 23 | 23 | 25 | 23 | 23 | 22 | 22 | 24 | 88 | 29 | - | - | - |
| Total lateral metres | m | 3,047 | 83 | 162 | 171 | 160 | 209 | 205 | 225 | 210 | 206 | 165 | 167 | 183 | 676 | 225 | - | - | - |
| Total vertical metres | m | 157 | - | - | - | - | 52 | - | - | 40 | - | - | - | 65 | - | - | - | - | - |
| Waste tonnes mined | t | 101,647 | 2,822 | 5,105 | 5,434 | 5,448 | 7,206 | 6,573 | 7,256 | 7,115 | 6,599 | 5,598 | 5,663 | 6,210 | 22,964 | 7,655 | - | - | - |
| **Stope tonnes mined** | **t** | **650,415** | **-** | **-** | **27,839** | **45,098** | **47,433** | **50,023** | **48,773** | **49,480** | **47,637** | **46,768** | **48,560** | **48,945** | **49,248** | **49,279** | **48,571** | **35,752** | **7,008** |
| Tonnes per day | t/d | 482 | | | 309 | 501 | 527 | 556 | 542 | 550 | 529 | 520 | 540 | 544 | 547 | 548 | 540 | 397 | 78 |
| Gold mined | kg | 3,173 | - | - | 190 | 288 | 280 | 267 | 248 | 233 | 198 | 190 | 203 | 231 | 244 | 238 | 210 | 126 | 28 |
| Silver mined | kg | 1,474 | - | - | 74 | 97 | 94 | 101 | 92 | 101 | 99 | 91 | 93 | 114 | 123 | 131 | 140 | 104 | 19 |
| **Gold grade** | **g/t** | **4.88** | | | **6.8** | **6.4** | **5.9** | **5.3** | **5.1** | **4.7** | **4.1** | **4.1** | **4.2** | **4.7** | **4.9** | **4.8** | **4.3** | **3.5** | **4.0** |
| Silver grade | g/t | 2.27 | | | 2.7 | 2.2 | 2.0 | 2.0 | 1.9 | 2.0 | 2.1 | 2.0 | 1.9 | 2.3 | 2.5 | 2.7 | 2.9 | 2.9 | 2.8 |

## 16.17 MINE LABOUR REQUIREMENTS

Mining labour requirements are summarized in Table 16.8.

Development crews will be hired during preproduction to start underground development. Stoping crews will also be hired so that underground mining training can be undertaken. Underground mining labourers will require a one-month training program to learn practical mining skills as well as safety and emergency response procedures. Planning staff will be sourced both locally and internationally. These personnel will also begin working during preproduction to allow training and detail planning of underground mining to take place before production.

**Table 16.8 Mining Labour**

| | Year | | | | |
|---|---|---|---|---|---|
| | -1 | 1 | 2 | 3 | 4 |
| Development Labour | 22 | 56 | 40 | 40 | 0 |
| Stoping Labour | 26 | 34 | 34 | 34 | 34 |
| Management, Maintenance, Planning and Administration | 19 | 48 | 48 | 44 | 44 |
| Total Mining Staff | 67 | 138 | 122 | 118 | 78 |

# 17.0 RECOVERY METHODS

Based on the metallurgical test results, whole mill feed cyanide leach technology is proposed for treatment of the Da Tambuk mineralization. The Da Tambuk processing facilities are designed to process at a nominal rate of approximately 200,000 t/a, or 550 t/d, of gold-silver bearing material from an underground mining operation to produce gold-silver doré product.

The unit processes selected were based on the results of metallurgical testing performed at BCR, located on Vancouver Island, Canada, and the project-related parameters provided by Tetra Tech and EAM.

The proposed process flowsheet is summarised as follows:

- Conventional crushing and ball mill grinding for comminution with a cyclone for particle size classification of the ground mill feed. A centrifugal gravity concentrator in the grinding circuit will be used to recover coarse and liberated gold particles, and a shaking table will be used to up-grade the gravity concentrate before smelting.
- The ball mill cyclone overflow will be treated in a six-stage CIL circuit to extract gold and silver from the feed material using sodium cyanide solution. The extracted gold and silver will be adsorbed from this solution onto activated carbon.
- The gold and silver loaded carbon will initially be acid-washed to remove calcium and other impurities, followed by the elution, or stripping, process to recover gold and silver from the carbon into a gold-and-silver-bearing pregnant solution. Then, the gold and silver will be recovered from the pregnant solution onto cathodes by electro-winning.
- The eluted carbon will be reactivated in a thermal kiln followed by attrition to remove carbon fines before being returned to the CIL circuit.
- The CIL tailings will be treated to destroy WAD cyanide by a sulphur dioxide/air procedure. After the chemical treatment, the WAD cyanide concentration is expected to reduce to the level that meets regulatory requirements.
- The detoxified tailings will be pumped to a thickener to recover the process water.

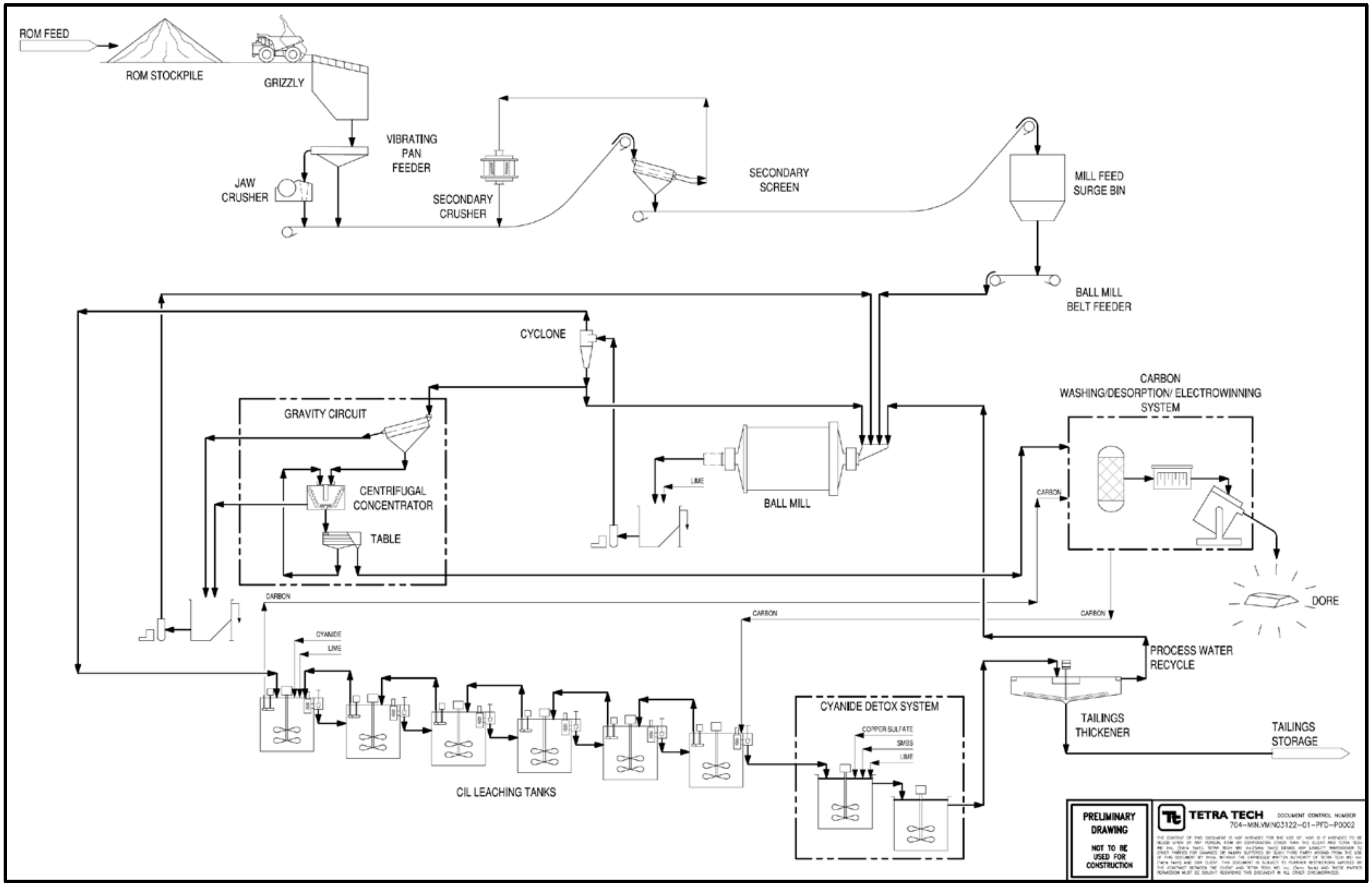
Process water will be recycled from the tailings thickener overflow, and this will be supplemented with the water recovered from the tailings containment facility. Fresh water will be used for reagent preparation and gold-silver loaded carbon elution circuit as well as for water make-up purposes, as required.

The Da Tambuk processing facility will consist of the following unit operations:

- two-stage crushing and screening
- crushed fine material storage bin and reclaim system for grinding
- ball mill grinding and classification
- gravity recovery circuit
- CIL circuit
- carbon acid washing, elution and thermal reactivation
- electrowinning and smelting
- cyanide detoxification
- tailings thickening and delivery system.

The simplified flowsheet is shown in Figure 17.1.

**Figure 17.1 Simplified Process Flowsheet**



## 17.1 MAJOR DESIGN CRITERIA

The process plant has been designed to treat gold and silver bearing material at the rate of 550 t/d, equivalent to approximately 200,000 t/a. The major criteria used in the design are outlined in Table 17.1.

**Table 17.1 Major Design Criteria**

| Criteria | Unit | Value |
|---|---|---|
| Operating Days per Year | d | 365 |
| Crushing Circuit Utilization (One Shift per Day) | % | 75 |
| Grinding, CIL and Carbon Circuits Utilization | % | 90 |
| Crushing Circuit Throughput Rate | t/h | 73 |
| Grinding and Leaching Process Rate | t/h | 25.5 |
| Ball Mill Feed Size, 80% Passing | µm | 9,000 |
| Ball Mill Product Size, 80% Passing | µm | 80 |
| Ball Mill Circulating Load | % | 250 - 300 |
| Bond Ball Mill Work Index, Design | kWh/t | 16.0 |
| Bond Ball Mill Work Index, Average | kWh/t | 12.0 |
| Mill Feed Material Specific Gravity | | 2.83 |
| Mill Feed Moisture Content | % | 2.0 |
| Leach Circuit Retention Time | h | 30 |
| Head Grade, Design | Au g/t | 9.0 |
| Head Grade, Average | Au g/t | 4.7 |
| Anticipated Recovery, Design | Au % | 95.1 |
| Anticipated Recovery, Average | Au % | 93 |

The design parameters selected are based on test work results obtained from BCR and typical industry parameters for this type of process.

### 17.1.1 OPERATING SCHEDULE AND AVAILABILITY

The main processing plant is designed to operate 24 hours per day for 365 days per year while the crushing circuit will be operated on day shift. The plant operations will have three eight-hour shifts per day.

The crusher utilization is projected to be 75% with one shift per day, and the ball mill grinding, CIL, and carbon circuit utilization will be 90% with three shifts per day. These utilizations have allowed enough downtime for scheduled and unscheduled maintenance of the process plant equipment.

## 17.2 PROCESS PLANT DESCRIPTION

### 17.2.1 CRUSHING CIRCUIT

The crushing circuit will reduce the mined material size from a nominal top size of 400 mm to a product size $P_{80}$ of 9.0 mm in preparation for the grinding process. The crushing facility will contain the main equipment listed below:

- stationary grizzly
- run-of-mine (ROM) dump bin
- jaw crusher vibrating feeder
- jaw crusher, 75 kW
- conveyor belts
- belt magnet and metal detector
- sizing screen
- cone crusher, 150 kW
- belt scale
- crushed material surge bin.

Haulage trucks will bring ROM material to the crushing plant. The material will be dumped directly from the trucks for crushing, although provision has been made for material to be dumped onto a temporary ROM stockpile if unscheduled crusher plant stoppages occur.

A stationary grizzly will be provided to prevent oversize rocks from entering the ROM dump pocket. With a nominal capacity of 18 $m^3$, the dump pocket will be equipped with a vibrating feeder that will feed the ROM material to the jaw crusher. The jaw crusher will reduce the feed size from finer than 400 mm to less than 100 mm. Together with the vibrating feeder undersize material and the material from the secondary crusher discharge, the crushed material will be discharged onto a conveyor belt which will transport these materials to the sizing screen.

The sizing screen will be a vibrating screen with a final product size $P_{80}$ of approximately 9.0 mm. The screen oversize will be conveyed to a cone crusher for additional crushing. The cone crusher will be in a closed circuit with the sizing screen. The screen undersize will be discharged onto a conveyor, which will transport the crushed material to a mill feed stockpile. The crushed material will then be loaded onto a ball feed surge bin with a live capacity of 200 t.

### 17.2.2 GRINDING CIRCUIT

The grinding circuit will reduce the size of the crushed material to a final product size of $P_{80}$ of 80 μm, suitable for the subsequent gold recovery by gravity concentration and cyanide leaching processes. The grinding circuit will have the following main items of equipment:

- ball mill feed conveyor belt
- conveyor belt weigh scale
- ball mill, 3.2 m diameter by 3.7 m long
- mill discharge pumpbox
- cyclone feed slurry pumps
- classification cyclone cluster
- vibrating trash screen.

The material will be drawn from the mill feed bin at a controlled feed rate. A belt scale will be installed to control the feed rate to the ball mill. The mill new feed rate will be 25.5 dry t/h. The cyclone underflow will also constitute part of the feed to the mill. Process water will be added as required to maintain the slurry density in the ball mill at approximately 72% solids.

The discharge from the ball mill together with the tailings from the gravity concentration circuit will be directed into a pumpbox where dilution water will be added as required to adjust the slurry density for efficient cyclone classification. The slurry in the mill discharge pumpbox will be pumped to a cyclone cluster for particle size classification to $P_{80}$ of 80 µm. The circulating load in the grinding circuit will be between 250 to 300%. The cyclone underflow will be returned to the ball mill together with the new feed material for further grinding. A 30% split of the cyclone underflow stream will be directed to the gravity concentration circuit.

The cyclone overflow will be directed to the downstream cyanidation circuit.

Provision will be made for adding lime to the ball mill to adjust the pH of the slurry in the grinding circuit before the leaching process.

Grinding balls will be added to the mill as required to maintain the grinding efficiency.

### 17.2.3 GRAVITY CONCENTRATION AND CONCENTRATE TABLING

The gravity concentration circuit with a centrifugal concentrator and a table is designed to recover coarse gold grains from the cyclone underflow. The concentrate from the centrifugal concentrator will be further upgraded on a shaking table for on-site smelting.

The main items of equipment in this circuit will be:

- trash sizing screen
- centrifugal gravity concentrator
- shaking table.

A nominal 30% portion of the cyclone underflow in the grinding circuit will be directed to the gravity circuit for recovering the liberated coarse gold grains. The gravity circuit feed will initially be screened to remove oversize and trash materials greater than 2 mm in size. The screen oversize material will be returned to the grinding circuit for further grinding.

The primary gravity concentrator will operate continuously and will be flushed twice every hour to remove the gold concentrate collected in the unit. The concentrator flush will be discharged into the concentrate holding tank, which will collect all the concentrate from the centrifugal concentrator over an entire day of production. Gravity tailings will be discharged from the concentrator and returned to the grinding circuit.

The centrifugal gravity concentrate will be upgraded on the shaking table as a batch process on a daily basis. The tabling will upgrade the centrifugal gravity concentrate to the level which is suitable for direct smelting. The table tailings will be returned to the head of the centrifugal concentrator.

### 17.2.4 CIL Circuit and Gold Recovery Circuit

The gold and silver will be leached from the ground material with a sodium cyanide solution, and the extracted gold and silver will be adsorbed onto granules of activated carbon (carbon) in a series of agitated leach tanks.

The cyclone overflow will be thickened in a high rate thickener to approximately 47% w/w solids. The thickener overflow will be reused as process water. The thickened slurry will feed into the No. 1 CIL tank and flow sequentially from Tank No. 1 to Tank No. 6. The carbon will be transferred counter-current to the slurry flow, from Tank No. 6 to Tank No. 1. The gold and silver dissolved will be simultaneously collected onto the carbon. The loaded carbon will be removed from Tank No. 1 CIL and transferred to the carbon elution circuit to recover the gold and silver. After elution, the carbon will be reactivated in a carbon kiln and returned to the leach tanks. The main items of equipment will be the following:

- six CIL tanks equipped with agitation impellers, each 7.0 m diameter by 7.7 m high
- carbon transfer air-lifts
- interstage screens
- loaded carbon screen
- carbon safety screen.

The slurry from the grinding circuit will be fed into the first tank of six CIL tanks. The slurry pH will be controlled by lime slurry as required. Sodium cyanide solution will be added to maintain the necessary concentration required for leaching. Each CIL tank will be equipped with a mechanical agitator to provide slurry mixing and to ensure the activated carbon particles are well distributed within the leach tank. Each CIL tank will also be equipped with air injection nozzles to maintain the dissolved oxygen at a concentration of less than 5 mg/L. The slurry residence time in the CIL circuit will be approximately 30 hours.

Each CIL tank will be equipped with an inter-stage wedge wire screen and an air-lift carbon/slurry transfer system. The screens will retain the carbon in the respective CIL tank while permitting the pulp to flow through the screen to the next CIL tank in the circuit. The carbon concentration in each tank will be maintained at approximately 20 g/L. Every day, approximately 0.6 to 1.1 t of loaded carbon will be transferred from the first tank in the CIL circuit to the carbon elution circuit. An equivalent amount of reactivated or fresh carbon will also be added to the final tank in the CIL circuit every day. Air-lifts, installed in each tank, will be used to advance the carbon from tank to tank in counter-current flow. Generally, the inter-tank carbon transfer will be achieved in a semi-continuous mode.

Loaded carbon will leave the first CIL tank and report to the loaded carbon screen equipped with spray water nozzles to wash the slurry off the carbon. The loaded carbon (screen oversize) will be transferred to the carbon elution circuit for acid wash treatment and subsequent gold/silver elution. The screen underflow will be returned to the first CIL tank.

The leached slurry will exit the CIL circuit and flow by gravity to the carbon safety screen to recover any escaped carbon particles. The safety screen undersize slurry will be transferred to the cyanide detoxification circuit prior to the tailings thickener.

### 17.2.5 CYANIDE DETOXIFICATION AND TAILINGS DEPOSITION

The slurry from the CIL circuit will be sent to the cyanide destruction circuit to reduce the WAD cyanide level so it is at the applicable regulated cyanide limit or lower. The cyanide detoxification will take place in two cyanide detoxification tanks before the slurry is pumped to the tailings containment facility.

The main items of equipment will be:

- two cyanide detoxification tanks, each with an agitator
- air generation and supply system
- reagent supply systems.

