



## **Volta Grande Project, Pará, Brazil**

Preliminary Economic Assessment, NI 43-101

**Prepared for:**

Belo Sun Mining Corp.

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## GLOSSARY

### *Units of Measure*

|                              |                 |
|------------------------------|-----------------|
| Annum (year) .....           | a               |
| Centimetre cubic .....       | cm <sup>3</sup> |
| Centimetre square .....      | cm <sup>2</sup> |
| Centimetre .....             | cm              |
| Day .....                    | d               |
| Degree .....                 | °               |
| Degrees Celsius .....        | °C              |
| Dollar (United States) ..... | \$              |
| Gram .....                   | g               |
| Grams per litre .....        | g/L             |



|                                         |                   |
|-----------------------------------------|-------------------|
| Grams per tonne.....                    | g/t               |
| Greater than .....                      | >                 |
| Hectare (10,000 m <sup>2</sup> ) .....  | ha                |
| Hour .....                              | h                 |
| Hours per day .....                     | h/d               |
| Kilo (thousand) .....                   | k                 |
| Kilogram.....                           | kg                |
| Kilograms per cubic metre.....          | kg/m <sup>3</sup> |
| Kilograms per hour .....                | kg/h              |
| Kilograms per square metre .....        | kg/m <sup>2</sup> |
| Kilometre .....                         | km                |
| Kilovolt .....                          | kV                |
| Kilowatt hour .....                     | kWh               |
| Kilowatt hours per tonne (metric) ..... | kWh/t             |
| Kilowatt hours per annum.....           | kWh/a             |
| Kilowatt.....                           | kW                |
| Less than .....                         | <                 |
| Litre.....                              | L                 |
| Mega Pascal .....                       | MPa               |
| Megawatt per hour.....                  | MWh               |
| Megawatt .....                          | MW                |
| Metre cubic.....                        | m <sup>3</sup>    |
| Metre square .....                      | m <sup>2</sup>    |
| Metre .....                             | m                 |
| Metres above mean sea level .....       | m amsl            |
| Microns.....                            | µm                |
| Milligram.....                          | mg                |
| Milligrams per litre .....              | mg/L              |
| Millimetre .....                        | mm                |
| Million annum.....                      | Ma                |
| Million tonnes.....                     | Mt                |
| Million.....                            | M                 |
| Ounce.....                              | oz                |
| Parts per billion.....                  | ppb               |
| Parts per million.....                  | ppm               |
| Percent .....                           | %                 |
| Specific gravity.....                   | SG                |
| Tonne (1,000 kg) .....                  | t                 |
| Tonnes per day .....                    | t/d               |
| Tonnes per hour .....                   | t/h               |
| Tonnes per year .....                   | t/a               |



## *Abbreviations and Acronyms*

|                                                                   |          |
|-------------------------------------------------------------------|----------|
| Build Own Operate Transfer .....                                  | BOOT     |
| Abrasion Index .....                                              | Ai       |
| ACE Core Tool .....                                               | ACT      |
| Acme Laboratory .....                                             | Acme     |
| Quality Control .....                                             | QC       |
| AGP Mining Consultants Inc. ....                                  | AGP      |
| ALS Chemex S.A. in Lima, Peru .....                               | ALS Peru |
| Acid Rock Drainage / Metal Leaching .....                         | ARD/ML   |
| Atomic Absorption.....                                            | AA       |
| Banded Iron Formation.....                                        | BIF      |
| Banded Iron Formations.....                                       | BIF      |
| Battle Mountain Gold Mineração .....                              | BMG      |
| Belo Sun Mining Corp. ....                                        | Belo Sun |
| Boart Longyear Ltd. ....                                          | Longyear |
| Bond Ball Work Index .....                                        | BBWi     |
| Brandt Melo Ambiente .....                                        | Brandt   |
| Build Own Operate Transfer .....                                  | BOOT     |
| Carbon-in-Leach.....                                              | CIL      |
| Caterpillar's FPC software.....                                   | FPC      |
| Closure and Rehabilitation Plan.....                              | C&RP     |
| Companhia de Pesquisa de Recursos Minerais .....                  | CPRM     |
| Companhia Nacional de Mineração .....                             | CNM      |
| Compensação Financeira pela Exploração de Recursos Minerais ..... | CFEM     |
| Construction Site Environmental-Management Plan .....             | CSEMP    |
| Crushing Work Index .....                                         | CWi      |
| Departamento Nacional de Produção Mineral.....                    | DNPM     |
| Down-the-Hole .....                                               | DTH      |
| Environmental Assessment .....                                    | EA       |
| Environmental Incident Response Plan .....                        | EIRP     |
| Environmental Investigation Assessment.....                       | EIA      |
| Environmental Management Plans .....                              | EMP      |
| Environmental Resources Management Ltd .....                      | ERM      |
| Environmental, Health, and Safety .....                           | EHS      |
| Forbes & Manhattan Inc. ....                                      | F&M      |
| Fugro/Engenharia e Prospecções S.A. ....                          | Fugro    |
| General and Administrative.....                                   | G&A      |
| Geologia e Sondagens S.A. ....                                    | Geosol   |
| Geoserv Pesquisas Geológicas S.A. ....                            | Geoserv  |
| Geostatistical Software Library.....                              | GSLIB    |
| Global Positioning System .....                                   | GPS      |
| Good International Industry Practice .....                        | GIIP     |



|                                                                                      |                    |
|--------------------------------------------------------------------------------------|--------------------|
| Half Absolute Difference .....                                                       | HARD               |
| High-Grade.....                                                                      | HG                 |
| Installation Licence .....                                                           | LI                 |
| Instituto de Tecnologia August Kekulé .....                                          | ITAK               |
| Internal Rate of Return .....                                                        | IRR                |
| International Finance Corporation .....                                              | IFC                |
| International Society for Rock Mechanics .....                                       | ISRM               |
| Joint Alteration .....                                                               | Ja                 |
| Joint Roughness .....                                                                | Jr                 |
| Life-of-Mine .....                                                                   | LOM                |
| Light Detection and Ranging.....                                                     | LIDAR              |
| Low-Grade .....                                                                      | LG                 |
| Medium-Grade .....                                                                   | MG                 |
| Ministry of Mines and Energy.....                                                    | MME                |
| National Instrument .....                                                            | NI                 |
| Net Present Value.....                                                               | NPV                |
| Oca Mineração Ltda.....                                                              | Oca                |
| Operating Licence .....                                                              | LO                 |
| Organization for Economic Cooperation and Development .....                          | OECD               |
| Performance Standards .....                                                          | PS                 |
| Point Load Tests.....                                                                | PLT                |
| Preliminary Economic Assessment .....                                                | PEA                |
| Preliminary Licence.....                                                             | LP                 |
| Qualified Person .....                                                               | QP                 |
| Quality Assurance .....                                                              | QA                 |
| Quality Control and Quality Assurance.....                                           | QA/QC              |
| Rede Engenharia e Sondagem S.A. ....                                                 | Rede               |
| Reverse Circulation.....                                                             | RC                 |
| Roscoe Postle Associates Inc. ....                                                   | RPA                |
| Run-of-Mine.....                                                                     | ROM                |
| SAG Power Index .....                                                                | SPI                |
| Secretaria da Receita Federal .....                                                  | SRF                |
| Secretaria de Estado de Meio Ambiente (State Secretary of Environment of Pará) ..... | SEMA               |
| Semi-Autogenous Grinding.....                                                        | SAG                |
| SGS Geosol Laboratories.....                                                         | SGS                |
| Small-Scale Miners.....                                                              | <i>garimpeiros</i> |
| Specific gravity.....                                                                | SG                 |
| SRK Consulting Canada Inc. ....                                                      | SRK                |
| Tailings management Facility .....                                                   | TMF                |
| TVX Participações S.A. ....                                                          | TVX                |
| Verena Minerals Corporation .....                                                    | Verena             |
| VOGBR Recursos Hidricos & Geotecnia SA .....                                         | VOGBR              |