The CIL leach residue will be pumped to the cyanide detoxification system consisting of two reactors in parallel to destroy residual cyanide in the slurry. The cyanide detoxification tanks will be equipped with air injection nozzles and an agitator to enable the air and the reagents to be thoroughly mixed with the tailings slurry. Reagents to be added will include copper sulphate, SMBS to generate the sulphur dioxide required for the cyanide detoxification reactions, and lime added as required to maintain an alkaline pH for the optimum cyanide detoxification.

Based on extensive industry experience, the slurry residence time in the detoxification tanks is designed to be one hour; however, the circuit will be designed with an appropriate design factor to provide excess detoxification capacity. The overflow from the cyanide detoxification tanks will be pumped to a tailings thickener before it is sent to the TCF.

### 17.2.6 Tailings Thickener

The plant tailings will be thickened to maximize the recovery of water before transfer of the tailings to the TCF. The tailings dewatering circuit will consist of one 7 m diameter high rate thickener, flocculant preparation/distribution system, and related pumps.

To settle the tailings solids in the thickener, a flocculant (dilute solution of 0.02% strength) will be added at a rate of 20 to 30 g/t.

The thickener overflow solution will be directed to a standpipe which will direct the overflow solution to the process water tank for re-use in the plant. The thickener underflow slurry will be thickened to a pulp density of 60% w/w solids and pumped to the TCF.

### 17.2.7 Carbon Circuit

#### *Acid Washing*

Loaded carbon will enter the acid wash tank from the loaded carbon screen. Under normal operating conditions, the loaded carbon will first be rinsed with a diluted acid solution (washed), then neutralized with caustic solution, or thoroughly rinsed with water, and then forwarded to the subsequent elution stage.

The acid wash tank will receive a batch of approximately 0.6 to 1.1 t of loaded carbon for acid washing prior to eluting. A 3% hydrochloric acid strength solution will be re-circulated through the bed of the carbon. This acid washing treatment will remove scale build-up and other inorganic contaminants which may inhibit gold adsorption onto the carbon or report to the downstream electrowinning circuit. This will be followed by a water rinse to remove the remaining traces of hydrochloric acid.

#### *Loaded Carbon Elution/Desorption/Stripping*

The gold and silver adsorbed onto the carbon will be desorbed/eluted in the elution column.

After acid washing, the loaded carbon will be pumped to the elution column. The elution solution will be heated. After reaching the elution/stripping temperature, the solution will be pumped upward through the elution column. The elution column/strip vessel will be designed to treat an approximately 1.1 t batch of loaded carbon, although the planned production rate is approximately 0.6 to 1.1 t depending on mill feed grade and operational conditions. The elution/stripping of gold and silver from the loaded carbon will be accomplished using a modified Zadra based elution process. The gold will be eluted from the carbon under elevated temperature and pressure conditions to form a pregnant solution. The gold-bearing solution will exit the elution vessel and then flow through the two cool-down heat exchangers to recover the heat prior to the electrowinning circuit.

After the elution cycle is complete, the carbon will be transferred to the reactivation kiln storage bin.

#### ELECTROWINNING

The gold and silver will be recovered by electrowinning from the pregnant solution.

The pregnant solution will enter the electrowinning cells from the pregnant solution stock tank. The gold and silver will be electro-plated onto stainless steel wool cathodes. The solution leaving the electrowinning cells will flow by gravity to the barren solution tank for making up to strength with caustic and cyanide for the following elution/stripping cycle. The cathodes will be lifted out of the cells, and the deposited metal will be washed off and collected in a sludge tank. The precious metal bearing sludge will then be pumped to the electrowinning sludge filter press to remove the bulk of the solution, which will be re-used in the electrowinning circuit or recycled to the leach circuit. The dewatered metal sludge will be placed into trays for drying in the drying oven, followed by smelting.

A typical elution cycle time will be approximately 18 hours. The elution and electrowinning circuit design of 1.1 t per elution will allow for treating higher grade material or accommodating maintenance demands.

#### REFINERY

The gold and silver will be smelted into doré bars. The metal sludge will be mixed with fluxes, typically a combination of borax, nitre, and silica sand. Smelting will take place in a tilting crucible furnace. A cascading mould system will be used to collect the melt metals. The doré bars will be cleaned to remove adhering slag and will be stored in the doré safe until the bars are despatched to their final destination.

#### CARBON MANAGEMENT

The carbon handling circuit will include all the components necessary to move, store, add, reactivate, and remove carbon in the carbon system. Carbon will be transferred between the various unit operations in the plant by recessed impellor type pumps and by pressurization in the CIL and elution column. Carbon transfer in the adsorption circuit will be by air-lifts. Carbon reactivation will be conducted in a thermal rotary kiln. Fresh carbon will be attritioned to remove carbon fines and sized together with the reactivated carbon before this is added to the CIL circuit.

Reactivating the eluted carbon includes removing adsorbates that have accumulated during the adsorption process. This reactivation process will restore the porous structure of the activated carbon using a rotary kiln. The eluted carbon will be transferred hydraulically to the reactivation kiln feed bin via a vibrating dewatering screen. An inclined screw conveyor will feed the carbon to the rotary kiln at the temperature of approximately 680°C.

The reactivated carbon will exit the kiln and drop directly into the quench tank. The carbon will then be dewatered and sized over the reactivated carbon sizing/dewatering screen.

### 17.2.8 REAGENT PREPARATION

The reagent preparation section will prepare the reagents for use in the various parts of the processing circuit. The main items of equipment will be:

- bag breakers
- exhaust fans
- screw conveyors
- mixing and holding tanks
- transfer and metering pumps.

The reagents will be prepared close to the point of usage. The reagent preparation section will be under a roof to protect the reagents and equipment from rain. Most reagents will be received in bulk as in palletized bags, chemtainers, drums, or bulk bags. The reagent preparation section will contain strategically located safety showers and eyewash stations. Each reagent preparation area will be bunded to contain potential accidental spillage during the preparation stage, and each bunded area will be served by a sump pump for cleaning up and controlling any spillage.

#### *LIME*

The design is based on using hydrated lime as the pH modifier for the various unit processes. Hydrated lime will be delivered in 1 t capacity bulk bags or 40 t trucks, depending on the local supply capability. It will be added to the grinding circuit, to the CIL circuit for protective alkalinity to prevent formation of hydrogen cyanide gas, and to the cyanide detoxification tank. The hydrated lime slurry strength will be 20%. The hydrated lime will be distributed to the addition points via a closed loop piping system.

#### *SODIUM CYANIDE*

The sodium cyanide will be delivered in sealed steel bulk containers in the form of small briquettes. Sodium hydroxide (caustic) will initially be added to the mixing tank to ensure that the solution will be alkaline. The cyanide will be dissolved in water to the required concentration strength of 20% in a mixing tank. The cyanide solution will then be transferred to the holding tank from where it will be distributed to the points of usage.

The cyanide preparation area will be isolated, and only approved personnel will be allowed to enter the preparation area. This area will be completely bunded to contain accidental spillage and equipped with a hydrogen cyanide monitor to warn if hydrogen cyanide gas is present.

### FLOCCULANT

Flocculant will be used to aid the solids settling process. The flocculant will be prepared at the required concentration in a proprietary vendor-supplied flocculant preparation facility. Flocculant will be delivered in bulk bags. A screw conveyor will deliver the correct amount of dry flocculant powder to be mixed with water before delivery into the flocculant mixing tank. The flocculant will be allowed to hydrate in the mixing tank before being transferred to the holding tank where it will be made up to the required dosing strength. A metering pump will transfer the required amount of flocculant from the holding tank to the points of addition at the CIL feed thickener and the tailings thickener.

### HYDROCHLORIC ACID

Hydrochloric acid will be used for dissolving acid-soluble contaminants on the carbon particles, typically calcium that has precipitated as calcium carbonate in the pores of the activated carbon. The hydrochloric acid will be delivered as concentrated acid. The acid will be pumped from the acid containers directly to the water-containing acid wash pumpbox where the concentration will be adjusted to approximately 3% acid strength.

### SODIUM HYDROXIDE

The sodium hydroxide will be delivered in bulk bags. It will be mixed with water to make up batches of caustic solution at the required solution strength of 20%. The caustic solution will then be transferred to the caustic storage tank and then pumped to the elution circuit as required.

### SODIUM METABISULPHITE

SMBS will be supplied as a solid material in bulk bags. It will be mixed with water to a 20% solution strength in the mixing tank. This solution will be pumped from the mixing tank to the holding tank, then pumped to the cyanide detoxification tank at the required dosage rate.

### COPPER SULPHATE

Copper sulphate will be supplied in pentahydrate form as a solid crystalline material shipped in bulk bags. It will be mixed with water to a 20% solution strength in the copper sulphate conditioning tank. The solution will be pumped to the cyanide detoxification tank at the required dosage rate.

### ACTIVATED CARBON

Activated carbon will be delivered in bulk bags. It will be added to the quench tank as required and pumped to the carbon sizing screen to remove any fines prior to entering the CIL circuit.

### 17.2.9 WATER CIRCUIT

The water circuit will provide the amount and type of water required for use in different areas of the plant. The main items of equipment will be the water tanks and pumps for the different water circuits.

The water system for the process plant consists of the following circuits:

- fresh water supply system
- fire water supply system
- gland service water supply system
- process water supply system.

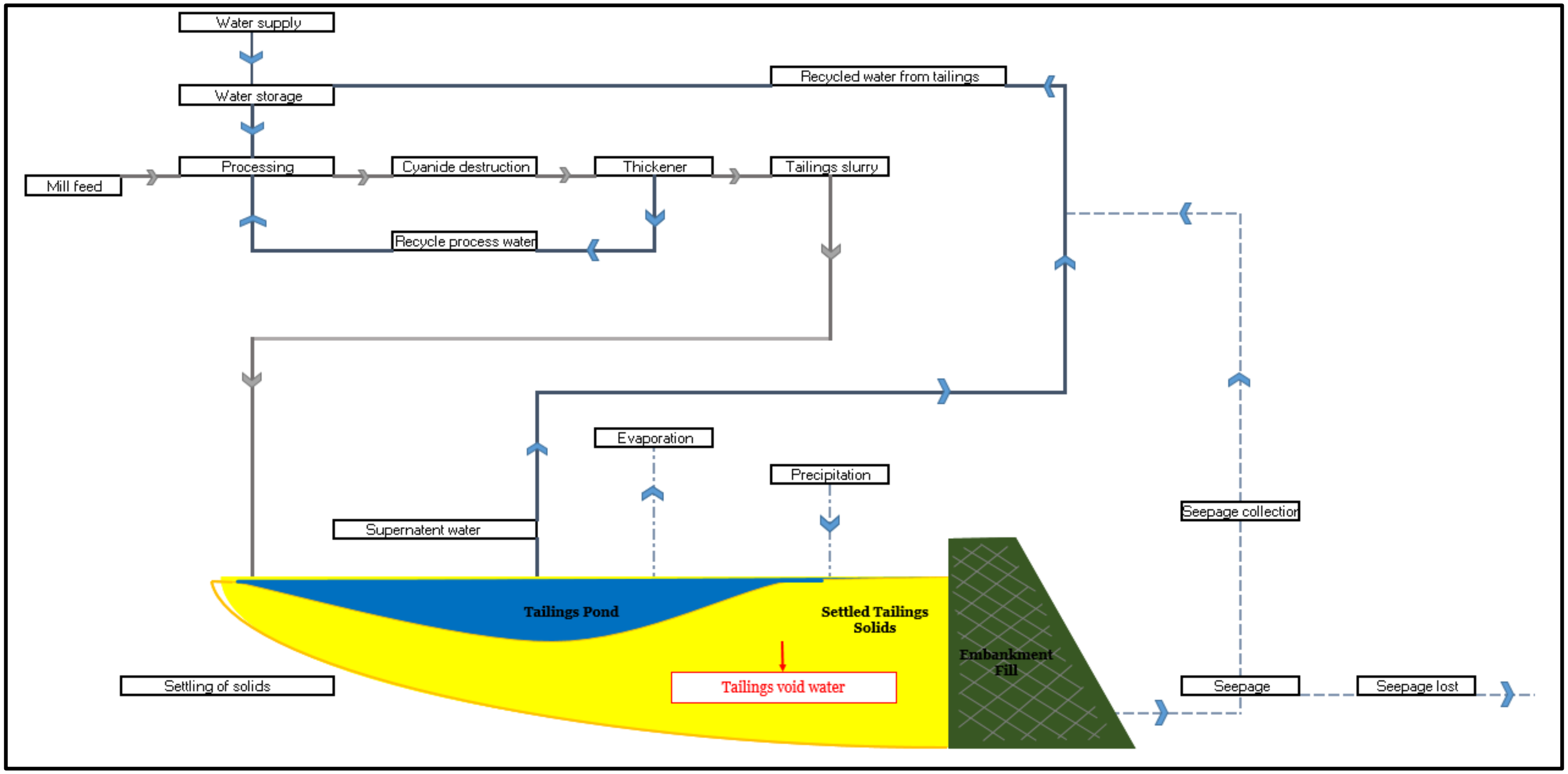
*FRESH WATER*

Fresh water will be supplied from boreholes (water wells). The fresh water will be pumped to the fresh/fire water tank for distribution to the gland water service circuit, to the reagent preparation section, and to the plant water system as make-up water, as required.

*PROCESS WATER*

The overflow solutions from the CIL feed thickener and the tailings thickener will make up the bulk of the process water with the rest coming from the TCF. This process water will be used for grinding and in other parts of the plant as required. Figure 17.2 shows a schematic of the process water flowsheet. The key features include cyanide destruction prior to thickening, and recycling of process water from the thickener. The thickener underflow will have a solid density of around 60% and will be pumped to the TCF. Water is then recovered from the TCF less losses due to evaporation, unrecoverable water in tailings mass (void water) and unrecoverable seepage. Water is recovered from the tailings both from pumping out of supernatant water and through seepage collection, downstream of the TCF. Additional water will enter the TCF from precipitation. The capacity of the TCF is designed to contain the additional water from precipitation, which will continue to be used through the dry months as process water.

**Figure 17.2 Process Water Flow Sheet**



### 17.2.10 AIR SUPPLY

Air will be required for process use and instrumentation. The main items of equipment required will be:

- air compressors and receiver
- plant and instrument air filter, drier and receiver
- process air blowers.

Two air compressors will supply the required plant and instrument air to the process plant using one common distribution system. The air from the compressors will be fed to an air receiver. For the instrument air, the air from the receiver will be dried and stored in a separate receiver before use.

Two centrifugal air blowers will provide the air required for the CIL circuit and the cyanide detoxification circuit.

# 18.0 PROJECT INFRASTRUCTURE

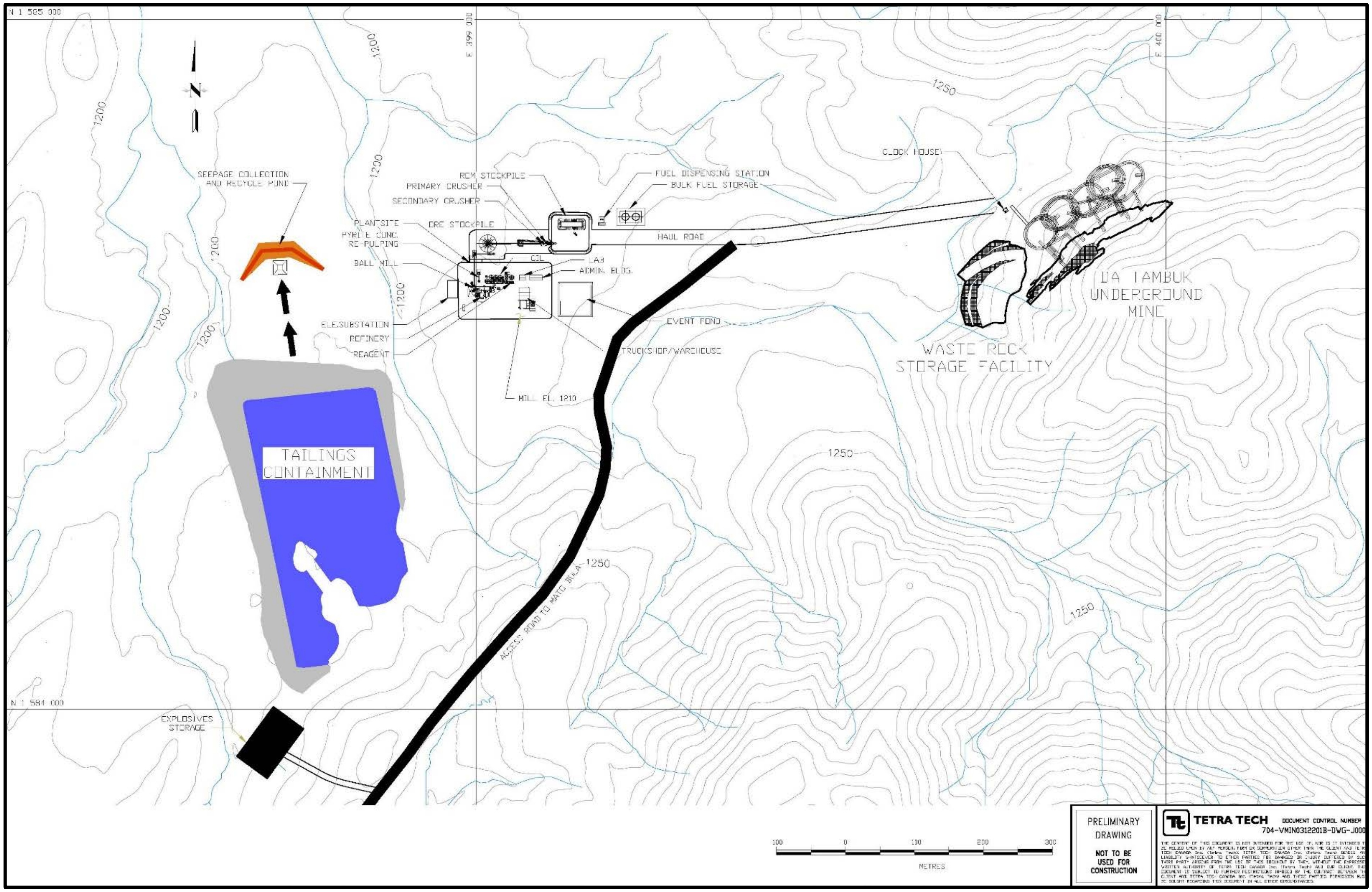
## 18.1 SITE LAYOUT

Tetra Tech completed and prepared preliminary infrastructure layouts and estimated the cost of infrastructure to support the Da Tambuk Project.

The infrastructure required to support the mining and processing operations will include the following:

- mining:
  - equipment laydown areas
  - mobile equipment maintenance facilities
  - fuel storage area
  - explosives storage and magazines
  - temporary waste rock storage facility (WRSF)
- processing:
  - assay and metallurgical laboratories
  - warehouse for supplies, consumables, and spare parts
  - reagent and consumables storage area
  - electrical substation and distribution
  - water management infrastructure
  - TCF
- general:
  - vehicle and mobile equipment maintenance shop
  - warehouse
  - emergency vehicle storage
  - mine site administration office building with emergency first aid room
  - site water purification and distribution system
  - electrical systems
  - fire water system
  - site and internal access roads.

## Figure 18.1 Site Layout for the Da Tambuk Operations



## 18.2 MINING FACILITIES

EAM will provide ancillary facilities to support mining operations. These are further detailed below.

### 18.2.1 EQUIPMENT LAYDOWN AREAS

The equipment laydown area is required for storage of large and/or bulk equipment and supplies used in operations.

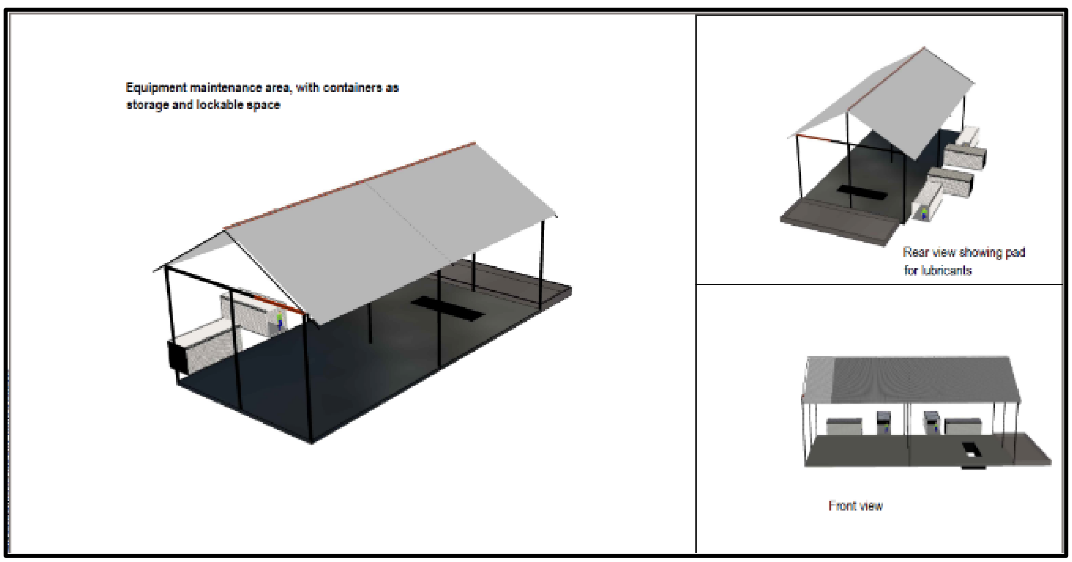
The laydown area may include a shift change parking area for mine mobile equipment. It will include a brake check facility so that, before each shift, a brake check can be performed on the mobile equipment, before descending into the underground workings.

### 18.2.2 EQUIPMENT MAINTENANCE FACILITIES (TRUCK SHOP)

EAM will provide a mobile equipment maintenance facility that is roofed and has a concrete floor. This facility will be used for mobile equipment maintenance and miscellaneous equipment repairs, and will house tools, steel working equipment, and a tire replacement and compressor facility.

The facility will include a lined area for storing lubricants and other fluids used in equipment maintenance. Parts and office supplies will be stored in customized containers, which will be placed at the facility.

**Figure 18.2 Mobile Equipment Maintenance Building (Truck Shop)**



### 18.2.3 FUEL STORAGE AREA

The fuel for mobile equipment will be stored in a tank that will be placed on a curbed (bunded) concrete pad. The curbed concrete pad will be sized to contain 110% of the full volume of the fuel tank. The fuel tank is planned to be located adjacent to the equipment maintenance facility (truck shop) as shown in Figure 18.2.

### 18.2.4 EXPLOSIVES STORAGE AND MAGAZINES

Explosives will be stored in purpose-built structures in a designated area a minimum of 500 m away from any inhabited or active area. The explosive storage will include two areas, namely ammonium nitrate prill storage and magazines for detonators and cartridges.

## 18.3 LUBRICANT STORAGE

Lubricant storage for mining equipment and processing equipment will be stored in a curbed concrete facility, adjacent to the equipment maintenance workshop. The facility may be enclosed with a lean-to structure if deemed necessary.

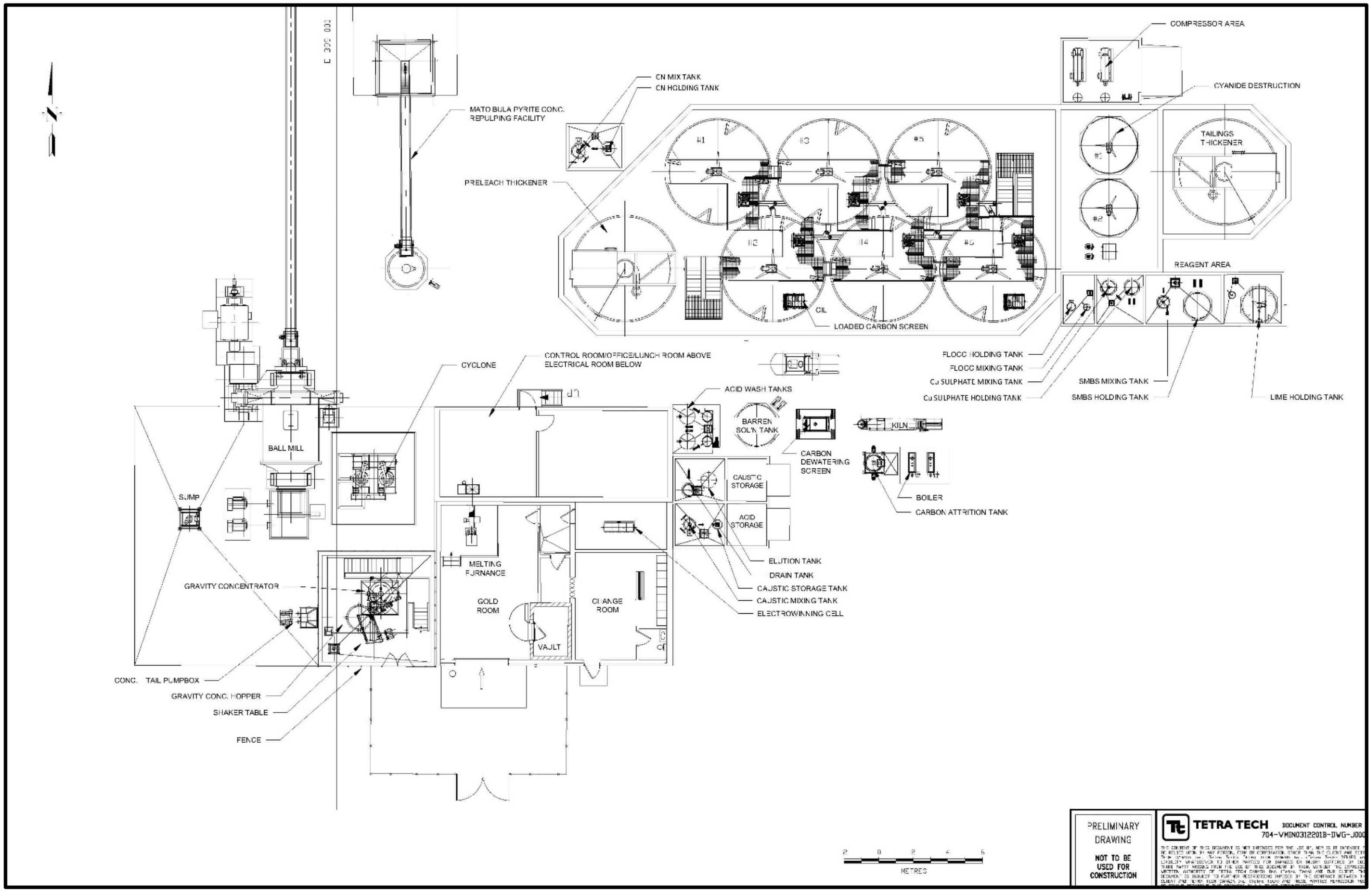
## 18.4 PROCESSING PLANT AND ADMINISTRATION FACILITIES

The processing plant consists of distinct areas as identified below:

- crushing facility
- grinding circuit
- gravity concentration circuit
- carbon in leach circuit
- carbon elution system and recovery
- slurry dewatering and recycle
- cyanide detoxification
- assay and metallurgical laboratories
- reagent storage.
- hazardous waste storage

The processing plant layout is shown in Figure 18.3.

**Figure 18.3 Process Plant Layout Drawing**



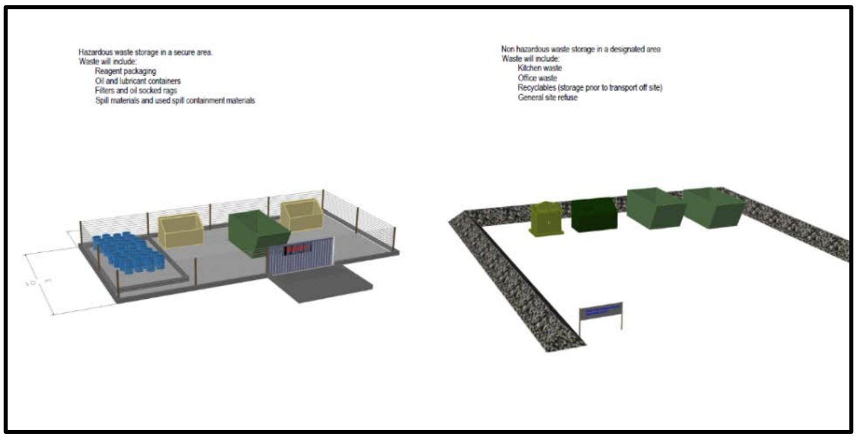
## 18.5 WASTE MANAGEMENT FACILITIES

EAM will maintain strict standards for managing all potential waste originating from the mine site. A dedicated facility will be constructed for managing hazardous wastes. Figure 18.4 shows a conceptual layout of hazardous waste facilities for the mine. An area will be allocated for storing general waste from the mine site, such as:

- kitchen and office waste
- non-hazardous waste from mine site
- building rubble
- recyclable waste.

A dedicated pad will be constructed for hazardous waste, which will be used to store waste that could be hazardous (EAM will put processes in place to eliminate or significantly reduce residual hazardous material from mine site). This will include reagents packaging, old oil containers, general hazardous substances from offices and the mine site.

**Figure 18.4 Waste Management Facilities**




## 18.6 TAILINGS CONTAINMENT FACILITY

The design of the TCF for the Da Tambuk Project considers optimizing tailings containment capacity by using available construction materials, maximizing tailings density, and mitigating potential environmental impact.

The facility was designed based on the following criteria:

- four- year production at up to 200,000 dmt/a.

- total tailings production of 650,000 t with 25% of this being used as backfill within the underground workings
- assumed settled dry density of 1.3 t/m$^3$ slurry tailings density for resulting calculation of approximately 375,000 m$^3$ tailings storage required, including an allowance for operational water management and freeboard requirements
- designed to accommodate the 1-in-100 year 24-hour storm precipitation event
- the geotechnical setting, arid environment, and limited construction materials availability are expected to favour upstream raising construction using tailings
- an underdrainage collection and supernatant water return system will be incorporated into the design
- topsoil in the TCF footprint will be stripped and stockpiled for use at closure.

Figure 18.5 shows the TCF alignment at full capacity. The facility is located approximately 0.4 km south of the plant. The paddock type storage facility is formed by construction of perimeter embankments on three sides of the TCF and keying in to a hillside on the eastern boundary. The starter embankments will be constructed from silty clay borrow material obtained from the construction footprint. The embankments will be constructed on a prepared foundation and include a key trench to intercept shallow seepage.

**Figure 18.5 TCF Alignment**

Tailings will be deposited using sub-aerial deposition techniques from multiple spigot locations around the perimeter embankments. The tailings spigots will be placed to maintain the supernatant water pond around a decant structure positioned towards the eastern end of the facility and away from the perimeter embankments.

The design incorporates equipment for return water within the facility. A pump will be operated within the tailings containment on a floating barge to pump water back to the plant. The water will be stored in a tank near the plant ready for re-use in the process.

Upstream embankment raises will be undertaken using tailings sourced from within the TCF. The tailings will be excavated, moisture conditioned, and roller compacted to form the raised portion of the embankments.

The starter embankments and raised embankments will have design slopes of 3H:1V (horizontal to vertical) downstream and 2.5H:1V upstream slopes. The maximum embankment height at the end of the facility life will be nominally 20 m with average height at approximately 8 m.

An underdrainage system has been incorporated into the design to assist in recovering water from the tailings and to reduce potential horizontal seepage losses. The underdrainage system will be installed in the TCF basin and drain by gravity outfall pipes allowing discharge of underdrainage water to an external sump. The underdrainage lines will consist of slotted pipe surrounded by a filter zone composed of aggregate and sand, wrapped in geotextile and stabilized with select rock. The system will be designed to accommodate the 1-in-100 year 24 hour storm precipitation event.

The monitoring program for the TCF will include seepage monitoring and collection wells as well as scheduled and documented visual inspections by operators and technical specialists, and measurements of groundwater quality.

### 18.6.1 TAILINGS CONTAINMENT FACILITY WATER BALANCE

An initial water balance assessment was completed for the Da Tambuk TCF to assess the excess or shortage of water within the containment facility. The analysis was completed using the end-of-mine geometry of the TCF. The current analysis helps understanding the behaviour of impoundment for various seasons. A detailed GoldSIM model is later required to assess the water balance through the life of mine.

The water balance input to the Da Tambuk TCF includes precipitation and water in tailings slurry.

The water balance losses from the TCF include:

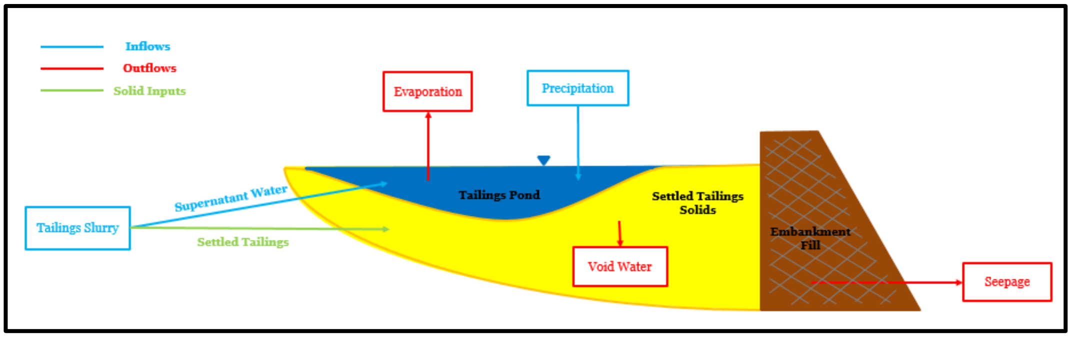
- evaporation
- water in tailings voids
- seepage flows.

The water balance was completed using spreadsheet analysis on a monthly time step. The assumptions and parameters used in the water balance analysis are summarized below:

- The seepage was roughly estimated using a high-level flow analysis and the Darcy formula.
- The mill production used in the analysis was 550 t/d.
- The tailings solids specific gravity was 2.83 t/m$^3$, the density of placed tailings was 1.3 t/m$^3$, and percent solids by weight was 73%.

A general schematic of the water balance processes at the Da Tambuk TCF is illustrated in Figure 18.6.

**Figure 18.6 TCF Water Balance Processes**




The TCF will contain water from precipitation and from the settled tailings slurry. This water will be recycled to the mill and as such less make-up water is required than prior years, when the TCF may not have adequate water all year round, depending on precipitation.

The TCF will be designed with enough capacity to contain the large inflows during the wet season. In order to pass the inflow design flood, a spillway has to be constructed. The magnitude of gains and losses are quite sensitive to the amount of seepage from the TCF, and the pond level can depend on the seepage rate. The seeped water will be recovered back to the mill and could be used for mill water usage.

## 18.7 SITE WATER MANAGEMENT

The key facilities for the water management plan are:

- open pit
- WRMF
- process plant (including fresh and process water tanks)
- TCF
- diversion and water management structures
- fresh water supply
- sediment and erosion control measures for the facilities.

An overall high-level average site water balance assessment was carried out to determine the preliminary water management strategy and process makeup water requirements for the Da Tambuk Project. A detailed GoldSIM modeling will be conducted during the next phase of the Da Tamkbuk Project, to assess the site water balance through the LOM.

### 18.7.1 STORM WATER MANAGEMENT

A rainfall runoff hydrological model was completed for pond and diversion sizing and for assessing the river inundation at each site.

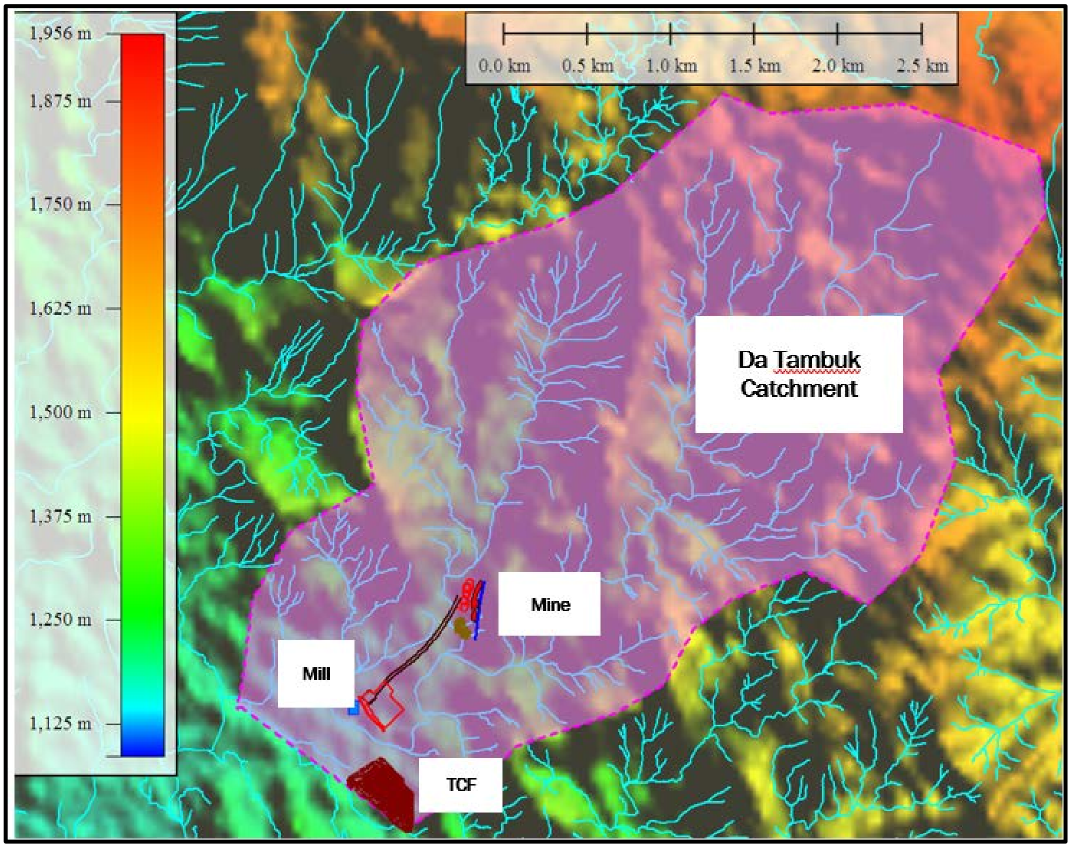
The HEC-HMS model from US Army Corps of Engineers V4.0 was used for the purpose of rainfall runoff modeling. The daily maximum rainfall data for a period between 1997 and 2016 from the Shire station was used for frequency and extreme flow analysis. The methods used to complete the frequency analysis included the GEV methods of moments and the log Pearson type III. Table 18.1summarizes the extreme rainfall depth estimated for various return periods by averaging the values taken from the two mentioned frequency analysis methods.