**BELO SUN MINING CORP.**

PRELIMINARY ECONOMIC ASSESSMENT, NI 43-101

VOLTA GRANDE PROJECT

PARÁ, BRAZIL



|                                       |             |
|---------------------------------------|-------------|
| Volta Grande Mineração Ltda.....      | VGML        |
| Volta Grande Project .....            | the Project |
| Waste Rock Management Facilities..... | WRMF        |
| Water Storage Facility .....          | WSF         |
| Tailings Management Facility .....    | TMF         |
| Weak Acid Dissociable .....           | WAD         |
| World Health Organization .....       | WHO         |



## **1 SUMMARY**

Belo Sun Mining Corp. (Belo Sun) retained AGP Mining Consultants Inc. (AGP) to carry out a preliminary economic assessment (PEA) of their Volta Grande property. The 100% owned Project is located approximately 60 km southeast of the town of Altamira in the northern region of Pará State, Brazil. The Volta Grande Project (the Project) comprises 18 contiguous exploration permits, four mining concession applications, and 23 exploration applications, covering a total area of 178,559 ha.

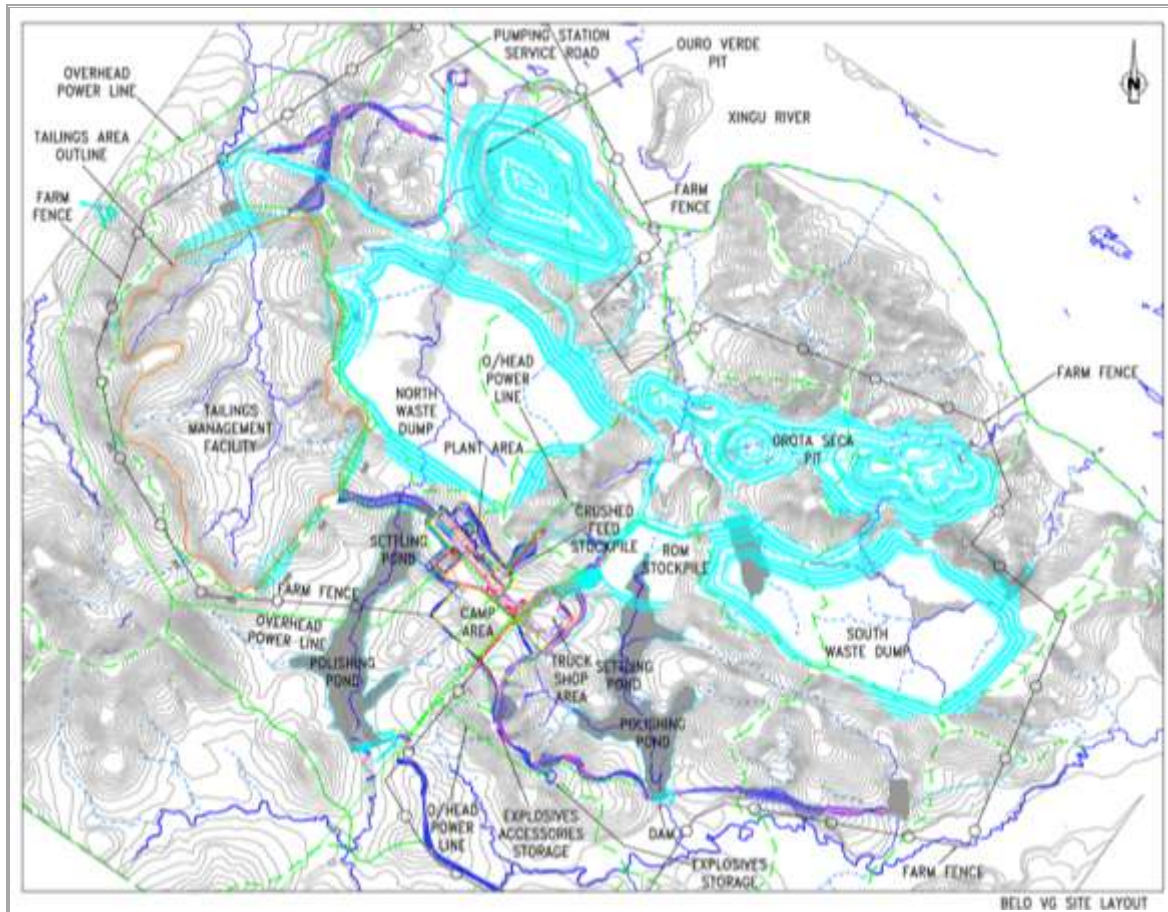
The PEA considered two main areas of mineralization in the Project known as Ouro Verde and Grota Seca. They have two main types of gold mineralization: primary gold in intrusive rock and secondary gold in saprolitic rock. Both types of gold mineralization occur within a major shear zone. In general, the gold mineralization in bedrock occurs in zones of intense hydrothermal replacement.

The study utilizes a phased development approach in the Ouro Verde and Grota Seca areas of the Project and incorporates the results of the updated National Instrument (NI) 43-101 compliant mineral resource estimation for the Project announced by Belo Sun on 3 October 2013.

The PEA concluded that the Ouro Verde and Grota Seca areas could be developed as open pits sending feed material to a nearby process plant. The plant operates with conventional crushing, grinding followed by gravity concentration, carbon-in-leach, carbon stripping and Electrowinning for metal recovery. The plant initially would process material at a rate of 3 Mt/a, but in Year 8 would ramp up to 6 Mt/a and continue at that rate until Year 21. A site layout has been prepared to illustrate the proposed location of required infrastructure, mining, and processing facilities (Figure 1-1).

The study used a base case gold price of \$1,300/oz for the economic analysis. The analysis was completed using 4Q 2013 values with no escalation assumed. The exchange rate is based on 2.35 Brazilian Real to 1 United States dollar; (BRL:US\$=2.35:1). Capital and Operating Cost estimates were developed. AGP concludes that the Project has the potential to generate a pre-tax net present value (NPV) with a 5% discount rate of \$533 million and an internal rate of return (IRR) of 17.7%. Post-tax, the NPV is \$418 million at a 5% discount rate and with an IRR of 16.1%. Payback on initial project capital is expected to be 4.0 years pre-tax and 4.2 years post-tax.

**Figure 1-1 Site Layout**



The PEA utilizes only Measured and Indicated resources from Grota Seca and Ouro Verde for calculation of the economics. Some Inferred material has been incorporated as dilution and upgraded in category if a minor percentage occurs in the mining block. There is no certainty that the assumptions utilized in the PEA will be realized. Inferred mineral resources are presently considered too speculative geologically to have economic considerations applied to them that would enable them to be categorized as reserves. Mineral resources that are not mineral reserves do not have demonstrated economic viability.

Based on the results of the PEA study, AGP recommends that Belo Sun continue with additional studies to determine a project execution decision. Recommendations and associated budgets are provided to ensure sufficient information is available going forward. These may be added to the cost of a potential feasibility study should it be required for financing of the Project.