**Table 18.1 Storm Frequency Analysis**

| Return Period (Year) | Rainfall Depths (mm/day) |
|---|---|
| 2 | 57.3 |
| 3 | 64.1 |
| 5 | 71.9 |
| 10 | 81.9 |
| 20 | 91.7 |
| 50 | 105 |
| 100 | 115 |
| 200 | 125 |

The catchments were delineated using Global Mapper V18 and the river catchment boundary are shown in Figure 18.7.

**Figure 18.7 Catchment Delineation- Flow Pattern**




A summary of physical catchment characteristics for various infrastructures are shown in Table 18.2.

**Table 18.2 Catchment Physical Characteristics**

| Catchment ID | Catchment Area ($km^2$) | Hydraulic Length (m) | Slope (m/m) | Time of Concentration (min) | Lag Time (min) |
|---|---|---|---|---|---|
| Da Tambuk Creek | 11.30 | 6100 | 0.09 | 90 | 54 |
| Da Tambuk Mill Collection Ditch | 0.07 | 315 | 0.05 | 8 | 4.5 |
| Da Tambuk WRD Diversion | 0.05 | 250 | 0.45 | 3 | 2 |

The hydrological data was input into the HEC-HMS model, and the runoff hydrographs were generated. Table 18.3 summarizes the peak flow and volume for the delineated catchments.

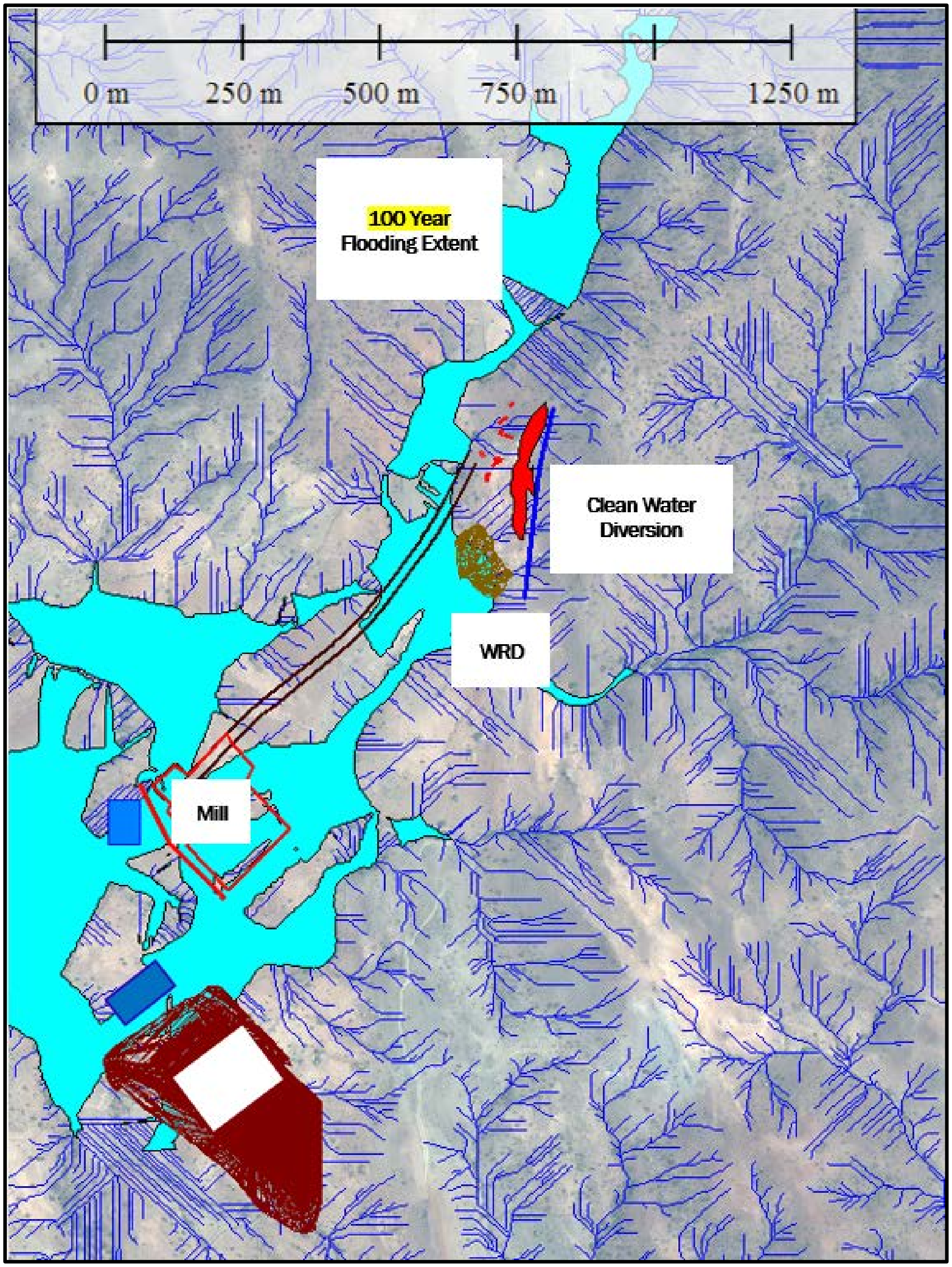
**Table 18.3 Runoff Peak Flow and Volumes**

| Catchment ID | Storm Event (year) | Peak Flow ($m^3/s$) | Flood Volume ('000 $m^3$) |
|---|---|---|---|
| Da Tambuk Creek | 1:100 | 85 | 675 |
| Da Tambuk Mill Collection Ditch | 1:100 | 1.8 | 6 |
| Da Tambuk WRD Diversion | 1:10 | 0.7 | 2.3 |

A hydraulic analysis was completed using HEC-RAS 2D V5.0.3, developed by US Army Corps of Engineers, to assess the inundation extent due to the river flooding. The analysis was completed using topographical survey from the site with contour accuracy of 10 m. The extent of inundation at May Selay Stream is illustrated in Figure 18.8.

The mill and the TCF are located in a relatively flat area where the floodplain widens. As shown in Figure 18.8, the mill and a portion of TCF could be inundated following an extreme flooding event. To mitigate the flood hazard, it is therefore recommended to design and build a diking system surrounding the mill and the TCF area.

**Figure 18.8 Expanded View for Da Tambuk Project Site and the Potential Extent of Flooding adjacent to the Mine Facilities**



### 18.7.2 OVERALL PROCESS MAKE-UP WATER REQUIREMENTS

The overall process make-up water will be a function of rainfall for each year of operation. However, the estimate for make-up water requirements is based on the dry season and a dry year. As such the make-up water requirements are estimated to range between 74,000 $m^3$ for a dry year and 50,000 $m^3$ for the years with average rainfall. Dry months will require as much as 6,200 $m^3$, while average monthly consumption will be 2,000 $m^3$ per month. Water will be recovered from groundwater seepage into the underground mine, which will be used for process water.

## 18.8 EARTHWORKS

For various infrastructure aspects of the project, either cut or fill is required to form level working areas for building sites and vehicle traffic. Cut-and-fill slopes are designed with 3 to 1 slopes (20° from horizontal) where excavations or pads need to be created for the different infrastructure around the mine site. Fill material will be sourced from pre-stripping of the open pit or borrow sites, based on a suitability assessment at the time of construction.

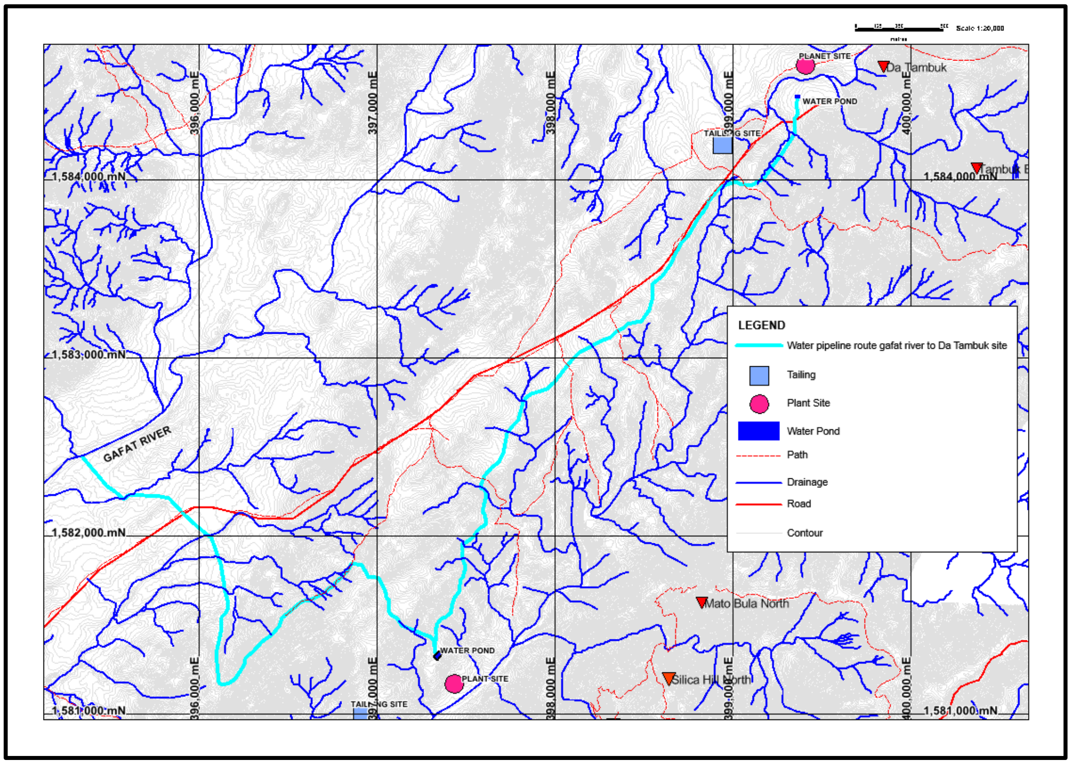
## 18.9 WATER SUPPLY

Water supply for Da Tambuk will be sourced from either wells or from the nearby Gafat River. Preliminary work has been completed by EAM to determine the potential alignment of a water supply pipeline to provide water for Da Tambuk, as well as the wholly-owned Mato Bula Project, to the south of Da Tambuk.

In addition, contact water collected at the mine site, including underground dewatering, tailings water and process site run-off will be reused and recirculated through the processing facility.

Figure 18.9 shows the potential alignment of the pipeline to source water from the Gafat River.

**Figure 18.9 Water Supply to the Da Tambuk Project Site**




## 18.10 POWER SUPPLY AND DISTRIBUTION

Power for the Da Tambuk Project will be sourced from the Ethiopian National Grid. EAM, through TRI, would request a connection point roughly 1.5 km south of Adi Dairo from the Ethiopian Electricity Authority. From this point, a line would be constructed 6.5 km towards the South West to the mine site. The following infrastructure would be required for power supply to the mine:

- a tap point near Adi Dairo
- 7.5 km, 34 kV line from the tap point to the mine site
- substation at mine site including:
  - mine site disconnects
  - three-phase stepdown transformer from 34 kV to 380 V mine voltage
  - main switch gear and metering equipment
  - grounding protection
- mine site power distribution cabling.

## 18.11 SECURITY

EAM will provide security services for the mine site project facilities, personnel, and key activities. EAM would contract to an experienced and highly respected Ethiopian-based security service.

## 18.12 STAFF ACCOMMODATIONS AND TRANSPORTATION

EAM project employees will live in the nearby towns and villages, and the company will provide daily bus transportation to the site. A cafeteria will be constructed to provide an eating area and hot meal service for employees along with a small camp for temporary accommodation of expatriate employees and visitors.

## 18.13 EMERGENCY AND FIRE RESPONSE

EAM will provide emergency response capabilities are provided at the mine site. This will include the following key tasks:

- emergency first aid training for dedicated site safety personnel
- fire response training for dedicated safety personnel
- completing an emergency response plan, including incident training for potential site incidents
- hazardous materials safe handling
- provision of equipment to support first aid, safety, fire control and other emergency response procedures.

Site firefighting equipment will include alarm system, a diesel fire water pump and site firewater distribution system including fire hoses and portable fire extinguishers. Water storage for the mine site operations will include a water reserve for firefighting that is not accessible for operations.

## 18.14 ADMINISTRATION FACILITY

EAM will provide a site administration building. The administration building will include the following:

- reception and meeting room
- offices, workstations and data storage areas
- training room with audio/visual equipment
- kitchen and dining areas
- toilets and change rooms

- parking area
- rooms for overnight stays (used for expats staff, staff on standby and visitors)
- additional tented accommodation for temporary employees
- potable water treatment

## 18.15 OFF-SITE INFRASTRUCTURE

A power line and substation will be installed to connect the project site to the grid approximately 6.5 km northeast of the Da Tambuk Project site.

EAM will maintain minimal offsite infrastructure, including an office and company guest house in Shire.

### 18.15.1 ROADS

For the Da Tambuk operations, a road is proposed to be constructed to access the existing Zelazle road to the south of the project site. This road would require approximately 19 km of upgrade to an existing track. A number of river crossings are also required.

This road would be constructed to a width required for highway trucks.

### 18.15.2 ROAD MAINTENANCE AND UPGRADE

Access maintenance was required before starting the drilling programs each year, as summer heavy rainfall and fast flowing water washed away parts of the road and filled the creeks with mud and rocks (Figure 18.10). Road maintenance was conducted for permanent solutions to the erosion and mud build-up along the Adyabo access routes. The work involved:

- Tracing (contouring the land to slow down water flow speed),
- Building road pads (over muddy areas).
- Channelling (divert the direction of the water away from the road). and
- Building drains (when water has to be diverted under the road).

**Figure 18.10 Road Maintenance along the road to the Da Tambuk Deposit**

| | |
|---|---|
|  *Picture shows muddy creek difficult for driving (before)* |  *Picture shows foundation and filling stones to construct the pad (during construction)* |
|  *Cement concrete pad over the muddy creeks* |  *Picture shows strong flash water gorge needs to maintain with systematic drainage* |

# 19.0 MARKET STUDIES AND CONTRACTS

## 19.1 MARKETING

The Da Tambuk operations will produce a gold and silver doré. The doré will be transported off-site for refining. The feasibility study includes provision for freight and insurance costs, refining costs, and a deduction from the value of the precious metals made by the refinery. Table 19.1 shows the deductions and charges applied to the payable metal value.

**Table 19.1 Marketing Costs and Parameters applied to Da Tambuk**

| Marketing | Unit | Value |
|---|---|---|
| Freight, Refining, and Insurance Costs for Gold | US$/tr oz | $7.00 |
| Freight, Refining, and Insurance Costs for Silver | US$/tr oz | $0.70 |
| Gold Payable by Refinery | % | 99.5 |
| Silver Payable by Refinery | % | 95 |
| Ethiopian Government Royalty for Gold | % | 7% of value of payable gold |
| Ethiopian Government Royalty for Silver | % | 7% of value of payable silver |

## 19.2 MARKETING

EAM will employ standard gold mining industry practice to sell the gold and silver produced to local and/or international gold and silver buyers.

# 20.0 ENVIRONMENTAL STUDIES, PERMITTING AND SOCIAL OR COMMUNITY IMPACT

## 20.1 KEY FINDINGS OF THE ESIA

Most of the proposed project area has no farm land due to the steep, mountainous topography. There exists some farmland and a few houses in the southern and northern ends of the Da Tambuk Project area. Many of the houses are temporary and constructed for artisanal miners. The land is covered with patchy grassland with bushes, and there is no thick woodland or forests in the Da Tambuk Project area.

The proposed mine development will require change in land use and land cover in the immediate area of the mine and will require relocating inhabitants from the immediate project area. The most important social issue is relocating and compensating the local inhabitants directly affected by the proposed project development.

The assessments indicate that there are no endangered, endemic or rare species in the project area.

The source of water for the mining operations will be either from boreholes and/or surface water sources. This may include the Gafat River located approximately 7 km from the Da Tambuk Project site. Importantly, the study concludes that the Da Tambuk Project consumption of water is relatively low relative to the supply and therefore will not negatively impact the water available for local inhabitants.

There are no cultural heritage sites or archeologically or socially sensitive areas within the mining area.

Overall, most of the community stated that they are in favour of implementing the Da Tambuk Project, on the basis that proper compensation for land use will be made, basic public services will be improved, and project development will result in creating better livelihood and services to the local community.

Based on the findings of the ESIA, the independent consultant concluded that it is possible to mitigate all probable environmental impacts from the proposed project. The consultant further recommends issues related to compensation for land access and relocation of those inhabitants directly affected by the project be negotiated and agreed before project development. Such negotiations should include the relevant governmental authorities and result in a mutually agreed Resettlement Action Plan.

The ESIA demonstrates that the benefits of the project are very important and the adverse impacts identified can be satisfactorily mitigated through implementing the proposed management and monitoring plan included in the ESIA. Therefore, the independent consultant recommends implementing the Da Tambuk Project with strict observation and compliance to the environmental and monitoring plans.

## 20.2 LOCATION, ENVIRONMENTAL AND PHYSICAL SETTING

The Da Tambuk Project area is located in the Tigray National Regional State approximately 600 km north-northwest of the capital city Addis Ababa. The Tigray region is characterized by a temperate to hot climate and has both dry and wet seasons. The wet season extends from mid-June to mid-September with average rainfall of 800 to 1,000 mm/a, with high intensity rainfall events. Mean daily temperatures range from a high of 32.5°C in March to a minimum of 13°C in January.

The Da Tambuk Project area is located in an area of varying relief ranging from 1,120 to 1,550 masl. Mountain slopes are generally steep and valleys range from very wide gently undulating to very narrow. Rivers in the area mainly drain south and southwest wards ultimately towards the Tekeze River approximately 75 km south of the Da Tambuk Project area. All of the streams in the region are seasonal. There are few perennial rivers including Gafat River which is considered as the most viable source for the water supply to the Da Tambuk Project.

Most of the region is devoid of vegetation, particularly during the dry season, with small areas of shrub brush and trees most commonly located along rivers and their tributaries or ephemeral drainage.

The closest protected areas to the project are the Shire Wildlife Reserve and the Simien Mountains National Park. The Shire Wildlife Reserve, covering an area of 75,300 ha, is located approximately 55 km south of the project area. The Simien Mountains National Park covers an area of 17,900 ha and is located approximately 110 km to the southeast.

## 20.3 ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT PROGRAMME

EAM, through TRI, engaged Beles in July 2017 to undertake an ESIA for the Adyabo area, which contains the Da Tambuk Project and the nearby Mato Bula Project. Beles completed the ESIA in November 2017. Subsequently, in November 2017 the ESIA Study Report was submitted to the MoMPNG in support of mining licence applications for both the Da Tambuk and Mato Bula projects.

Beles is a qualified Ethiopian environmental and social consultancy based in Addis Ababa. Beles has strong national and international links with companies working in water, land and environment. Beles has a Grade I licence from the Ministry of Environment, Forest and Climate Change to conduct ESIA study in any development projects.

This ESIA study was carried out as per the requirements prescribed under the Ethiopian Environmental Impact Assessment (EIA) Proclamation (No. 299/2002) in order to proceed to mining activities. The scale of the project is rated as Schedule I which requires a full-fledged ESIA study. The ESIA report was prepared taking into account the guidelines of the FDRE Environmental Protection Authority and the current Ministry of Environment Forest and Climate Change and the World Bank Operative Directive (OD)4.01. In addition, the World Bank Environmental Assessment requirements are based on a three part classification system with Category A, Category B, and Category C. A project designated as Category A requires a full environmental assessment followed by Independent Environmental Review, Category B requires a lesser level of environmental investigations, and Category C requires no environmental analysis beyond that determination. The Da Tambuk project falls under Category A.

The ESIA describes the baseline environmental and social conditions in the project area, presents an assessment of potential impacts associated with the project, and proposes mitigation and management measures to minimize potential impacts. The report in its entirety is submitted independently along with this PEA report.

## 20.4 BASELINE INVESTIGATION METHODS

Site visits were made to collect data and update baseline information of the project area. Observations were made on biophysical and socio-economic environment of the project area. Photographic images that depict key environmental features were taken, and GIS was used for spatial analysis. Samples of water were collected and analysed. In situ measurements for water quality and noise levels were made. Soil samples were also described based on visual observations.

During the field visits, consultations were held with local community, community leaders and key informants in the affected area. Opinions and attitudes of Project Affected Persons (PAPs) were assessed through questionnaires, focused group discussions and public meetings at community level. in addition, consultations with officials at Kebele, woreda, zone and region levels were made. The environmental and social impacts of the project were identified by considering all proposed activities during the mobilization, construction, operation and decommissioning phases and the concerns and issues raised by stakeholders. The interactions (impact) of each activity with the environmental and socio-economic receptors were assessed using a matrix.

## 20.5 SOCIO-ECONOMIC CONDITIONS

The ESIA study indicated that most people living in the project area belong to the Tigre ethnic group. The large majority of residents are Orthodox Christians with few Muslims. Tigrigna is the working language of the Woreda that is spoken by the majority of the residents, however; other languages such as Amharic are spoken by a few residents of the Woreda. Agriculture forms the basis of livelihood of a large part of the inhabitants of the Kebele, with artisanal mining also practiced in the project area.

There are 50 schools in the Woreda: 47 primary schools, two secondary schools, and one preparatory school. The number of females continuing their education at the high school and preparatory level far exceeds the number of male students due to the fact that most male students prefer to begin working as miners rather than continue their education. Literacy in the region is still considered low, as 56.7% of study respondents are not able to read or write.

## 20.6 FLORA

The study area characterized by scattered vegetation (wood land species) dominated by Acacia spp. and considerable vegetated land with shrubs dominated by *Dodonaea Angustifolia*. Less common are woody and herbaceous climbers. The semi mountainous areas of the region are covered by dense shrub vegetation including Tahises (Dodonaea Angustifolia). Woody vegetation exists along major perennial rivers such as the Gafat River. The typical landscape and vegetation cover is shown in Figure 20.1 and Figure 20.2.

**Figure 20.1 Typical Topography and Bush Vegetation Cover**

**Figure 20.2 Typical Topography Showing Dry Stream Bed and Bush Vegetation Cover**

## 20.7 FAUNA

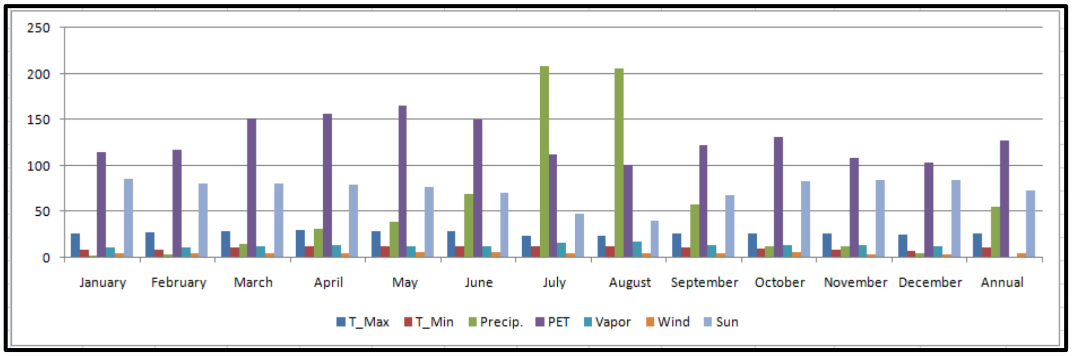
The wildlife information in the project area is obtained through formal and informal discussions with the local communities, elders and experts living in the project area based on their daily experience and historic observation, plus visual observations made by traversing the study area. In addition to visual observations of fauna, evidence of their presence was studied in the form of tracks, nests, burrows, and feathers etc. The baseline study documented thirteen mammals, one amphibian, three reptiles, fifteen bird species and six species of invertebrates. The assessments also indicate that there are no endangered, endemic or rare species in the project area. Some of the species are listed as Least Concern and Vulnerable on the International Union for Conservation of Nature and Natural Resources Red List data.

## 20.8 CLIMATE

The nearest meteorological station for the project site is located at the town of Shire, approximately 33 km from the Da Tambuk Project area. The data shows that the climate is semi-arid. The annual average precipitation and potential evapotranspiration is 55.23 mm and 127.91 mm, respectively. The average annual temperature is 21°C.

The meteorological record shows wide seasonal variations in meteorological parameters. The area receives significant rainfall from June to September, and December to March is the dry season. Major water stress exists in January, February and March. The region has unimodal rainfall pattern. The main groundwater recharge and surface runoff occurs from June to September, the peak rainfall occurs in July. Figure 20.3 shows the seasonal variation of meteorological elements.

**Figure 20.3 Long-term Average Meteorological Data at Shire**




## 20.9 WATER RESOURCES AND GROUNDWATER HYDROLOGY

Due to relatively low rainfall intensity the discharge of the streams is low for most of the year. Many streams are dry during the dry season or have very low discharge. However, in July and August (the wet season) the discharge of the streams and rivers is relatively high due to the high level of precipitation and of the low permeability of the basement rocks which enhances surface runoff.

The only nearest perennial river to the project area is Gafat which is anticipated to be the primary water source for mine operation. Importantly, the study concludes that the Da Tambuk project consumption of water is relatively low relative to the supply and therefore will not negatively impact the water available for local inhabitants.

Conventional hydrogeological investigation has been carried out to understand the hydrogeological conditions. Brief description of the hydrogeology based on the conventional field observations is indicated below.

According to the hydrogeological map of Ethiopia (Mengesha Tefera et al. 1998) the region has low to medium groundwater potential. In general depth to groundwater level is shallow. Deep groundwater resources are unlikely to exist except in proximity to large regional faults. Relatively better productive shallow wells are confined along the course of rivers and close to major faults. The main source of the groundwater recharge is precipitation during the wet season.

### 20.9.1 COMMUNITY WATER SUPPLY

The rural residents in the area gets water from hand dug wells and springs along the course of streams and rivers. More recently, boreholes fitted with hand pumps are being used in some areas, although the wells are not well distributed in the region. Some people travel long distance to fetch water in the highland rugged areas.

## 20.10 PERMITTING

In November 2017 EAM/TRI submitted an application for a mining licence for the Da Tambuk Project to the MOMPNG. As part of the formal application review process, the MOMPNG requested clarification on a number of aspects of the proposed project. EAM/TRI submitted a formal response with the additional information in May 2018. As of the date of this report, the mining licence application is still under review.

# 21.0 CAPITAL AND OPERATING COST ESTIMATES

## 21.1 SUMMARY

The capital and operating costs for the Project were estimated and are summarized in Table 21.1 and Table 21.2.

**Table 21.1 Capital Cost Summary**

| Description | Cost (US$ million) |
|---|---|
| Overall Site | 2.52 |
| Mining (Excluding Development) | 2.79 |
| Process | 10.04 |
| TCF | 1.27 |
| On-site Infrastructure | 1.39 |
| Project Indirect Costs | 6.55 |
| Owner's Costs | 3.00 |
| Contingencies | 6.46 |
| **Total Initial Capital Cost** | **34.02** |

**Table 21.2 Operating Cost Summary**

| Description | Unit Cost (US$/t processed) |
|---|---|
| Mining | 31.02 |
| Process and TCF | 21.78 |
| G&A and Site Services | 9.05 |
| Total Operating Cost | 61.85 |

All costs are reflected in Q1 2018 US Dollars unless otherwise specified. The expected accuracy range of the cost estimates is -20% to +35%. When required, costs in this report have been converted using currency exchange rates of US$1:Ethiopian Birr (ETB) 23.

## 21.2 CAPITAL COST ESTIMATE

Tetra Tech developed and prepared the capital cost estimate for the Da Tambuk Project based on preliminary design work, vendor budgetary estimates and quotes, Tetra Tech's cost database and industry cost publications.

Tetra Tech established the capital cost estimate using a hierarchical work breakdown structure (WBS). The accuracy range of the estimate is -20% to +35%. The base currency of the estimate is US dollars. A blended labour rate of US$8.00/h was used throughout the estimate.

The total estimated initial capital cost for the design, construction, installation, and commissioning of the Project is US$42 million. This total includes all direct costs, indirect costs, Owner's costs, and contingencies. A summary breakdown of the initial capital cost is provided in Table 21.3.

**Table 21.3 Capital Cost Summary**

| Description | Cost (US$ million) |
|---|---|
| Overall Site | 2.52 |
| Mining | 2.79 |
| Process | 10.04 |
| TCF | 1.27 |
| On-site Infrastructure | 1.39 |
| Project Indirect Costs | 6.55 |
| Owner's Costs | 3.00 |
| Contingencies | 6.46 |
| **Total Initial Capital Cost** | **34.02** |

### 21.2.1 ESTIMATE BASE DATE AND VALIDITY PERIOD

This estimate was prepared with a base date of Q4 2017/Q1 2018 and does not include any escalation beyond this date. Where applicable, the budgetary quotations used for this estimate were obtained in Q4 2017/Q1 2018 and typically have a validity period of 90 calendar days or less.

### 21.2.2 MINING CAPITAL COST ESTIMATE

The capital cost for mining is based on purchase of mining equipment and on underground mine development. A total of US$2.79 million was estimated for initial mining equipment purchasing and mine development.

Sustaining capital of US$7.93 million was included for ongoing mine development and additional mining equipment purchases.

Life of mine development costs have been estimated at $6.59 million, or roughly $2,200/m of underground development.

### 21.2.3 PROCESSING CAPITAL COST ESTIMATE

A total of US$10.04 million was estimated for procurement, shipping, installation and commissioning of all process equipment. The cost includes crushing, agglomeration, Merrill Crowe circuit, leaching, reagent systems and the assay laboratory.

All process equipment and material costs are included as free carrier (FCA) or free board marine (FOB) manufacturer plants and are exclusive of spare parts, taxes, duties, freight, and packaging. These costs, if appropriate, are covered in the indirect cost section of the estimate.

### 21.2.4 OVERALL SITE INFRASTRUCTURE CAPITAL COST ESTIMATE

A total of US$5.18 million was estimated for site preparation, earthworks, foundations, procurement, shipping, installation and commissioning for the overall site infrastructure, including tailings management facilities, seepage ponds and their pipe work and liner systems. The cost includes administration building, truck shop, explosive storage, laydown area, water supply, sewage, on-site roads and the plant mobile fleet.

### 21.2.5 PROJECT INDIRECT COSTS

The estimated project indirect costs of US$6.55 million include construction indirects, spare parts, and freight and logistics, are calculated on a percentage basis based on Tetra Tech's work experience. Allowances for initial fills are provided for grinding media, reagents, lubricants and fuel. Engineering, procurement and construction management (EPCM) allowance is calculated on a percentage basis based on Tetra Tech in-house experience. Commissioning and start-up, and vendor assistance allowances are calculated based on the number of engineers required on site, estimated duration, and the average man-hour rates.

### 21.2.6 OWNER'S COSTS AND CONTINGENCIES

The US$3.0 million Owner's costs were provided by EAM. The estimated contingencies, totalling US$6.46 million, are allowances for undefined items of work which is incurred within the defined scope of work covered by the estimate. Each discipline was allocated different contingency factors due to the varied risk level. The average contingency for the Da Tambuk Project is 36 % of the total direct costs.

### 21.2.7 EXCLUSIONS

The following items are excluded from the capital cost estimate:

- working capital (included in the financial model)
- financing costs

- refundable taxes and duties
- land acquisition
- currency fluctuations
- lost time due to severe weather conditions
- lost time due to force majeure
- additional costs for accelerated or decelerated deliveries of equipment, materials, or services resultant from a change in project schedule
- warehouse inventories, other than those supplied in initial fills
- any project sunk costs (studies, exploration programs, etc.)
- mine reclamation costs (included in financial model)
- mine closure costs (included in financial model)
- escalation costs
- community relations.

### 21.2.8 SALVAGE

Since the mine life is shorter than other comparable projects and typical equipment life, it is expected that most of the process equipment will be salvageable by the end of four-year LOM.

### 21.2.9 SUSTAINING CAPITAL COST ESTIMATE

The sustaining capital cost during LOM is US$7.93 million. This includes sustaining capital for mining equipment of US$6.59 million and underground mine development of $1.34 million.

## 21.3 OPERATING COSTS

### 21.3.1 OPERATING COSTS SUMMARY

On, average, the LOM on-site operating costs for the Project were estimated to be US$61.85/t of material processed. The operating costs are defined as the direct operating costs including mining, processing, site servicing, and G&A costs. Table 21.4 shows the cost breakdown for various areas.

**Table 21.4 Operating Cost Summary**

| Description | Unit Cost (US$/t processed) |
|---|---|
| Mining | 31.02 |
| Process and TCF | 21.78 |
| G&A and Site Services | 9.05 |
| Total Operating Cost | 61.85 |

The cost estimates in this section are based on information from Tetra Tech's in-house database, published information from the industry or experience in similar projects. The expected accuracy range of the operating cost estimate is -20% to +35%. All the costs have been estimated in US dollars, unless otherwise specified.

It is assumed that operation personnel will reside in towns or villages nearby, excluding the management and senior technical team. There will be no accommodation or catering services to be provided at the site. Personnel would commute to the site by company bus for which costs are included in the operating costs. Labour costs include provision for the following burden costs (approximately 50% of the base payment):

- annual leave
- sick leave (as per labour proclamation of the country)
- accident and illness insurance
- social security provisions
- vacation allowance
- travel costs and airfares for expatriates.

The operating costs exclude shipping and marketing charges for gold and silver doré, which are included in financial analysis.

### 21.3.2 Mining Operating Costs

The estimated mining costs were modelled based on the mining schedule. Mining is considered as owner mining. The costs presented in Table 21.5 and Figure 21.1 include the following items:

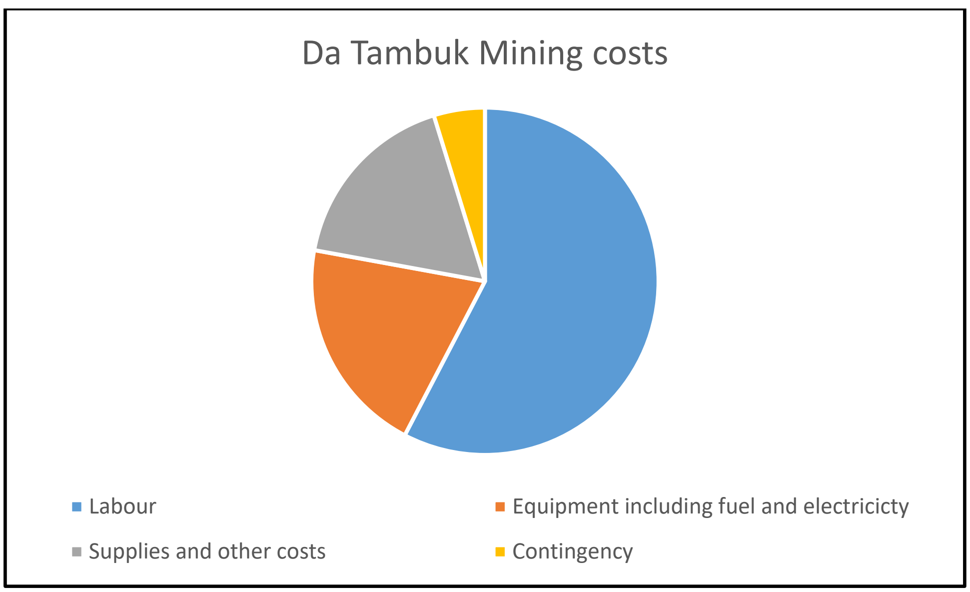
- mining engineering, planning, management, and administration, including some skilled staff assumed to be expatriate workers
- mining equipment operating costs, including maintenance, fuel, and power (electricity)
- support equipment operating costs
- mining crews for development and stoping

- equipment maintenance and support labour
- mining labour costs included vary from US$2.37 to US$27 per hour (excluding burden costs) for underground workers and supervisors
- supplied needed for underground mining, such as ventilation tubing, water pipes, rock support, communication cable, power cable, and safety supplies.
- contingency of 5%.

**Table 21.5 Da Tambuk Mining Costs**

| Underground Mining Costs | LOM Cost (US$) | Unit Cost (US$/t) |
|---|---|---|
| Development Labour | 2,813,000 | 4.33 |
| Development Equipment | 874,000 | 1.34 |
| Development Supplies | 2,451,000 | 3.77 |
| Vertical Development | 138,000 | 0.21 |
| Total Development Costs | 6,276,000 | 9.65 |
| Stoping Labour | 7,563,000 | 11.63 |
| Stoping Equipment | 3,171,000 | 4.88 |
| Stoping Supplies | 2,186,000 | 3.36 |
| Total Stoping Costs | 12,920,000 | 19.86 |
| Support Labour | 5,474,000 | 8.42 |
| Support Equipment | 1,517,000 | 2.33 |
| Other Expenses | 1,310,000 | 2.01 |
| Total Mining Costs Including Capitalized Costs | 27,497,000 | 42.27 |
| Mining Operating Costs | 20,174,000 | 31.02 |

**Figure 21.1 Breakdown of Mining Costs by Category**



### 21.3.3 PROCESS OPERATING COSTS

Estimated processing costs consist of reagent purchases, labour, power, maintenance, and laboratory expenses. Process management is included in general and administrative costs. The average LOM unit process operating cost was estimated at US$21.78/t processed, at a nominal processing rate of 550 t/d, or approximately 200,000 t/a, including the power cost for the processing plant.