South Block, while not a component of the PEA study, represents an opportunity for Belo Sun should further exploration be considered. At that time, its inclusion in the overall project could be assessed.

With the current level of information for the Project, AGP does not foresee Mineral Resources, potential economics, or environment issues that would inhibit the Project from advancing to further levels of study.

## **1.1 Geology**

The Project is located on the Xingu River, north of the Carajás mineral province, approximately 60 km southeast of the city of Altamira.

The Volta Grande project comprises 18 contiguous exploration permits, four mining concession applications, and 23 exploration applications, covering a total area of 178,559.30 ha. It is located in the municipality of Senador José Porfírio in the northern region of Pará State in northern Brazil.

The Volta Grande area is situated along a major ductile deformation zone within the Três Palmeiras Greenstone Belt. It is underlain by west-northwest-trending and steeply south-dipping gneisses of metasedimentary and/or metavolcanic origin and syntectonic diorite.

The Três Palmeiras Greenstone Belt is interpreted to consist of a basal portion of predominantly metasedimentary rock in the southern part of the belt, and predominantly mafic volcanic rock in the northern part of the belt as well as synvolcanic intrusions. The sedimentary assemblage includes thin units of chemical sediments (chert, graphitic sedimentary rock, and oxide-facies iron formation), which serve as marker horizons in the interpretation of the local geology. Both assemblages commonly exhibit strong penetrative fabric (foliation and lineation) as well as metamorphic banding. In places, where the rock has undergone migmatization, mylonitic zones with associated silicification are commonly observed.

The volcanic, sedimentary and syntectonic rocks of the Project have been affected by a widespread hydrothermal alteration event. Surficial alteration is present in an extensive layer of red saprolite, which covers the entire property, including topographic highs and lows.

The Project contains two target areas named the North and South Blocks; the former contains two large mineralized areas: the Ouro Verde area in the northwestern part of the North Block and the Grota Seca area, which contains the Grota Seca West, Grota Seca, and Grota Seca East areas, along the southern part of the North Block. The South



Block comprises three target areas: Pequi in the northern part of the South Block, Grande in the southern part of the South Block, and Itatá in the southeastern part of the South Block. The North and South Blocks include old and new *garimpeiros* workings. The PEA is focused on the Ouro Verde and Grota Seca Areas.

In the central part of the North Block, a north-northwest-trending lineament separates the southeastern mineralized zones of the Grota Seca from the northwestern zones at Ouro Verde. This lineament is parallel to other regional lineaments with similar orientation.

There is a complicated contact relationship between auriferous bedrock and the overlying saprolitic material. At Grota Seca, near the current *garimpeiros* workings, almost fresh diorite is in sharp contact with saprolitic material, which is at least 8 m thick. This juxtaposition indicates that the saprolite is not made up of regular regolithic material developed on top of bedrock, but is transported by faulting parallel to the major shear zone that hosts the gold mineralization.

There are two types of gold mineralization at Volta Grande: primary gold in intrusive rock and secondary gold in saprolitic rock. Both types of gold mineralization occur within a major shear zone. In general, the gold mineralization in bedrock occurs in zones of intense hydrothermal replacement and is associated with up to approximately 5% sulphides (pyrite and/or arsenopyrite) at Grota Seca and Ouro Verde.

In all cases, the distribution of alteration assemblages and the replacement textures suggest evolution of fluid-rock alteration. The initial hydrothermal alteration involved silicification (quartz flooding) of the host diorite. Subsequent alteration included replacement by pyrite and/or arsenopyrite, followed by potassium feldspar alteration and sericitization.

Finally, all of the rocks in the area were subjected to carbonate alteration. This alteration is evidenced by the presence of numerous calcite veinlets in the diorite as well as in the metavolcanic rock.

Gold mineralization at the Project occurs primarily in intrusive rock, while subordinate mineralization occurs in saprolitic rock. Primary gold mineralization is associated with altered diorite within a 300-m wide alteration zone, which straddles the contact zone between the intrusive and the metasedimentary rock. Gold occurs in a stack of mineralized zones ranging in size from strike trends over 1 km long, depths from surface to approximately 400 m, with true thickness ranging up to 50 m.

The dip of the mineralized zones is generally moderate to steep (50° to 85°) to the south. Mineralization in the Ouro Verde area extends for approximately 1,100 m along an



approximate northeast-southwest strike and extends to a vertical depth of 540 m below surface. Mineralization in the Grota Seca area extends for approximately 2,900 m along a west-northwest trend and extends to a vertical depth of 400 m below surface. Recent drilling in the area between the Ouro Verde and Grota Seca has intersected mineralization, suggesting a continuous zone of mineralization.

Surficial weathering has resulted in an extensive saprolitic profile overlying the primary mineralization at the Project. In general, the thickness of the saprolitic material ranges from 3 m to 20 m. Locally, the thickness can reach up to 45 m, as in the Ouro Verde area. Occasional outcrops of saprolitic material occur in the project area.

VGML, Verena, and Belo Sun drilled a combined total of 667 core boreholes (approximately 168,136 m) and 59 reverse circulation (RC) boreholes (11,225 m) at Ouro Verde and Grota Seca in the North Block of the Project. A total of 62 core boreholes (14,274 m) have been drilled in the South Block. Belo Sun drilling data contributes about 80% of the total drilling information (measured by drilled metres).

Procedures undertaken by Belo Sun at the Volta Grande Project for reverse circulation and core drilling, chip and core handling, logging and maintenance of the database for the Project are well managed, documented, and undertaken with a well-defined set of procedures that exceed industry standard practice.

SRK considers that the exploration data collected by Belo Sun and previous project operations are of sufficient quality to support mineral resource evaluation.

## **1.2 Resource Statement**

CIM *Definition Standards for Mineral Resources and Mineral Reserves* (November 2010) define a Mineral Resource as:

*“[A] concentration or occurrence of diamonds, natural solid inorganic material, or natural solid fossilized minerals in or on the Earth’s crust in such form and quantity and of such a grade or quality that it has reasonable prospects for economic extraction. The location, quantity, grade, geological characteristics and continuity of a mineral resource are known, estimated or interpreted from specific geological evidence and knowledge.”*

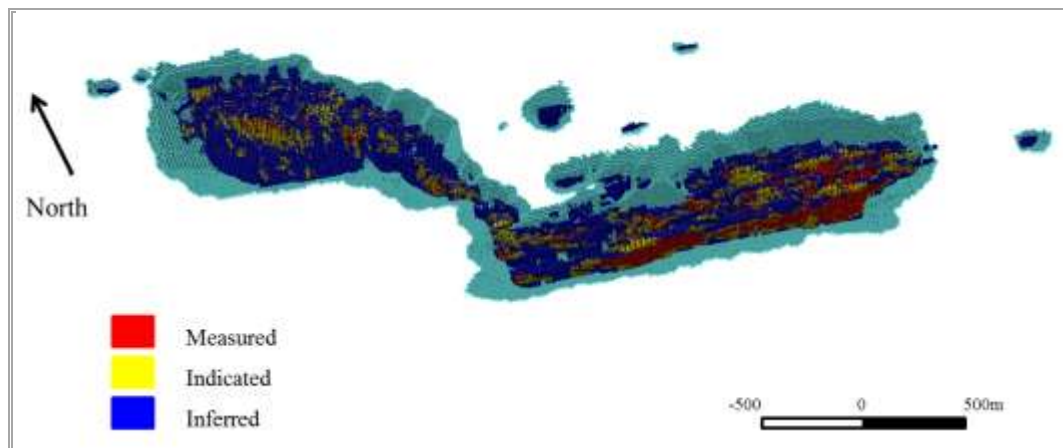
The “reasonable prospects for economic extraction” requirement generally implies that quantity and grade estimates meet certain economic thresholds and that mineral resources are reported at an appropriate cut-off grade that takes into account extraction scenarios and processing recovery.

SRK considers that the Ouro Verde and Grota Seca deposits are amenable to both open pit and underground extraction. To assist with determining which portions of the gold deposits show “reasonable prospect for economic extraction” and to assist with selecting a reasonable reporting cutoff grade, SRK has developed conceptual open pit shells using the following assumptions:

- pit berm height of 20 m consisting of two 10-m benches
- overall slope angle 31° saprolite, 53° unweathered rock
- processing and general and administrative (G&A) costs of \$14.87/t mined
- metallurgical gold recovery of 94% for saprolite and unweathered rock
- gold price of \$1,400/troy oz.

After review of optimization results, SRK considers that it is reasonable to report as open pit mineral resource those classified blocks located within the conceptual pit shells above a cut-off grade of 0.5 g/t Au (Figure 1-2), and that those blocks of the Ouro Verde and Grota Seca deposits located outside the conceptual pit shells above a cut-off grade of 2.0 g/t Au as underground mineral resources.

**Figure 1-2: Plan Showing Block Estimates within the Ouro Verde and Grota Seca Deposits Relative to the Conceptual Pit**



SRK is satisfied that the mineral resources were estimated by Belo Sun in conformity with the generally accepted *CIM Estimation of Mineral Resource and Mineral Reserve Best Practices Guidelines*. The mineral resources may be affected by further infill and exploration drilling that may result in increases or decreases in subsequent resource estimates. The mineral resources may also be affected by subsequent assessments of mining, environmental, processing, permitting, taxation, socio-economic, and other factors.

The audited Mineral Resource Statement presented in Table 1-1 was prepared by Camila Passos (CREA 5061868179/D), Dr. Oy Leuangthong, PhD., P.Eng. (PEO#90563867), and Dr. Jean-Francois Couture, PhD., P.Geo. (APGO#0196). Drs. Leuangthong and Couture are independent Qualified Persons (QP) as this term is defined in National Instrument (NI) 43-101. The effective date of the Mineral Resource Statement is 1 October 2013.

**Table 1-1: Audited Mineral Resource Statement\*<sup>(1)</sup>**

| Domain                         | Category             | Quantity ('000s t) | Gold Grade (g/t) | Contained Gold ('000s oz) |
|--------------------------------|----------------------|--------------------|------------------|---------------------------|
| <b>Ouro Verde Open Pit</b>     |                      |                    |                  |                           |
| Saprolite                      | Indicated            | 405                | 1.21             | 16                        |
|                                | Inferred             | 629                | 0.99             | 20                        |
| Unweathered                    | Measured             | 24,036             | 1.78             | 1,379                     |
|                                | Indicated            | 19,682             | 1.61             | 1,022                     |
|                                | Inferred             | 21,973             | 1.50             | 1,059                     |
| <b>Ouro Verde Underground</b>  |                      |                    |                  |                           |
| Unweathered                    | Indicated            | 64                 | 2.66             | 5                         |
|                                | Inferred             | 831                | 3.13             | 84                        |
| <b>Grota Seca Open Pit</b>     |                      |                    |                  |                           |
| Saprolite                      | Indicated            | 721                | 1.11             | 26                        |
|                                | Inferred             | 851                | 0.97             | 27                        |
| Unweathered                    | Measured             | 31,384             | 1.61             | 1,620                     |
|                                | Indicated            | 14,950             | 1.59             | 763                       |
|                                | Inferred             | 17,413             | 1.62             | 905                       |
| <b>Grota Seca Underground</b>  |                      |                    |                  |                           |
| Unweathered                    | Indicated            | 53                 | 2.88             | 5                         |
|                                | Inferred             | 695                | 3.38             | 75                        |
| <b>South Block Open Pit</b>    |                      |                    |                  |                           |
| Saprolite                      | Inferred             | 169                | 1.68             | 9                         |
| Unweathered                    | Indicated            | 2,503              | 3.06             | 246                       |
|                                | Inferred             | 2,752              | 4.08             | 361                       |
| <b>South Block Underground</b> |                      |                    |                  |                           |
| Unweathered                    | Indicated            | 24                 | 4.24             | 3                         |
|                                | Inferred             | 193                | 4.05             | 25                        |
| <b>Total Open Pit</b>          |                      |                    |                  |                           |
|                                | Measured             | 55,420             | 1.68             | 2,999                     |
|                                | Indicated            | 38,261             | 1.68             | 2,072                     |
|                                | Measured + Indicated | 93,682             | 1.68             | 5,070                     |
|                                | Inferred             | 43,788             | 1.69             | 2,381                     |
| <b>Total Underground</b>       |                      |                    |                  |                           |
|                                | Indicated            | 140                | 3.01             | 14                        |
|                                | Inferred             | 1,719              | 3.33             | 184                       |
| <b>Total</b>                   |                      |                    |                  |                           |
|                                | Measured             | 55,420             | 1.68             | 2,999                     |
|                                | Indicated            | 38,402             | 1.69             | 2,085                     |
|                                | Measured + Indicated | 93,822             | 1.69             | 5,084                     |
|                                | Inferred             | 45,507             | 1.75             | 2,565                     |

**Notes:** \*Mineral resources are not mineral reserves and have not demonstrated economic viability. All figures have been rounded to reflect the relative accuracy of the estimates. Open pit mineral resources are reported at a cutoff grade of 0.5 g/t Au and underground mineral resources are reported at a cutoff grade of 2.0 g/t Au. The cutoff grades are based on a gold price of \$1,400/troy oz and metallurgical recoveries of 94% for saprolite and unweathered material.

Mineral resources constrained within low, medium, and high-grade domains delineated from drilling data within Ouro Verde and Grota Seca.

<sup>(1)</sup> Volta Grande Project, Pará State, Brazil, SRK Consulting (Canada) Inc., 1 October 2013

### 1.3 Geotechnical

Belo Sun retained VOGBR Recursos Hidricos & Geotecnia SA (VOGBR) for work on the open pit slopes of the Project. Their work included various field programs (site investigation, geotechnical, and hydrogeological drilling) as well as laboratory test work on collected samples. This was then analyzed to provide slope design parameters for the mine design.

In the Ouro Verde and Grota Seca areas, 50 diamond drill core holes were completed amassing over 7,000 m of core samples. The holes were of either NQ or HQ2 diameter. The distribution of holes included:

- 24 geotechnical drill holes
- 16 hydrogeology drill holes
- 10 packer testing drill holes for permeability measurements.

The core was geomechanically logged.

The geotechnical descriptions of the drill core samples from the boreholes completed in the region of the project data were used in the development of the geomechanical model. The following geomechanical parameters were determined;

- Soil Parameters – thickness, colour, plasticity, granulometry, genesis
- Intact Rock – strength and degree of weathering
- Rock Mass – RQD and Joint Set Number
- Discontinuities – type (foliation, fracture, fault, etc.), spacing of discontinuity, Joint Roughness Number, Joint Alteration Number, Joint Condition Index.