The breakdown for the estimated process operating cost is summarized in Table 21.6.

**Table 21.6 Da Tambuk Operating Costs**

| Description | Manpower | Annual Cost (US$) | Unit Cost (US$/t CIL feed) |
|---|---|---|---|
| **Manpower** | | | |
| Operating Labour | 97 | 1,006,000 | 5.01 |
| **Subtotal Manpower** | **97** | **1,006,000** | **5.01** |
| **Supplies** | | | |
| Reagent Consumables | - | 2,029,000 | 10.11 |
| Maintenance Supplies | - | 607,000 | 3.02 |
| Operating Supplies | - | 36,000 | 0.18 |
| Power Supply | - | 436,000 | 2.17 |
| **Subtotal Supplies** | **-** | **3,108,000** | **15.48** |
| **Others** | | | |
| Plant G&A | - | 50,000 | 0.25 |
| Others | - | 208,000 | 1.04 |
| **Subtotal Others** | **-** | **258,000** | **1.29** |
| **Total** | **97** | **4,372,000** | **21.78** |

The process operating cost estimate includes:

- personnel requirements including supervision, technical supports, operation and maintenance; and salary/wage levels, including burdens as listed in Section 21.3.1
- steel grinding ball consumptions and jaw crusher and cone crusher liner consumptions estimated by the similar projects or Tetra Tech's experience; steel prices from Tetra Tech's database
- reagent consumptions, based on test results and reagent prices from quotations or the Tetra Tech's database, the main reagents including lime, sodium cyanide, SMBS, copper sulfate, hydrochloric acid, sodium hydroxide, granular activated carbon, flux, flocculant and anti-scalant
- maintenance supplies, based on approximately 8 to 10% of major equipment capital costs or estimated based on the information from the Tetra Tech's database/experience;

- other operation consumables, including laboratory and service vehicles consumables;
- power consumption for the processing plant based on the preliminary plant equipment load estimates and a power unit cost of US$0.07/kWh
- plant G&A costs.

All operating cost estimates exclude taxes unless otherwise specified. The cost estimates also do not include the shipping cost and refining cost for the doré. These costs are included in financial analysis.

### 21.3.4 General and Administrative Operating Costs

Table 21.6 summarizes estimated general and administrative costs over LOM.

**Table 21.7 General and Administrative Costs for Da Tambuk**

| Item | LOM Cost (US$000) | Unit Cost (US$/t processed) |
|---|---|---|
| Management, Administration and Security Salaries | 2,789 | 4.29 |
| Maintenance and Supplies | 158 | 0.24 |
| Insurance | 450 | 0.69 |
| Power Demand Charges | 180 | 0.28 |
| Accounting Services | 75 | 0.12 |
| Communications and IT | 383 | 0.59 |
| Consulting Services | 345 | 0.53 |
| Government Fees and Permit Expenses | 53 | 0.08 |
| Expat Travel and Accommodation | 945 | 1.45 |
| Community Development Fund | 231 | 0.35 |
| Contingency | 280 | 0.43 |
| **Total G&A Expenses** | **5,888** | **9.05** |

### 21.3.5 Other costs

Other costs included in the financial model for Da Tambuk, include $800k for reclamation, $2.35 million for government mandated community and social expenses and $451k for head office expenses allocated to the project.

# 22.0 ECONOMIC ANALYSIS

**A PEA should not be considered a Prefeasibility or Feasibility study, as the economics and technical viability of the Project have not been demonstrated at this time. The PEA is preliminary in nature and includes Inferred Mineral Resources that are considered too speculative geologically to have the economic considerations applied to them that would enable them to be categorized as Mineral Reserves. Furthermore, there is no certainty that the conclusions or results reported in the PEA will be realized. Mineral Resources that are not Mineral Reserves do not have demonstrated economic viability.**

Tetra Tech completed a pre-tax preliminary economic analysis based on estimated costs and revenues for mining and processing the Da Tambuk gold deposit.

The economic analysis was conducted in US dollars.

The economic analysis concluded the following financial results:

- pre-tax NPV of US$20.67 million, at an 8% discount rate
- pre-tax IRR of 37.8%
- pre-tax payback period of 1.3 years.

Tetra Tech was assisted by EAM to prepare a tax model for the LOM of the Da Tambuk Project, which produced the following financial results:

- post-tax cash flow of US$20.6 million
- income tax payable of US$8.3 million over the LOM
- government participation deductions of US$1.2 million over the LOM
- post-tax NPV of US$13.0 million at an 8% discount rate
- post-tax IRR of 28.6%
- post-tax payback period of 1.9 years
- all-in sustaining cash costs of US$642/tr oz of gold produced (net of by-product credits)

The key financial results are shown in Table 22.1.

**Table 22.1 Summary of Financial Results**

| | Units | Value |
|---|---|---|
| **Mine Information** | | |
| LOM | years | 4 |
| Tonnes of Ore Processed | kt | 650 |
| Gold Recovered | '000 tr oz | 95 |
| Silver Recovered | '000 tr oz | 22.5 |
| **Sales** | | |
| Off-site Costs | US$ millions | 0.7 |
| Net Revenue from Sales | US$ millions | 124 |
| **LOM Operating Costs** | | |
| Mining | US$ millions | 20.2 |
| Processing | US$ millions | 14.2 |
| G&A | US$ millions | 5.89 |
| Total LOM Operating costs | US$ millions | 40.2 |
| **Other Costs** | | |
| Reclamation Costs | US$ millions | 0.8 |
| Gov. Mandated Community and Social Expenses | US$ millions | 2.35 |
| Ethiopia Head Office Expenses | US$ millions | 0.23 |
| Ethiopian Government Royalty | US$ millions | 8.74 |
| Taxes | US$ millions | 8.50 |
| **Capital Costs** | | |
| Initial capital costs | US$ millions | 34.0 |
| Life of mine sustaining costs | US$ millions | 8 |
| **Cash Flow** | | |
| Post-tax Cash Flow | US$ millions | 20.6 |
| Post-tax NPV at 8% | US$ millions | 13.0 |
| Post-tax IRR | % | 28.6 |
| Post tax Payback period | Years | 1.9 |

## 22.1 ECONOMIC ANALYSIS ASSUMPTIONS

For the purpose of the PEA, the following assumptions were applied to financial modelling:

- base case gold price of US$1,32/tr oz
- production rate of 550 t/d
- gold recovery of 95% and a silver recovery of 50%
- pre-production capital costs of US$34 million and sustaining capital costs of US$8 million
- average operating costs of US$62/t processed

- Ethiopian government net sales royalty of 7%
- reclamation costs of US$0.8 million
- pre-production operating losses of US$1.2 million
- pre-stripping cost of US$1.92 million
- government mandated social and community responsibility expenses of US$2.35 million over the LOM (2% of revenue)
- portion of in-country G&A expenses of US$451,000 over the LOM
- working capital of US$2.25 million recovered over the LOM.

## 22.2 BASIS OF FINANCIAL EVALUATIONS

The production schedule has been incorporated into the 100% equity pre-tax financial model to develop monthly recovered metal production from the relationships of tonnes processed, head grades, and recoveries. Gold and silver payable values were calculated based on base case metal prices. Net invoice value was calculated each year by subtracting the applicable refining charges from the payable metal value. At-mine revenues are then estimated by subtracting transportation and insurance costs. Government royalties were deducted from net revenues from sales of doré.

Operating costs were then deducted from the remaining revenue to derive operating cash flow. Allowable capital cost depreciation, sustaining costs and other cash expenses were then deducted from operating cash flow to derive taxable income.

Capital costs were deducted in the year of expense, with non-cash costs (depreciation added back) to get pre-tax cash flow.

Taxes were calculated based on allowable deductions, and then deducted from pre-tax cash flow to derive post-tax cash flows.

## 22.3 SUMMARY OF FINANCIAL RESULTS

A summary of key financial results is shown in Table 22.2. Various gold prices were applied to evaluate project sensitivities.

**Table 22.2 Summary of Da Tambuk Financial Results**

| | Gold Price (US$/tr oz) | | | | |
|---|---|---|---|---|---|
| | $1,325 | $1,200 | $1,250 | $1,379 | Unit |
| **Production** | | | | | |
| Tonnes Processed | 650,415 | 650,415 | 650,415 | 650,415 | t |
| Gold Ounces Mined | 102,018 | 102,018 | 102,018 | 102,018 | tr oz |
| Silver Ounces Mined | 47,398 | 47,398 | 47,398 | 47,398 | tr oz |
| Gold Ounces Recovered | 94,877 | 94,877 | 94,877 | 94,877 | tr oz |
| Silver Ounces Recovered | 23,699 | 23,699 | 23,699 | 23,699 | tr oz |
| **Revenue** | | | | | |
| Net Revenue from Gold | 124,419 | 112,619 | 117,339 | 129,517 | $000 |
| Net Revenue from Silver | 366 | 366 | 366 | 366 | $000 |
| Total Project Revenue | 124,786 | 112,985 | 117,705 | 129,883 | $000 |
| Precious Metals Royalty (7%) | 8,735 | 7,909 | 8,239 | 9,092 | $000 |
| **Operating Costs** | | | | | |
| Mining Costs | 20,175 | 20,175 | 20,175 | 20,175 | $000 |
| Process Costs | 14,166 | 14,166 | 14,166 | 14,166 | $000 |
| G&A Costs | 5,888 | 5,888 | 5,888 | 5,888 | $000 |
| Total Operating Costs | 40,228 | 40,228 | 40,228 | 40,228 | $000 |
| Net Operating Income | 75,822 | 64,848 | 69,238 | 80,563 | $000 |
| Initial Capital | 34,028 | 34,028 | 34,028 | 34,028 | $000 |
| Sustaining Capital | 8,030 | 8,030 | 8,030 | 8,030 | $000 |
| Other Expenses | 3,601 | 3,156 | 3,244 | 3,470 | $000 |
| Cash Flow from Operations | 30,163 | 19,634 | 23,936 | 35,035 | $000 |
| Pre-tax NPV at 8% | 20,674 | 11,724 | 15,383 | 24,822 | $000 |
| Pre-tax IRR | 37.8 | 25.4 | 30.5 | 43.4 | % |
| Taxes | 9,548 | 7,007 | 8,102 | 10,927 | $000 |
| Post-tax Cash Flow | 20,615 | 12,627 | 15,834 | 24,109 | $000 |
| Post-tax NPV at 8% | 13,018 | 6,096 | 8,881 | 16,066 | $000 |
| Post-tax IRR | 28.6 | 17.8 | 22.2 | 33.4 | % |
| Post-tax Payback Period | 1.87 | 2.24 | 2.09 | 1.72 | years |
| C1 Cash Cost | 420 | $424 | 424 | 424 | US$/tr oz Au |
| All-in Sustaining Cost | 642 | $544 | 548 | 559 | US$/tr oz Au |

## 22.4 POST-TAX ANALYSIS

Tetra Tech was assisted by EAM in estimating of taxes payable over the LOM of the Da Tambuk Project.

The following assumption were made for tax purposes.

- It has been assumed that the Da Tambuk Project will be 100% financed through equity.

- The only taxable jurisdiction has been assumed to be Ethiopia.
- A statutory income tax rate of 25% has been assumed with the following additional deductions payable to the Ethiopian government:
  - 7% net sales royalty on the value of metal doré sold
  - 5% net profit deduction
- A portion of operating losses incurred during exploration have been carried forward to operations.
- Is has been assumed that taxes are payable in the month of April in the year after incurrence of revenues.

### 22.4.1 Taxes Included in the Financial Model

Table 22.3 summarises post tax results for the Da Tambuk Project.

**Table 22.3 Post-tax Results for the Da Tambuk Project**

| Item | Amount (US$ million) |
|---|---|
| Income from Sales of Doré | 124 |
| Ethiopian Government Royalty | 8.7 |
| Net Operating Income after Operating Expenses | 75.8 |
| Other Expenses | 47.6 |
| Taxable Income | 28.2 |
| Income Tax | 8.3 |
| Government Proclamation (5% of Net Profits) | 1.2 |
| Post-tax Cashflow | 20.6 |

## 22.5 Sensitivity Analysis

Tetra Tech conducted sensitivity analysis of several key financial inputs into the financial model (Figure 22.1, Figure 22.2 and Figure 22.3). This analysis was done using the post-tax NPV at an 8% discount rate.

Between recovery (or metal price), capital costs and operating costs, the financial results are most sensitive to variations in gold price (or recovery) as seen in Figure 22.1. NPV approaches zero at a gold price of about US$1,040. The Da Tambuk Project is relatively insensitive to variations in silver price (or recovery).

The Da Tambuk Project is about equally sensitive to capital and operating costs as seen in Figure 22.2. NPV approaches zero at an increase of about 32% for capital costs and 39% for operating costs.

Tetra Tech ran sensitivities from -10% to plus 100% on operating costs. The Da Tambuk Project is most sensitive to mining operating costs as opposed to processing and G&A

costs as shown in Figure 22.3. If mining costs are 80% higher than estimated, this would render a negative NPV.

**Figure 22.1 Project NPV Sensitivities to Metal Prices**

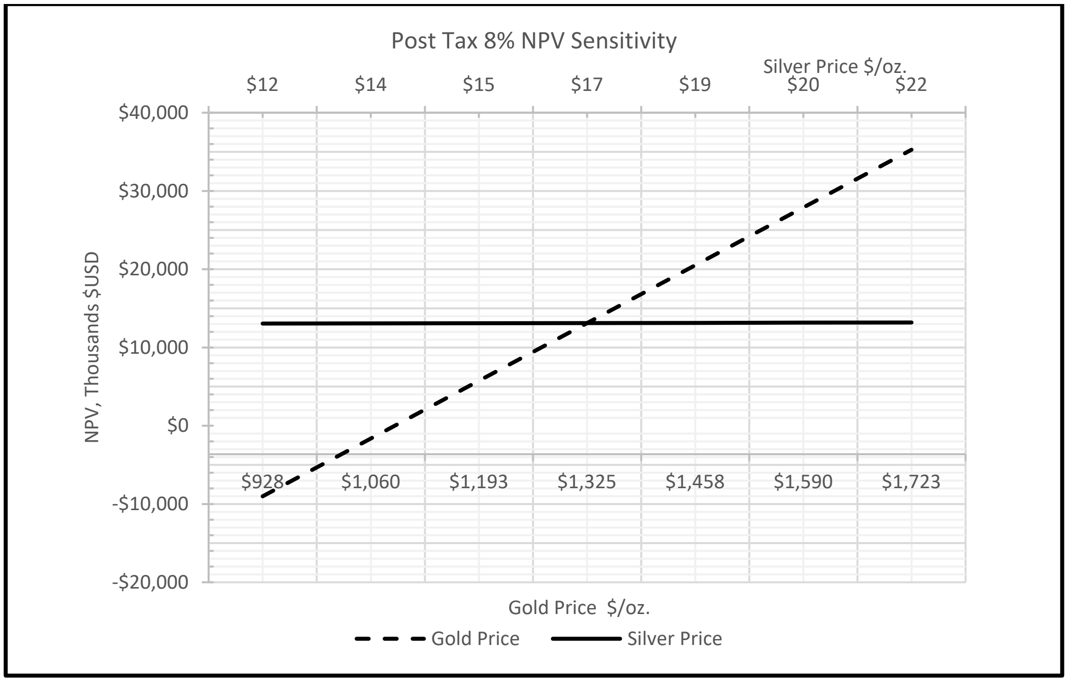



**Figure 22.2 NPV Sensitivity to Capital and Operating Costs**

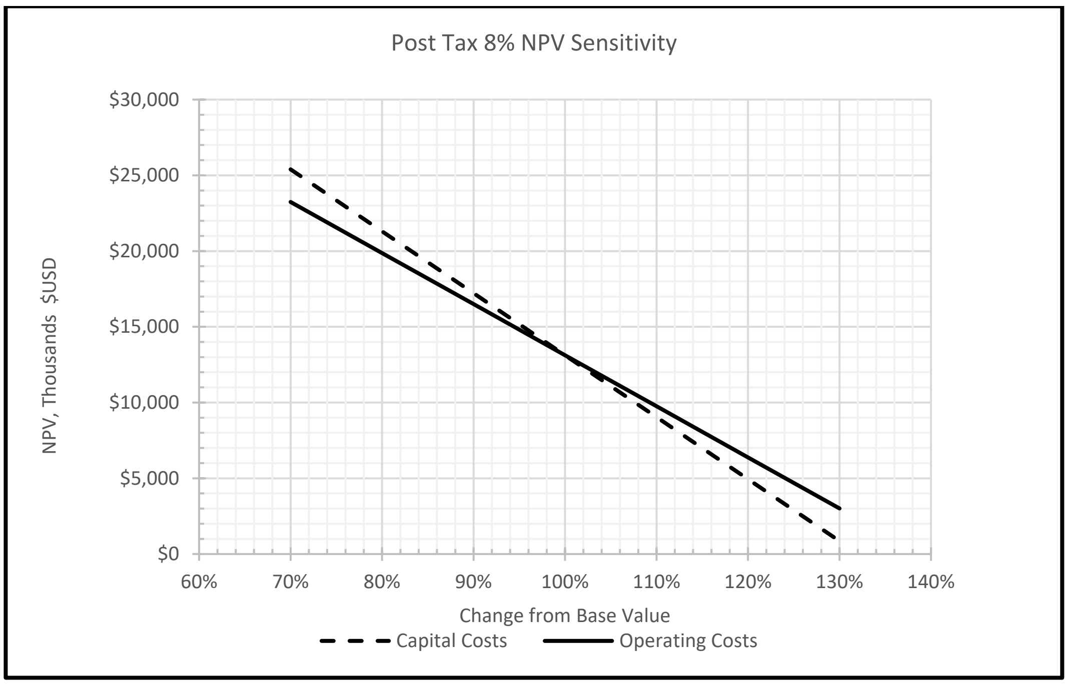
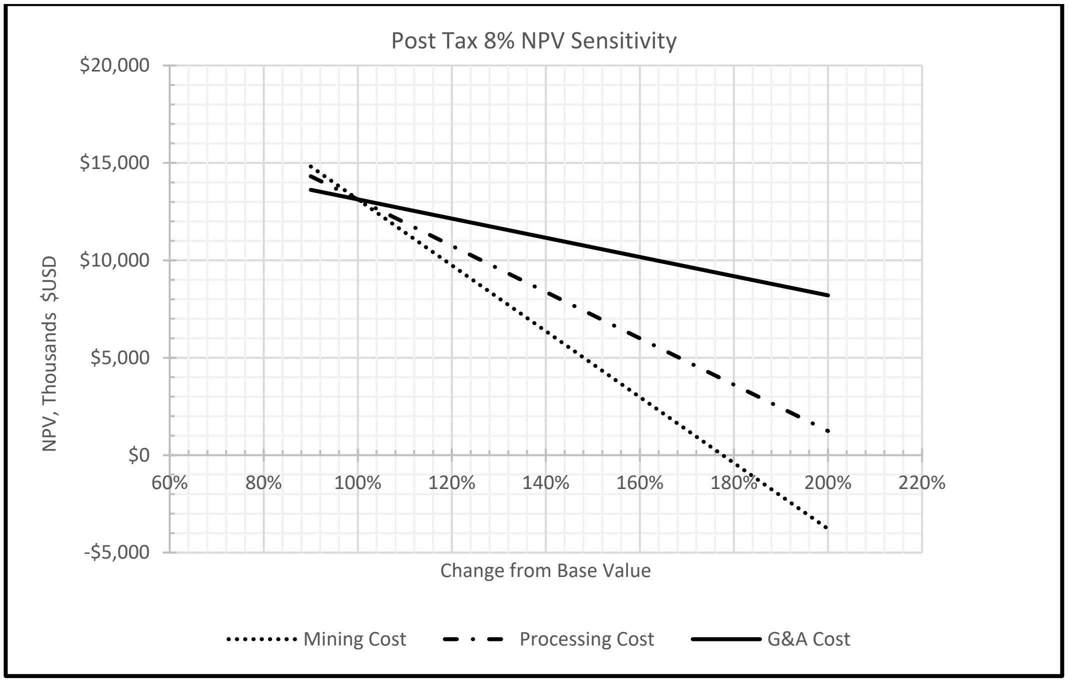


**Figure 22.3 NPV Sensitivity to Operating Costs Broken out by Mining, Process and G&A Costs**




## 22.6 DA TAMBUK CASH FLOW

A summary of the cash flow on which the financial analysis has been undertaken for Da Tambuk is presented in Table 22.4.