Each described parameter was statistically analyzed in order to gather enough information for interpretation and development of the geomechanical model. They were then grouped into five classes:

**Class V Rock Mass (very poor rock)** – surface rock mass covering the largest portion of the area.

**Class IV Rock Mass (poor rock)** – poor rock mass comprised of very altered and fractured rock. Located near the surface covered by the Class V rock.

**Class III Rock Mass (fair rock)** – comprises fractured rock mass. The rocks exhibit moderate to high strength and low alteration.

**Class I-II Rock Mass (good/very good rock)** – the most relevant to the study, representing approximately 80% and 68% of the exposed area of the slopes of the Ouro Verde and Grota Seca final pits, respectively.

The uniaxial and tri-axial compression strength test results exhibited high values for all lithologies when compared to the values found in the literature. Although the correlation for the direct shear tests for the same lithology is elevated, the results indicate very high basic attrition angle values.

A site investigation program was developed and executed for assessing the connectivity between the pit and the Xingu River, which borders the northern side of Ouro Verde. In this investigation, soil infiltration and water loss in rock tests were scheduled. The studies were conducted primarily in the Ouro Verde Pit region, due to the proximity between the pit limits and the Xingu River.

Permeability tests were analyzed together with the rock mass classes, where it would be expected to find higher permeability values for the classes below II-I. It was verified that there is not a significant permeability variation, and those found are low and show high homogeneity along the borehole. From the borings executed, it is noted that the rock mass does not exhibit persistent discontinuities, indicating that apparently there is no connection between the pit area and the Xingu River.

Based on the results of the geomechanical analysis, the Ouro Verde Pit was divided into seven sectors the Grota Seca Pit was divided into 10 geometric sectors. Within these sectors, slope analysis was completed. Slope designs were based on bench angles, inter-ramp angles and overall slope angles. The bench heights were discussed with Belo Sun and AGP prior to the design work initiating.

Kinematic analysis was completed for each section with various configurations. Potential modes of failures examined and considered in the slope criteria. The sectors were examined for the potential of wedge failures and toppling failures. With 10 m high benches, the exhibited factors of safety were quite high. A preference for 20 m heights between safety benches was discussed and examined. The results of that analysis were also favourable.

As a result of the analysis, the design parameters were provided for detailed design of the pits. The geometric sectors that have similar bench and inter-ramp angles were grouped in geotechnical sectors. A maximum inter-ramp height of 150 m was also included to provide sufficient catchment in the event of minor safety bench losses.

The inter-ramp stability analyses exhibited satisfactory safety factors. However, it is necessary for the drilling and blasting to be executed in well-controlled manner, avoiding

damage to the rock mass, minimizing block falls and ruptures due to undue fragmentation of upper benches that may affect the pit operations.

The proposed design criteria for mine design are shown in Table 1-2.

**Table 1-2: Proposed Geometry for the Final Pit**

| Class | Sectors | Berms (m) | Bench           |                | Inter-Ramp<br>"Bench toe-to-toe" |                |
|-------|---------|-----------|-----------------|----------------|----------------------------------|----------------|
|       |         |           | Max. Height (m) | Max. Angle (°) | Max. Height (m)                  | Max. Angle (°) |
| V/IV  | ALL     | 6.5       | 10              | 45             | 50                               | 31             |
| III   | 1       | 8.5       | 20              | 70             | 150                              | 52             |
|       | 2       |           |                 | 70             |                                  | 52             |
|       | 4 and 5 |           |                 | 65             |                                  | 48             |
|       | 3 and 6 |           |                 | 85             |                                  | 63             |
| I-II  | 1       | 8.5       | 20              | 70             | 150                              | 52             |
|       | 7       |           |                 | 70             |                                  | 52             |
|       | 2       |           |                 | 70             |                                  | 52             |
|       | 5       |           |                 | 75             |                                  | 55             |
|       | 4       |           |                 | 80             |                                  | 59             |
|       | 3 and 6 |           |                 | 85             |                                  | 63             |

**Note:** A 20 m wide safety bench is to be included every 150 m vertically.

The studies performed do not provide guidance regarding the geometries to be used during the implementation phase, but are sufficient for the design of the final pits at this level of study.

## 1.4 Open Pit Mining

The PEA focused on the potential development of the Project with two pits: Ouro Verde and Grotta Seca. The pits will be mined at a rate of 3 Mt/a for the first 7 years then ramped up to 6 Mt/a in Year 8 achieving full production in Year 9. The mining will continue at that rate until Year 21 when the project as it stands now is complete.

The Ouro Verde pit has been designed as a series of three pushbacks or phases. Grotta Seca has been designed with 6 phases. Mining will be by conventional methods. A total of 102.8 Mt of mill feed grading 1.14 g/t will be shipped to the mill over the 21 year mine life. Measured resources mined will total 51.8 Mt grading 1.29 g/t and Indicated resources will total 51 Mt grading 1.00 g/t.



The LOM strip ratio is 4.30:1 and 442.1 Mt of waste rock and saprolite will be stored over the course of the mine life.

Waste material will be stored in two main waste rock management facilities (WRMF). For this study, waste materials have been assumed to be non-acid generating based on the test work to date. Material from the Ouro Verde pit will be used as required to expand the main tailings dam and build some of the saddle dams as required over the mine life.

The Ouro Verde WRMF will reach a height of 100 m and the top level is expected to be the 190 m level. It will cover an area of 189.0 ha. The Grota Seca WRMF will reach a height of 120 m and the top level will be the 210 m level. It will cover an area of 157.1 ha. Both facilities, as they are currently designed, can accommodate all the waste material. Additional capacity exists with additional lifts if required. All material in the WRMF will be concurrently re-sloped and reclaimed as it reaches final design.

Operating costs for the open pits are expected to average \$2.37/t mined over the LOM. This includes costs for grade control in the pit (\$0.09/t mined) and cost of the mine equipment lease (\$0.34/t mined). The initial mine major fleet will be two 200 mm DTH drills, four 14.5 m<sup>3</sup> front-end loaders and thirteen 90 tonne trucks. Normal support equipment (track dozers, graders, and water trucks) would be part of the fleet. Two reverse circulation drills will be responsible for grade control and two large support backhoes will assist in the pit in feed / waste separation for the loaders.

At the peak of material movement in the pit in Year 9, the fleet will be different with six 200 mm DTH drills, two 18 m<sup>3</sup> front-end loaders, two 22 m<sup>3</sup> hydraulic front shovels and sixteen 136 tonne trucks. Normal support equipment will be present in addition to the support backhoes and reverse circulation drills.

Mining will focus on higher grade (Au >1.0 g/t) material for the first seven years with the lower grade material stockpiled near the crushing station. With the expansion to 6 Mt/a, the lower grade material will also be feed with the high grade. The low-grade cut-offs are 0.37 g/t Au for Ouro Verde and 0.42 g/t Au for Grota Seca.

The low-grade stockpile will be accessed in Years 8, 9 and 10 to maintain mill feed to plant capacity at the higher production rates while the mine pre-strips some additional phases. From Year 17 onwards it will also be reclaimed as the pits are finishing ensuring plant capacity is maximized. The stockpile will be depleted by the end of Year 21.

Dilution is estimated at 13% with a zero grade for the life of mine or 17.9% with a diluting grade of 0.19 g/t. This is based on 1.25 m of dilution per block.

## **1.5 Metallurgy**

Detailed metallurgical testwork programs on samples from the Project were carried out at SGS Chile in 2012 and 2013. The purpose of the testwork was to confirm the optimal flowsheet and provide feasibility level design data. The testwork results were consistent with historical findings, and indicated that composite samples from both deposits were amenable to conventional gold recovery by cyanide leaching.

Grindability testing of selected composites from the Ouro Verde and Grotta Seca mineralized zones indicated that the material is of moderate hardness, with an average Bond Rod Work Index (BRWi) of 16.0 kWh/t and an average Bond Ball Work Index (BBWi) of 15.4 kWh/t. Abrasion Index testing indicated that the material is of above average abrasiveness, while JK drop weight testing revealed that at a coarse particle size the ore is highly resistant to fracture.

Cyanide leach testwork identified an optimum grind size  $P_{80}$  of 75  $\mu\text{m}$ . Centrifugal gravity concentration, after grinding, was found to recover 40% to 50% of the contained gold to concentrate. Gravity tailings leach testwork indicated a leach time of 24 hours was sufficient, at a sodium cyanide concentration of 0.5 g/L and 50% pulp density. Overall, gold leach extraction was found to be dependent on head grade with extractions ranging from 84% to 97% on samples varying in head grade from 0.39 to 3.90 g/t Au. Based on a Phase 1 estimated average gold feed grade of 1.66 g/t, a gold recovery prediction of 94.1% was made.

A scoping level plant design was completed to process feed from the Ouro Verde and Grotta Seca deposits. The flowsheet consists of primary crushing, SAG milling, closed circuit ball milling with gravity concentration, intensive leach of the gravity concentrate, carbon-in-leach on the cyclone overflow, elution, electrowinning, and sludge refining to doré.

## **1.6 Infrastructure and Site Layout**

The Project infrastructure consists of the following:

- process plant, mobile equipment and maintenance buildings
- office /administration and support building
- main electrical substation and distribution system
- fuel storage and dispensing
- high voltage power supply
- settling dams and polishing ponds



- raw water storage facility
- tailings management facility
- camp accommodations with cafeteria.

This infrastructure is required to support a Phase 1 (3 Mt/a) open pit operation from two pits: Ouro Verde and Grota Seca. A Phase 2 project expansion involves doubling the process plant capacity to 6 Mt/a while mining from the same two pits.

The process plant is located to the south and west of the two open pits. The primary crusher and stockpile are situated near the process plant. Phase 1 incorporates a crushing system, which discharges via a short stacker conveyor onto the stockpile for the 3 Mt/a operation. For the Phase 2 expansion, this unit is replaced by a permanent jaw crushing station with a capacity of 6 Mt/a, which discharges to a larger stockpile that feeds the expanded grinding circuit.

Belo Sun requires accommodation for approximately 300 permanent personnel on shift to operate and maintain the site in addition to temporary accommodation for 1,000 construction personnel at the peak staffing level. These camp structures will also be prefabricated, shipped, and sent to site for quick erection.

The assay/metallurgical laboratory will handle samples from the mine and process plant and be built as part of the process facility. It will also be from a prefabricated type.

The site will have approximately 11 km of roads connecting the pits to the processing plant, services complex, camp, water storage facility (WSF), tailings management facility (TMF) and explosive storage.

Initial development of the site roads will include access to the TMF for construction purposes. This will be of single lane mining width. When mining starts, the mine fleet will widen these roads with pit material to full operating width of three times the operating width of the mine trucks.

The anticipated final average power demand for the entire site is 40 MW split approximately 60/40 between Phase 1 and Phase 2. The total HV capacity will need to be installed as part of the upfront infrastructure. The cost for the HV supply to the site will be borne by the utility on a Build Own Operate Transfer (BOOT) scheme. This will add a small premium to the power cost.

The TMF is located to the west of the plant and will be keyed into topographic high areas to maximize storage capacity and reduce areal disturbance. Using an average of 1.2 t/m<sup>3</sup> in situ tailings density, the facility has been designed to accommodate a minimum of 85.6 Mm<sup>3</sup> of tailings.



The tailings dam design for this study considers a single dam initially, situated between topography to maximize stability. This dam will be constructed entirely of saprolite.

As the tailings fills the valley, an additional seven saddle dykes are required. Three of those will be completed with mine material. The remaining four saddle dykes are smaller and remote from access to the mine. They will be constructed as part of the sustaining capital plan.

The tailings slurry will be pumped via a pipeline from the process plant to the TMF. Process water will be reclaimed from the TMF and returned to the plant via a dedicated reclaim water barge with pumps and a pipeline.

## 1.7 Capital and Operating Costs

### 1.7.1 Capital Costs

The capital costs for the Project are summarized in Table 1-3. All costs are expressed in Q4 2013 United States Dollars (US\$). The Brazilian Real to US Dollar exchange rate was R\$2.35 to US\$1.00 for this estimate. The costs are based on the estimate for an initial 3 Mt/a processing plant which is expanded to 6 Mt/a with construction of the expansion starting in Year 6 and production on line in Year 8. The mine has a 21-year processing life.

**Table 1-3: Capital Cost Summary**

| Capital Category       | Preproduction Capital<br>Year -3 to Year -1<br>(\$M) | Production Capital<br>Years 1 - 5<br>(\$M) | Sustaining Capital<br>Year 6 - 21<br>(\$M) | Total Capital<br>(\$M) |
|------------------------|------------------------------------------------------|--------------------------------------------|--------------------------------------------|------------------------|
| Open Pit Mining        | 12.6                                                 | 5.4                                        | 32.8                                       | 50.8                   |
| Processing             | 114.4                                                | 0.8                                        | 87.0                                       | 202.3                  |
| Infrastructure         | 76.0                                                 | 6.4                                        | 12.4                                       | 94.8                   |
| Environmental          | -                                                    | -                                          | 10.0                                       | 10.0                   |
| Indirects/Owners Costs | 68.9                                                 | 16.1                                       | 61.5                                       | 146.5                  |
| Contingency            | 28.4                                                 | 6.6                                        | 33.5                                       | 68.5                   |
| <b>Subtotal</b>        | <b>300.3</b>                                         | <b>35.3</b>                                | <b>237.2</b>                               | <b>572.9</b>           |
| Importation Tax        | 28.4                                                 | 4.4                                        | 31.4                                       | 64.1                   |
| <b>Total</b>           | <b>328.7</b>                                         | <b>39.7</b>                                | <b>268.6</b>                               | <b>637.0</b>           |

Initial capital requirements (pre-production) are estimated to be \$328.7 million. Production starts in Year -1 with the plant commissioning and full production for Year 1. It is anticipated that operating net revenue will pay for the plant expansion in Year 6 to increase the plant throughput. The time to expand the plant is estimated at 18 months.



At that time, a new mining fleet will be purchased to accommodate the increase in production.

Mining capital costs include a 20% down payment for the mining lease. Leasing is assumed to continue for the entire mine life as an expensed operating cost.

The indirect and contingency percentages are shown in Table 1-4.

**Table 1-4: Capital Category Indirect and Contingency Percentages**

| Capital Category | Indirects (%) | Contingency (%) |
|------------------|---------------|-----------------|
| Open Pit Mining  | 10.0          | 10.0            |
| Processing       | 40.0          | 15.0            |
| Infrastructure   | 45.0          | 15.0            |
| Environmental    | 5.0           | 15.0            |

### 1.7.2 Operating Costs

Operating costs were developed for an initial 3 Mt/a mining and milling operation ramping up to 6 Mt/a in Year 9 and continuing until Year 21. The pre-strip requirements add an additional nine months prior to milling commencement in Month 10 of Year -1. Three months of mill commissioning have been included in the overall production schedule prior to full production.