## Table 22.4 Da Tambuk Project Cash Flow

EAST AFRICA METALS

**East Africa Metals**
**Da Tambuk Project Prelimary Economic Assessment**

Unless otherwise noted:
-Currency is $USD Thousands
-Units in (Brackets) are negative/costs
-"oz." are troy ounces

| Mine Production Schedule | Unit | Total / Average | Year -1 | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 |
|---|---|---|---|---|---|---|---|---|
| Process Feed | kt | 650.4 | | 170.4 | 192.7 | 196.0 | 91.3 | |
| **Operating Costs** | | | | | | | | |
| Mining | | $ 20,175 | | $ 5,525 | $ 5,741 | $ 5,481 | $ 3,428 | |
| Processing | | $ 14,166 | | $ 3,711 | $ 4,196 | $ 4,270 | $ 1,989 | |
| G&A | | $ 5,888 | | $ 1,662 | $ 1,536 | $ 1,536 | $ 1,152 | |
| Total Operating Costs | | $ 40,228 | | $ 10,899 | $ 11,473 | $ 11,287 | $ 6,569 | |
| **Process Feed Grades** | | | | | | | | |
| Gold | g/t | 4.88 | 0.0 | 6.0 | 4.5 | 4.7 | 4.0 | 0.0 |
| Silver | g/t | 2.27 | 0.0 | 2.2 | 2.0 | 2.3 | 2.9 | 0.0 |
| **Metal Recoveries** | | | | | | | | |
| Gold | % | 93.0% | 93.0% | 93.0% | 93.0% | 93.0% | 93.0% | 93.0% |
| Silver | % | 50.0% | 50.0% | 50.0% | 50.0% | 50.0% | 50.0% | 50.0% |
| **Total Recovered Metals** | | | | | | | | |
| Gold | thousand oz. | 95 | | 31 | 26 | 27 | 11 | |
| Silver | thousand oz. | 24 | | 6 | 6 | 7 | 4 | |
| **Metal Payment Factors** | | | | | | | | |
| Gold | % | 99.5% | | 99.5% | 99.5% | 99.5% | 99.5% | 99.5% |
| Silver | % | 95.0% | | 95.0% | 95.0% | 95.0% | 95.0% | 95.0% |
| **Net Smelter Return** | | | | | | | | |
| Transport and Freight for Gold | US$/oz. | $ 7.0 | $ 7.0 | $ 7.0 | $ 7.0 | $ 7.0 | $ 7.0 | $ 7.0 |
| Transport and Freight for Silver | US$/oz. | $ 0.7 | $ 0.7 | $ 0.7 | $ 0.7 | $ 0.7 | $ 0.7 | $ 0.7 |
| Ethiopian Government Royalty | | $ (8,735) | | $ (2,822) | $ (2,390) | $ (2,519) | $ (1,004) | |
| Net Smelter Return | | $ 116,051 | | $ 37,499 | $ 31,750 | $ 33,462 | $ 13,340 | |
| Net Smelter Return Net of Operating Costs | | $ 75,822 | | $ 26,600 | $ 20,277 | $ 22,175 | $ 6,770 | |
| **Other Expenses** | | | | | | | | |
| Reclamation | | $ (800) | | | | | | $ (800) |
| Contribution Expenses | | $ (2,350) | $ (28.5) | $ (750) | $ (635) | $ (669) | $ (267) | |
| Ethiopia Head Office / In Country G&A | | $ (225.7) | $ (47.4) | $ (47.4) | $ (47.4) | $ (47.4) | $ (36.2) | |
| Total Other Expenses | | $ (46,533) | $ (75.9) | $ (12,163) | $ (11,628) | $ (11,269) | $ (10,598) | $ (800) |
| Total Operating Income | | $ 29,289 | $ (75.9) | $ 14,437 | $ 8,649 | $ 10,906 | $ (3,827) | $ (800) |
| **Capital Investment** | | | | | | | | |
| Initial Capital | | $ (34,028) | $ (34,028) | | | | | |
| Sustaining Capital | | $ (7,930) | | $ (2,558) | $ (2,138) | $ (1,746) | $ (1,488) | |
| Working Capital | | | | $ (2,254) | $ 1,886 | $ 235 | $ 133 | |
| Total Capital Investment | | $ (41,958) | $ (34,028) | $ (4,812) | $ (252) | $ (1,511) | $ (1,355) | |
| **Pre-Tax Cashflow Analysis** | | | | | | | | |
| Pre-Tax Net Present Value (8%) | | $ 20,963 | $ (34,104) | $ 19,435 | $ 16,583 | $ 15,835 | $ 3,758 | $ (544) |
| Pre-Tax Internal Rate of Return | % | 38.2% | | | | | | |
| **Post-Tax Cashflow Analysis** | | | | | | | | |
| Income Tax Payable | | $ (8,498) | | | $ (3,609) | $ (2,162) | $ (2,726) | |
| Government Participation (Proclamation No. 816/2013 ) | | $ (1,275) | | | $ (541) | $ (324) | $ (409) | |
| Net Annual Cash Flow - Post Tax & Govt Part'n | | $ 20,716 | $ (34,104) | $ 20,990 | $ 15,192 | $ 17,461 | $ 1,977 | $ (800) |
| Post Tax Net Present Value (8%) | | $ 13,126 | $ (34,104) | $ 19,435 | $ 13,025 | $ 13,861 | $ 1,453 | $ (544) |
| Pre-Tax Internal Rate of Return | | 28.8% | | | | | | |
| Post Tax Operating Payback | years | 1.86 | | | | | | |

# 23.0 ADJACENT PROPERTIES

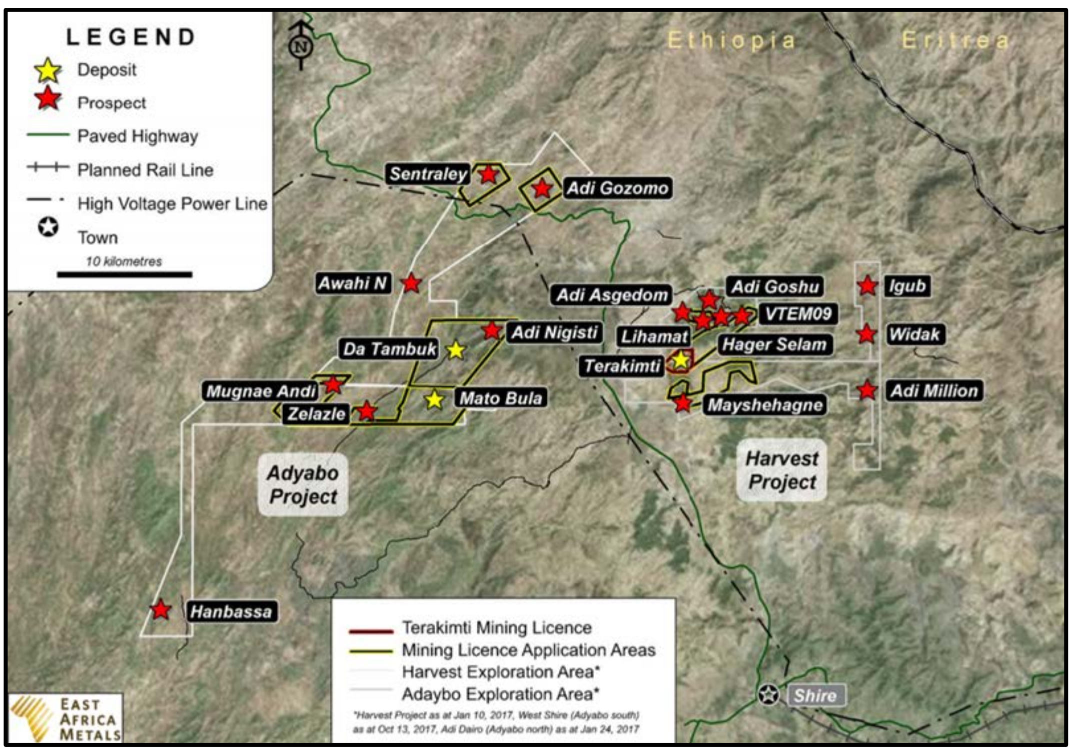
The Da Tambuk deposit forms part of the Adyabo Project, which is owned by TRI, wholly owned by EAM. The Adyabo Project extends to the north east and south west of the Da Tambuk deposit and includes the Mato Bula deposit, for which EAM has conducted a PEA.

EAM also owns 70% of the Harvest Project, which includes the Terakimti Property, now permitted for mining.

The geographical locations of these properties in relation to Da Tambuk is shown in Figure 23.1.

EAM and Tetra Tech have conducted preliminary studies on merging of Mato Bula and Da Tambuk projects showing positive results.

**Figure 23.1 Properties Surrounding Da Tambuk**



# 24.0 OTHER RELEVANT DATA AND INFORMATION

## 24.1 PROJECT DEVELOPMENT PLAN

To achieve the project schedule, the long-lead process equipment will need to be identified at the beginning of the detailed engineering stage. The critical path for the Project will be the supply and delivery of this equipment.

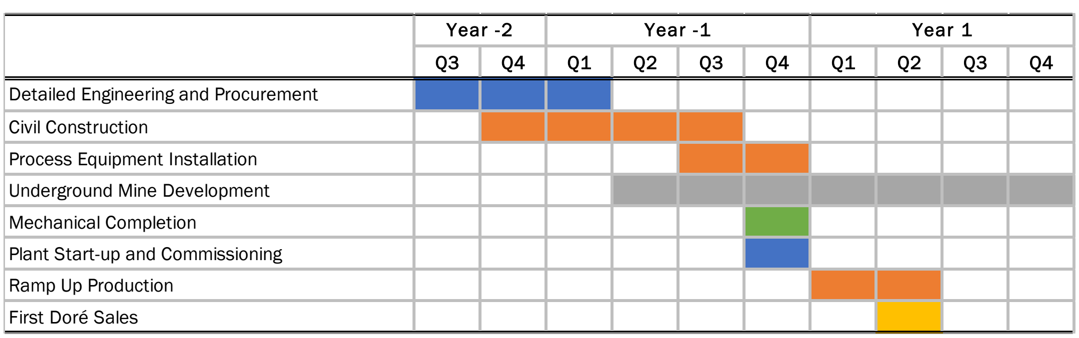
Upon construction commencement, the temporary construction facilities will be mobilized, including the batch plant and aggregate plant, or concrete will be sourced from nearby towns. Site preparation, grading, and road construction will commence immediately upon receipt of permits and approvals. Modular construction will be utilized wherever practical to reduce field construction.

Upon completion of foundation preparation, the concrete for the main process building, truck shop, and powerhouse building foundations will be poured to allow the buildings to be erected. Once the buildings are erected, the concrete inside the buildings (including equipment supports) can be poured.

Electrical and mechanical installation contracts will be bid lump sum to qualified contractors. A start-up and commissioning period has been allowed at the completion of construction in order to complete mechanical check out and acceptance and commissioning of the facilities.

A conceptual summary schedule for the Da Tambuk Project is shown in Figure 24.1.

**Figure 24.1 Conceptual Project Summary Schedule**



# 25.0 INTERPRETATIONS AND CONCLUSIONS

## 25.1 GENERAL

The current understanding of Mineral Resources, metallurgical test work and expected costs shows that there is potential for economic extraction of gold and silver at Da Tambuk.

### 25.1.1 RISKS

The following risks have been identified for Da Tambuk:

- Further work must be conducted on geotechnical conditions to enable better forecasting of underground mining costs.

### 25.1.2 OPPORTUNITIES

The following opportunities have been identified for Da Tambuk:

- The current understanding of rock quality for the underground mine, does not yet rule more cost effective bulk mining methods.

## 25.2 GEOLOGY

The Adyabo Property has undergone extensive exploration using traditional and modern exploration techniques since the concessions were optioned in 2012. Geochemical sampling programs (gold in soil, and portable XRF soil sampling) have been particularly successful in identifying anomalous areas for follow up drilling, and have identified gold rich VMS related and orogenic gold exploration targets. In the area of the Da Tambuk deposit, Mineral Resource definition drilling was undertaken and has delineated golf-rich VMS-style related mineralization.

The Da Tambuk deposit at the Adi Dairo concession of Adyabo is located within the large-scale target horizon known as the Mato Bula trend. This trend extends southward from the Da Tambuk area towards the Mato Bula deposit located on the West Shire concession of Adyabo, approximately 5 km to the south. This trend is defined geologically via alteration assemblages, multi-element soil geochemical signatures, and localized artisanal workings. The majority of exploration expenditures on the West Shire concession have been focused toward the Da Tambuk deposit, with minor early stage first pass drill testing also completed at the Adi Gozomo and Magnae Andi orogenic gold targets. These and additional orogenic targets remain on the Adyabo Project to be further investigated as lesser priority targets.

The drill testing to date has identified the Da Tambuk deposit as the prioritized, most prospective target on the project. Successive drill campaigns at Da Tambuk included the completion of 28 diamond drillholes for a total of 4,185.77 m. The gold mineralization is present over a strike distance of 400 m and has been identified to a depth of 260 m from surface.

Drilling determined that mineralization is associated with moderate to intense silica alteration and quartz veining, and disseminated to semi-massive pyrite, minor chalcopyrite, and sphalerite. The host rock is a pyrite-rich (greater than 10%) sericite schist that attains a thickness of 50 m. The mineralized horizon has a 13 m wide (true thickness) high-grade gold shoot that is present over a strike length of 135 m. The exploration programs to date have emphasized defining early resource footprints, with significant down dip and along strike exploration targets remaining for additional testing, including southward along the interpreted mineralized trend towards the Mato Bula deposit located on the West Shire concession of the Adyabo Property.

The geologic understanding of the deposit settings, lithologies, and structural and alteration controls on mineralization is sufficient to support estimation of Mineral Resources. The mineralization style and setting is well understood and is sufficient to support Mineral Resource estimation. The exploration programs completed to date are appropriate to the style of mineralization found in the deposit.

Mineral resource estimation is well-constrained by 3D wireframes representing geologically realistic volumes of mineralization.

Exploratory data analysis conducted on assays and composites shows that the wireframes are suitable domains for Mineral Resource estimation.

As a result of validation of the mineral resource block model Fladgate concludes:

- Visual inspection of block grade versus composited data shows a good reproduction of the data by the model.
- Checks for global bias in the grade estimates show differences generally within acceptable levels (less than 10%). Domains with larger differences between the NN model and OK model have a low number of composites.
- Checks for local bias (swath plots) indicate good agreement for all variables except in areas where there is significant extrapolation beyond the drillholes.
- Fladgate evaluated the impact of capping by estimating uncapped and capped grade models. Generally, the amounts of metal removed by capping in the models are consistent with the amounts calculated during the grade capping study on the assays.

Fladgate classified the mineral resource using distances which permit a reasonable assumption of geological and grade continuity.

Mineral Resources are constrained and reported using economic and technical criteria such that the Mineral Resource has reasonable prospects of economic extraction.

The Mineral Resource is not sensitive to changes in metal price.

Fladgate have estimated mineral resources for the Da Tambuk Project which conform to the requirements of CIM Definition Standards (2014).

## 25.3 METALLURGY

Metallurgical test work showed that the Da Tambuk sample responded well to whole material cyanidation. The cyanide leaching resulted in approximately 97% gold extraction. Flotation tests produce reasonable copper-gold concentrate grades and recoveries from the sample; however, gold recovery was lower than that achieved by whole material agitated cyanide leaching. The gravity concentration tests show that approximately 18.4% of the gold from the feed was recovered into a table concentrate containing 4,818 g/t gold.

## 25.4 PROCESS

The proposed 550 t/d processing plant will use conventional crushing, grinding, gravity concentration, cyanidation by CIL, and gold recovery from loaded carbon to produce gold doré. The CIL circuit discharge will be detoxified by sulphur dioxide/air process to destroy the residual WAD cyanide and dewatered in a thickener and the thickener underflow will be sent to the TCF for storage.

The flowsheet and equipment selected for the Da Tambuk Project have been widely used in mining industry.

## 25.5 MINING

The nature of the mineralization justifies the use of underground mining at Da Tambuk. A relatively shallow underground mine (up to 150 m deep) is using a ramp system for access is proposed. The mining methods selected for Da Tambuk are widely practiced in the mining industry.

## 25.6 ECONOMICS

The economic evaluation for Da Tambuk shows that the project has the potential to produce positive economics. Further resource work is required to improve the understanding of costs and additional work is required to upgrade Inferred Mineral Resources, prior to completion of more advanced project economic studies.

# 26.0 RECOMMENDATIONS

## 26.1 GENERAL

Tetra Tech recommends that EAM advance the development of the Da Tambuk through completion of a Feasibility Study.

A Feasibility Study is expected to cost up to US$1,000,000.

## 26.2 GEOLOGY

The Da Tambuk deposit remains open to mineralization extension both southward and to depth. Additionally, the alteration trend extending southwards warrants additional investigation, and should be further profiled through a geophysical IP survey coordinated with the exploration conducted related to Mato Bula to the south. Additionally, nearby orogenic gold targets should undergo further drill assessment as warrant merits. The Sentraley area of colluvial artisanal workings presents as a greater than 1 km long trend of extensive artisanal workings that spatially warrant further examination.