Diesel fuel pricing is estimated at \$0.761/L. The price for electrical power was set at \$0.0669/kWh, based on current pricing discussions by Belo Sun inclusive of the BOOT payback tariff.

The Ouro Verde and Grota Seca pits will be developed using conventional open pit technology. Initial fleet sizing is with 90 tonne trucks and 14.5 m<sup>3</sup> loaders. Backhoes will assist in dilution control on the mill feed material. Drilling is accomplished with diesel drills utilizing DTH hammers with bits 200 mm in diameter. Timing of the plant expansion in Year 8 coincides with the need for major equipment replacement. Slightly larger equipment is purchased that assists in lowering the unit operating cost to accommodate the increased stripping requirement. The drill fleet specification remains the same but the trucks increase in size to 136 tonnes and the loaders increase to 18 m<sup>3</sup> in bucket capacity for proper matching. Two hydraulic front shovels are also included in the fleet with 22 m<sup>3</sup> buckets.

The open pit LOM strip ratio is 4.3:1 (waste: feed). One year of pre-stripping is required to initiate full-scale production of 3 Mt/a mill feed to the plant. The operating strip ratio



in the first seven years averages 6.3:1 with lower grade material stockpiled adjacent to the crusher. In Year 8 the plant expansion to 6 Mt/a is complete and the stockpile is used as a source of feed material. The average strip ratio for the remaining years of the mine is 4.12:1 (waste:feed). LOM a total of 102.7 Mt of material will be feed to the mill over the 21 years. Waste rock totaling 442.1 Mt will be placed in waste rock management facilities over the mine life. At its peak, the low-grade stockpile will contain 22.6 Mt of low-grade feed. This peak occurs in Year 16, and is then drawn down as the mine is completed, finishing in Year 21.

The process plant is designed to operate at a nominal rate of 3 Mt/a for the first seven years. In Year 8, plant production will ramp up to 6 Mt/a achieving that rate in Year 9 and onwards. The plant will use conventional crushing and grinding followed by gravity concentration and CIL cyanidation of the gravity tailings. Tailings will be pumped 5.5 km horizontally to the tailings management area west of the plant.

G&A costs are based on an average of 59 management and administrative employees initially then 74 after the plant expansion. The G&A cost includes camp costs with meals for employees, life and health insurance, recruitment, personal transportation, public relations, etc. The expenses for maintaining offices in Belem, Belo Horizonte, and Altamira are also included in the G&A. Administrative employees in those offices will be recruited from the immediate area, and therefore will not require accommodation in a camp.

Table 1-5 shows a summary of all the operating cost categories on a cost per ounce basis and Table 1-6 on tonne mill feed basis.

**Table 1-5 Total Operating Costs (\$/oz payable)**

| Cost Category           | Years 1 to 6 | Years 7 to 21 | LOM        |
|-------------------------|--------------|---------------|------------|
| Open Pit Mining         | 383          | 373           | 388        |
| Processing              | 182          | 279           | 253        |
| G&A                     | 69           | 63            | 65         |
| Refining/Transportation | 23           | 23            | 23         |
| Royalties               | 13           | 13            | 13         |
| <b>Total Cash Cost</b>  | <b>670</b>   | <b>750</b>    | <b>742</b> |

**Note:** LOM includes commissioning mill feed



**Table 1-6 Total Operating Costs (\$/t mill feed)**

| Cost Category           | Years 1 to 6 | Years 7 to 21 | LOM          |
|-------------------------|--------------|---------------|--------------|
| Open Pit Mining         | 19.27        | 11.42         | 13.25        |
| Processing              | 9.13         | 8.53          | 8.64         |
| G&A                     | 3.49         | 1.93          | 2.22         |
| Refining/Transportation | 1.16         | 0.71          | 0.79         |
| Royalties               | 0.64         | 0.39          | 0.44         |
| <b>Total Cash Cost</b>  | <b>33.69</b> | <b>22.98</b>  | <b>25.33</b> |

**Note:** LOM includes commissioning mill feed

## 1.8 Economic Analysis

The project has pre-tax NPV with a 5% discount rate of \$533 million using a base price for gold of \$1,300/oz. Post-tax NPV with the same 5% discount rate and \$1,300 gold price was \$418 million. IRR are 17.7% pre-tax and 16.1% post-tax. Payback on the project capital is expected to be 4 years pre-tax and 4.2 years post-tax. Table 22-1 shows the detailed results.

The PEA utilizes only Measured and Indicated resources from Grota Seca and Ouro Verde for calculation of the economics. Some Inferred material has been incorporated as dilution and upgraded in category if a minor percentage occurs in the block. There is no certainty that the assumptions utilized in the PEA will be realized. Inferred mineral resources are presently considered too speculative geologically to have economic considerations applied to them that would enable them to be categorized as reserves. Mineral resources that are not mineral reserves and do not have demonstrated economic viability. The resources used for the PEA study were reported in the resource statement dated 3 October 2013.

Variable gold recoveries were applied by pit area and rock type. These recoveries vary by feed grade to the mill. The initial five years of the mine are expected to achieve a 94.1% gold recovery and the life of mine average is expected to be 92.8%.

**Table 1-7: Discounted Cash Flow Results**

| Cost Category              | Unit         | Low Case     | Base Case    | High Case    | Sensitivity Case |
|----------------------------|--------------|--------------|--------------|--------------|------------------|
| Gold Price                 | (\$/oz)      | <b>1,250</b> | <b>1,300</b> | <b>1,400</b> | <b>1,450</b>     |
| <b>Operating Costs</b>     |              |              |              |              |                  |
| Open Pit Mining            | (M\$)        | 1,361.3      | 1,361.3      | 1,361.3      | 1,361.3          |
| Processing                 | (M\$)        | 887.7        | 887.7        | 887.7        | 887.7            |
| G&A                        | (M\$)        | 228.6        | 228.6        | 228.6        | 228.6            |
| Subtotal Operating Costs   | (M\$)        | 2,477.6      | 2,477.6      | 2,477.6      | 2,477.6          |
| <b>Capital Costs</b>       |              |              |              |              |                  |
| Open Pit Mining            | (M\$)        | 50.8         | 50.8         | 50.8         | 50.8             |
| Processing                 | (M\$)        | 202.3        | 202.3        | 202.3        | 202.3            |
| Infrastructure             | (M\$)        | 94.8         | 94.8         | 94.8         | 94.8             |
| Environmental Costs        | (M\$)        | 10.0         | 10.0         | 10.0         | 10.0             |
| Owners Costs/Indirects     | (M\$)        | 146.5        | 146.5        | 146.5        | 146.5            |
| Contingency                | (M\$)        | 68.4         | 68.4         | 68.4         | 68.4             |
| Subtotal Capital Costs     | (M\$)        | 572.8        | 572.8        | 572.8        | 572.8            |
| Taxes                      | (M\$)        | 64.2         | 64.2         | 64.2         | 64.2             |
| <b>Total Capital Costs</b> | <b>(M\$)</b> | <b>637.0</b> | <b>637.0</b> | <b>637.0</b> | <b>637.0</b>     |
| Gold Revenue               | (M\$)        | 4,387.5      | 4,563.0      | 4,913.9      | 5,089.5          |
| Less Refining              | (M\$)        | 80.8         | 80.8         | 80.8         | 80.8             |
| Less Royalty               | (M\$)        | 43.1         | 44.8         | 48.3         | 50.1             |
| Net Gold Revenue           | (M\$)        | 4,263.6      | 4,437.3      | 4,784.8      | 4,958.6          |
| Pre-Tax Cash Flow          | (M\$)        | 1,148.9      | 1,322.7      | 1,670.2      | 1,843.9          |
| <b>Total Tax</b>           | <b>(M\$)</b> | <b>223.0</b> | <b>260.6</b> | <b>335.5</b> | <b>372.0</b>     |
| Post-Tax Cash Flow         | (M\$)        | 925.9        | 1,062.1      | 1,334.7      | 1,471.9          |
| Pre-Tax NPV at 5%          | (M\$)        | 442.0        | 533.0        | 717.0        | 808.0            |
| Pre-Tax IRR                | (%)          | 15.7         | 17.7         | 21.5         | 23.4             |
| Pre-Tax Payback Period     | Years        | 4.4          | 4.0          | 3.3          | 3.0              |
| Post-Tax NPV at 5%         | (M\$)        | 344.0        | 418.0        | 564.0        | 637.0            |
| Post-Tax IRR               | (%)          | 14.3         | 16.1         | 19.5         | 21.1             |
| Post-Tax Payback Period    | Years        | 4.6          | 4.2          | 3.6          | 3.3              |