The Da Tambuk deposit remains open for additional infill drilling advancement, and open to further extension.

It is recommended that the path forward for the Da Tambuk deposit area of the Adyabo Property should include the following main activities during the next two phases of the Da Tambuk Project.

### 26.2.1 PHASE I

Infill and extension drilling of the Da Tambuk mineralization are recommended to fully assess the Da Tambuk deposit and potential areas of extension. This should be preceded by a fully extended IP survey to fully profile the Mato Bula Trend. Specifically, the recommended work program will include:

- Profile the Mato Bula trend by conducting IP surveying southward towards the original grid at the Mato Bula deposit 5 km south, extending original lines lengths as better depth penetration than 400 m is indicated by the initial survey.
- Diamond drill test infill areas of the original resource, and conduct extension drill testing the areas warranting southward and to depth.
- Conduct trench work at Da Tambuk Silica Ridge and Sentraley to prequalify areas for diamond drill testing.

### 26.2.2 PHASE II

If positive results are achieved in Phase I, a second phase of work should be undertaken to further refine the mineral resources identified. This program will include:

- Conduct a Mineral Resource update at Da Tambuk, metallurgical investigations are required to bring any new mineralization into a resource context.
- Test resource extensions, and new targets identified from trenching and IP survey work, as warranted.

In total, the cost of this work is expected to be up to approximately US$3,870,000. A summary of the expenditure break-down is presented in Table 26.1.

**Table 26.1 Summary of Expenditure**

| Phase | Description of Work | Cost (US$) |
|---|---|---|
| 1 | Extension and infill diamond drilling Da Tambuk | 3,060,000 |
| | Trench work, drill test Sentraley region | |
| | Trench work, drill test Da Tambuk Silica Ridge | |
| | IP surveying, extensions from previous survey along mineralized trend | 190,000 |
| | **Subtotal Phase 1** | **3,250,000** |
| | Da Tambuk Resource Update | 20,000 |
| | Resource extension/target follow-up | 300,000 |
| | IP target testing | 300.000 |
| | **Subtotal Phase 2** | **620,000** |
| Total | | 3,870,000 |

## 26.3 MINING

A comprehensive geotechnical assessment including the drilling additional geotechnical holes for initial mining areas, geotechnical core logging, rock quality analysis and rock strength testing is recommended. This assessment will provide an enhanced understanding of the strength of the rock, the nature and orientation of jointing, and the interaction of the rockmass with mining.

This assessment will provide the information and parameters required for detailed mine design and will establish ground control practices to be implemented during mining.

The cost of this study is expected to be in the order of US$150,000.

## 26.4 METALLURGY, PROCESS AND WATER SUPPLY

Additional metallurgical test work on representative samples of the Da Tambuk deposit is recommended to fully characterize the deposit and provide the information required to establish design parameters for the engineering of the Da Tambuk process plant. The recommended test work is proposed below:

- Verify metallurgical responses of the samples collected from various rock zones, lithological zones, and spatial locations of the deposit.
- The test work should include coarse gold recovery by gravity concentration and gold recovery by cyanidation. The metallurgical response of the mineralization to flotation to recover copper minerals prior to the cyanidation leaching stage should be tested to determine if lower cyanidation consumption may be achieved in leaching.
- Comminution test work including the determination of abrasion indices, crushing indices and Bond Work Indices to establish comminution design-related parameters.
- Agitated kinetic leach tests at various grind size to determine the optimum particle size for leaching and confirm the leach time required.
- Settling test work is recommended on samples of agitated leach circuit tailings to determination the settling rate of the tailings. This information will be required to establish design parameters for the thickeners
- Cyanide destruction testing to investigate optimum reagent dosages, reaction retention time, and other related parameters for the cyanide destruction circuit.

The estimated cost for this test work is approximately US$150,000.

Further optimizations on plant design and plant arrangements are recommended. The costs associated with the optimizations will be part of the next phase of study.

Additional assessment of the potential water sources in the Da Tambuk project area is recommended to confirm the optimum supply source (or sources), with regard to location, quantity and seasonal variation. This assessment should include assessment of groundwater sources in addition to surface sources.

## 26.5 COSTS

Once more advanced studies have been completed for mining, metallurgy and process, it is recommended that cost estimates are updated and that additional vendors of mining and process equipment are engaged to provide additional confidence in cost estimates.

This is expected to cost US$20,000.

# 27.0 REFERENCES

Abdelsalam, M.G., Stern, R.J., 1996. Sutures and shear zones in the Arabian–Nubian Shield. J. Afr. Earth Sci. 23, 289–310.

Alene and Sacchi, 2000. The Neoproterozoic low-grade basement of Tigrai, northern Ethiopia. Abstracts: 18th Colloquium of African Geology, Graz. J. Afr. Earth Sci. 30 (4), 5–6.

Alene, M., 1998. Tectonomagmatic evolution of the Neoproterozoic rocks of the Mai Kenetal–Negash area, Tigrai, northern Ethiopia. Unpublished Ph.D. Thesis, University of Turin.

Alene, M., Jenkin G. R. T., Leng, M. J., and Darbyshire, D. P. F., 2006. The Tambien Group, Ethiopia: An early Cryogenian (ca. 800–735 Ma) Neoproterozoic sequence in the Arabian–Nubian Shield: Precambrian Research, 147, 79-99.

Archibald, S. M., Martin, C., and Thomas, D. G., 2015, NI 43-101 Technical Report on a Mineral Resource Estimate at the Mato Bula Trend, Adyabo Project (centred at 38°05'E, 14°33'N), Tigray National Region, Ethiopia: Prepared for East Africa Metals Inc. (available at: http://www.eastafricametals.com/i/pdf/filings/EAM-Adyabo-NI43-101_June16_Final.pdf).

Beyth, M., 1971. The Geology of central and western Tigre. Min. Mines, Addis Ababa, unpublished report.

Blue Coast Research Ltd. February 18, 2016, Da Tambuk and Mato Bula Scoping Study Metallurgical Testwork Report REV. A, Report #: PJ5162.

Dubé, B., Gosselin, P., Hannington, M., and Galley, A., 2007, Gold-Rich Volcanogenic Massive Sulphide Deposits: Geological Association of Canada, Mineral Deposits Division, Special Publication no. 5, p. 75-94.

East Africa Metals Inc. http://www.eastafricametals.com

Gardoll, S. J., Warren, H. L., Caven, S. K., Warren, H. L., and Groves, I. M., , 2014a. 2013 Annual Exploration Report for Precious and Base Metals on the Adi Dairo Concession, Tigray National Region State, Northern Ethiopia. East Africa Metals Inc., Internal company report, 55 pp.

Gardoll, S. J., Warren, H. L., Caven, S. K., Warren, H. L., and Groves, I. M., , 2014b. 2014 Annual Exploration Report for Precious and Base Metals on the West Shire Concession, Tigray National Region State, Northern Ethiopia. East Africa Metals Inc., Internal company report, 61 pp.

Gardoll, S., Caven, S. K., Warren, H. L., Groves, I. M., and Weston, B., 2015, The Mato Bula – Da Tambuk Gold Rich-VMS Deposits, Tigray Region, Northern Ethiopia: Unpublished Report for East Africa Metals.

Graham, Hugh, 2016. Understanding the Mato Bula – Da Tambuk Au-rich VMS system in the Arabian-Nubian Shield, Northern Ethiopia. MSc thesis – University of Leicester., 148 pp.

Hamimi, Z., El-Kazzaz, Y., Fawzy, K., Abdelrahman, E., El-Shafei, M., and Elfakharani, A., 2014, Geology and Tectonic Setting of the Arabian-Nubian Shield: The Open Geology Journal, v. 8, p. 1-2.

Hustrulid, W.A., Bullock, R.L., 2001, Underground Mining Methods: Engineering Fundamentals and International Case Studies. Society for Mining, Metallurgy and Exploration, Inc.

Johnson, P. R., and Woldehaimanot, B., 2003, Development of the Arabian-Nubian Shield: perspectives on the accretion and deformation in the northern East African Orogen and the assembly of Gondwana: Geological Society of London, Special publications 2003, v. 206, p. 289-325.

Johnson, P. R., Andresen, A., Collins, A. S., Fowler, A. R., Fritz, H., Ghebreab, W., Kusky, T., and Stern, R. J., 2011, Late Cryogenian–Ediacaran history of the Arabian–Nubian Shield: A review of depositional, plutonic, structural, and tectonic events in the closing stages of the northern East African Orogen: Journal of African Earth Sciences, v. 61, p. 167-232.

Morag, N., Avigad, D., Gerdes, A., Belousova, E., and Harlavan, Y., 2011, Crustal evolution and recycling in the northern Arabian-Nubian Shield: New perspectives from zircon Lu-Hf and U-Pb systematics: Precambrian Research, v. 186, p. 101-116.

Stern, R. J., 2002, Crustal evolution in the East African Orogen: a neodymium isotopic perspective: Journal of African Earth Sciences, v. 34, p. 109-117.

Tadesse, T., Hoshino, M., Suzuki, K., Iisumi, S., 2000. Sm–Nd, Rb–Sr and Th–U–Pb zircon ages of syn- and post-tectonic granitoids from the Axum area of northern Ethiopia: Journal of African Earth Sciences, 30, 313–327.

Tefera, M., Chernet, T., and Haro, W., compilers, 1996, Geology of Ethiopia: Ethiopian Ministry of Mines, Geological Survey of Ethiopia, scale 1:2,000,000.

Thomas, D., 2016, Mineral Resources Estimate Section June 2, 2016, 67 pp.

Trench, A., and Groves, D., 2015, The Western Arabian-Nubian Shield: A Rapidly Emerging Gold Province: SEG Newsletter, April 2015, v. 101, p. 1, 13-16.

Wilson, G. C., 2014. Mineralogy and Petrology of Drill-core Samples from Da Tambuk, Northern Ethiopia. Report prepared for East Africa Metals Inc., 66 pp.

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I, David G. Thomas, P. Geo., of #601 – 1788 West Georgia Street, Vancouver, British Columbia, Canada, do hereby certify that:

- I am the principal mineral resource geologist and owner of the geological consulting firm DKT Geosolutions Inc.
- This certificate applies to the technical report entitled 'Technical Report and Preliminary Economic Assessment for the Da Tambuk Project, Adyabo Property, Tigray National Regional State, Ethiopia' with an effective date of April 30th, 2018 (this "Technical Report") that was prepared for the Issuer.
- I am a graduate of Durham University, in the United Kingdom with a Bachelor of Science degree in Geology and am a graduate of Imperial College, University of London, in the United Kingdom with a Master of Science degree in Mineral Exploration.
- I have practiced my profession for over 23 years. In that time, I have been directly involved in reviews of exploration programs, geological models, exploration data, sampling, sample preparation, quality assurance-quality control, databases, and mineral resource estimates for a variety of mineral deposits, including VMS deposits and other copper-gold deposit types (Canada, Ethiopia and Eritrea).
- I am a member in good standing of the Association of Professional Geoscientists of British Columbia (APEGBC NRL # 149114). I am also a member of the Australasian Institute of Mining and Metallurgy (MAusIMM # 225250).
- I have read the definition of "Qualified Person" set out in National Instrument 43-101 – Standards of Disclosure for Mineral Projects ("NI 43-101") and certify that by reason of my education, affiliation with a professional association (as defined in NI 43-101) and past relevant work experience, I fulfill the requirements to be a "Qualified Person" for the purposes of NI 43-101.
- I most recently visited the subject property from March 22 to March 25, 2015.
- I am responsible for Sections 1.4, 1.5, 1.13.2, 7.0, 8.0, 9.0, 10.0, 11.0, 12.0, 14.0, 25.2, 26.2, and 27.0 of the Technical Report.
- I am independent of the Issuer applying all the tests in Section 1.5 of NI 43-101.
- I have had prior involvement with the property that is the subject of this Technical Report. I completed the initial Mineral Resource estimate at Da Tambuk (with effective date of April 27, 2015) and subsequently updated the Mineral Resource estimate (with an effective date of May 31st, 2016)
- I have read NI 43-101 and NI 43-101F1 and this Technical Report has been prepared in compliance with that instrument and form.
- As of the effective date of this Technical Report, to the best of my knowledge, information and belief, this Technical Report contains all scientific and technical information that is required to be disclosed to make the Technical Report not misleading.

// Signed and Sealed //

David G. Thomas, P.Geo.

DATED at Bogota, Colombia, this 11th day of June 2018.

## HASSAN GHAFFARI, P.ENG.

I, Hassan Ghaffari, P.Eng., of Vancouver, British Columbia, do hereby certify:

- I am a Director of Metallurgy with Tetra Tech Canada Inc. located at Suite 1000, 10th Floor, 885 Dunsmuir Street, Vancouver, British Columbia, V6C 1N5.
- This certificate applies to the technical report entitled "Technical Report and Preliminary Economic Assessment for the Da Tambuk Deposit, Adyabo Property, Tigray National Regional State, Ethiopia" dated April 30th, 2018 (the "Technical Report").
- I am a graduate of the University of Tehran (M.A.Sc., Mining Engineering, 1990) and the University of British Columbia (M.A.Sc., Mineral Process Engineering, 2004). I am a member in good standing of the Association of Professional Engineers and Geoscientists of British Columbia (#30408). My relevant experience includes 27 years of experience in mining and plant operation, project studies, management, and engineering. As the lead metallurgist for the Pebble Copper/Gold Moly Project in Alaska, I am coordinating all metallurgical test work and preparing and peer reviewing the technical report and the operating and capital costs of the plant and infrastructure for both the scoping and prefeasibility studies. For the Ajax Copper-Gold Project in BC, I was the Project Manager responsible for the process, infrastructure and overall management of the 60,000 t/d mill. As well, I was the Project Manager responsible for ongoing metallurgical test work and technical assistance for the La Joya Project Copper/Silver/Gold Project in Durango, Mexico. I am a "Qualified Person" for the purposes of National Instrument 43-101 (the "Instrument").
- I have not completed a personal inspection of the Property that is the subject of this Technical Report.
- I am responsible for Sections 1.10, 3.0, 20.0, 21.2, and 27.0 of the Technical Report.
- I am independent of East Africa Metals Inc. as defined by Section 1.5 of the Instrument.
- I have no prior involvement with the Property.
- I have read the Instrument and the sections of the Technical Report that I am responsible for have been prepared in compliance with the Instrument.
- As of the date of this certificate, to the best of my knowledge, information and belief, the sections of the Technical Report that I am responsible for contains all of the scientific and technical information that is required to be disclosed to make the Technical Report not misleading.

Signed and dated this 8th day of June 2018 at Vancouver, British Columbia.

*"Original document signed and sealed by*
*Hassan Ghaffari, P.Eng."*

Hassan Ghaffari, P.Eng.
Director of Metallurgy
Tetra Tech Canada Inc.

## JIANHUI (JOHN) HUANG, PH.D., P.ENG.

I, Jianhui (John) Huang, Ph.D., P.Eng., of Coquitlam, British Columbia, do hereby certify:

- I am a Senior Metallurgist with Tetra Tech Canada Inc. located at Suite 1000, 10th Floor, 885 Dunsmuir Street, Vancouver, British Columbia, V6C 1N5.
- This certificate applies to the technical report entitled "Technical Report and Preliminary Economic Assessment for the Da Tambuk Deposit, Adyabo Property, Tigray National Regional State, Ethiopia" dated April 30th, 2018 (the "Technical Report").
- I am a graduate of North-East University, China (B.Eng., 1982), Beijing General Research Institute for Non-ferrous Metals, China (M.Eng., 1988), and Birmingham University, United Kingdom (Ph.D., 2000). I am a member in good standing of the Association of Professional Engineers and Geoscientists of British Columbia (#30898). My relevant experience includes over 35 years involvement in mineral processing for base metal ores, gold and silver ores, and rare metal ores. I am a "Qualified Person" for purposes of National Instrument 43-101 (the "Instrument").
- I have not completed a personal inspection of the Property that is the subject of this Technical Report.
- I am responsible for Sections 1.6, 1.8, 1.13.4, 13.0, 17.0, 21.3.3, 25.3, 25.4, 26.4, and 27.0 of the Technical Report.
- I am independent of East Africa Metals Inc. as defined by Section 1.5 of the Instrument.
- My prior involvement with the Property includes some internal studies in 2017.
- I have read the Instrument and the sections of the Technical Report that I am responsible for have been prepared in compliance with the Instrument.
- As of the date of this certificate, to the best of my knowledge, information and belief, the sections of the Technical Report that I am responsible for contains all of the scientific and technical information that is required to be disclosed to make the Technical Report not misleading.

Signed and dated this 8th day of June 2018 at Vancouver, British Columbia.

*"Original document signed and sealed by*
*Jianhui (John) Huang, Ph.D., P.Eng."*

Jianhui (John) Huang, Ph.D., P.Eng.
Senior Metallurgist
Tetra Tech Canada Inc.

## MARK HORAN, P.ENG.

I, Mark Horan, P.Eng., of North Vancouver, British Columbia, do hereby certify:

- I am a Senior Mining Engineer with Tetra Tech Canada Inc. located at Suite 1000, 10th Floor, 885 Dunsmuir Street, Vancouver, British Columbia, V6C 1N5.
- This certificate applies to the technical report entitled "Technical Report and Preliminary Economic Assessment for the Da Tambuk Deposit, Adyabo Property, Tigray National Regional State, Ethiopia" dated April 30th, 2018 (the "Technical Report").
- I have a BSc. Mining Engineering degree from the University of Witwatersrand, South Africa and a MSc. from Rhodes University, South Africa. I am a member in good standing of the Association of Professional Engineers and Geoscientists of British Columbia (#170768). I have 18 years' experience including working in precious and base metal operations and in consulting. I am a "Qualified Person" for purposes of National Instrument 43-101 (the "Instrument").
- My most recent personal inspection of the Property that is the subject of this Technical Report was on April 6th, 2017, for one day.
- I am responsible for Sections 1.1, 1.2, 1.3, 1.7, 1.9, 1.11, 1.12, 1.13.1, 1.13.3, 2.0, 3.0, 4.0, 5.0, 6.0, 15.0, 16.0, 18.0, 19.0, 21.1, 21.3.1, 21.3.2, 21.3.4, 21.3.5, 22.0, 23.0, 24.0, 25.1, 25.5, 25.6, 26.1, 26.3, 26.5 and 27.0 of the Technical Report.
- I am independent of East Africa Metals Inc. as defined by Section 1.5 of the Instrument.
- I have no prior involvement with the Property.
- I have read the Instrument and the sections of the Technical Report that I am responsible for have been prepared in compliance with the Instrument.
- As of the date of this certificate, to the best of my knowledge, information and belief, the sections of the Technical Report that I am responsible for contains all of the scientific and technical information that is required to be disclosed to make the Technical Report not misleading.

Signed and dated this 8th day of June 2018 at Vancouver, British Columbia.

*"Original document signed and sealed by*
*Mark Horan, P.Eng."*

Mark Horan, P.Eng.
Senior Mining Engineer
Tetra Tech Canada Inc.