The Project base case (\$1,300/oz Au) costs are also expressed in terms of dollars per ounce and dollars per tonne of mill feed in Table 1-8 and Table 1-9.

**Table 1-8: Base Case Costs - \$/oz**

| Cost Category                            | Year 1 to 6 | Year 7 to 21 | LOM <sup>(1)</sup> |
|------------------------------------------|-------------|--------------|--------------------|
| <b>Cash Cost</b>                         |             |              |                    |
| Open Pit Mining                          | 383         | 373          | 388                |
| Processing                               | 182         | 279          | 253                |
| G&A                                      | 69          | 63           | 65                 |
| <b>Total Operating Cost</b>              | <b>634</b>  | <b>715</b>   | <b>706</b>         |
| Royalties                                | 13          | 13           | 13                 |
| Total Operating Cost including Royalties | 647         | 727          | 719                |
| Refining                                 | 23          | 23           | 23                 |
| <b>Total Cash Cost</b>                   | <b>670</b>  | <b>750</b>   | <b>742</b>         |
| <b>Capital Cost</b>                      |             |              |                    |
| Open Pit Mining                          | 7           | 12           | 14                 |
| Processing                               | 20          | 27           | 58                 |
| Infrastructure                           | 12          | 3            | 27                 |
| Environmental Costs                      | 0           | 4            | 3                  |
| Owners Costs/Indirects                   | 36          | 17           | 42                 |
| Contingency                              | 16          | 10           | 19                 |
| Tax (importation)                        | 12          | 10           | 18                 |
| <b>Total Capital Cost</b>                | <b>104</b>  | <b>83</b>    | <b>181</b>         |
| Taxes (Income with credits)              | 32          | 90           | 74                 |
| <b>Total Mine Site Cost (inc. tax)</b>   | <b>805</b>  | <b>923</b>   | <b>997</b>         |

**Note:** <sup>(1)</sup> LOM includes pre-production values

**Table 1-9: Base Case Costs - \$/t Mill Feed**

| Cost Category                            | Year 1 to 6  | Year 7 to 21 | LOM <sup>(1)</sup> |
|------------------------------------------|--------------|--------------|--------------------|
| <b>Cash Cost</b>                         |              |              |                    |
| Open Pit Mining                          | 19.27        | 11.42        | 13.25              |
| Processing                               | 9.13         | 8.53         | 8.64               |
| G&A                                      | 3.49         | 1.93         | 2.22               |
| Total Operating Cost                     | 31.89        | 21.88        | 24.11              |
| Royalties                                | 0.64         | 0.39         | 0.44               |
| Total Operating Cost including Royalties | 32.53        | 22.27        | 24.55              |
| Refining                                 | 1.16         | 0.71         | 0.79               |
| <b>Total Cash Cost</b>                   | <b>33.69</b> | <b>22.98</b> | <b>25.34</b>       |
| <b>Capital Cost</b>                      |              |              |                    |
| Open Pit Mining                          | 0.37         | 0.37         | 0.49               |
| Processing                               | 1.00         | 0.83         | 1.97               |
| Infrastructure                           | 0.61         | 0.09         | 0.92               |
| Environmental Costs                      | 0.00         | 0.12         | 0.10               |
| Owners Costs/Indirects                   | 1.84         | 0.53         | 1.43               |
| Contingency                              | 0.81         | 0.30         | 0.67               |
| Tax (Importation)                        | 0.60         | 0.45         | 0.62               |
| <b>Total Capital Cost</b>                | <b>5.23</b>  | <b>2.69</b>  | <b>6.20</b>        |
| Taxes (Income with credits)              | 1.60         | 2.75         | 2.54               |
| <b>Total Mine Site Cost (inc. tax)</b>   | <b>40.51</b> | <b>28.42</b> | <b>34.07</b>       |

**Note:** <sup>(1)</sup> LOM includes pre-production values



A review of recent studies and market consensus showed a range from \$1,250 to above \$1,300/oz. A \$1,020/oz price for design purposes was considered reasonable based on pit geometry and strip ratio. The base case for the economic analysis was set at \$1,300/oz. The high price case gold price was set just over this at \$1,400/oz and the lower price set at \$1,250/oz. The sensitivity case price was set to \$1,450/oz.

Gold payable is estimated to be 99.9% with a refining and transportation charge of \$23/oz. Local and international transportation of the doré formed the bulk of the cost at \$19.15/oz with the actual refining at \$3.85/oz.

The royalty rate for gold is currently 1% arising from the sale of the mineral product less the sales tax of the mineral product, transportation and insurance costs.

The tax planning for the Project was developed by L&M, Belo Sun's Brazilian tax advisors, taking into consideration the existing current tax laws applied to capital costs, operating costs, sales of gold and profits.

The work was developed from the basic taxes applicable to various activities of the Project and the tax benefits provided for by the legislation of each tribute, whether at the Federal, State, or municipal level.

The greatest sensitivity to the Project is gold price. The base case price of \$1,300/oz provides an NPV (5%) of \$418 million. If the gold price rises by 20% to \$1,560/oz, the NPV would rise to \$799 million. This equates to a 91% increase in NPV showing the impact of higher gold prices. The IRR rises to 24.7%. Conversely, a 20% reduction in gold price to \$1,040/oz results in a drop of the project NPV to \$30 million, still positive but a 93% decrease in NPV. The IRR with the 20% reduction in gold price is 5.9%.

Operating costs are the second most sensitive to the overall project economics but to a lesser degree than gold price. A 20% increase in the operating cost drops the NPV (5%) to \$205 million with an IRR of 10.6%. This is a 51% decrease in the project NPV. Conversely, a 20% decrease in operating cost results in a 51% increase in project NPV.

Capital cost is the least sensitive parameter to the overall project economics. With a 20% increase in the capital cost, the NPV (5%) drops by 19% to \$337 million. The smaller impact is partially a result of the leasing of mine equipment so the sensitivity affects the operating cost more than the capital cost. If the capital costs are reduced by 20%, the NPV rises to \$498 million, a 19% improvement.

The results of the sensitivity analysis are shown in Figure 1-3 and Figure 1-4.

**Figure 1-3: NPV Sensitivity (Post-tax)**

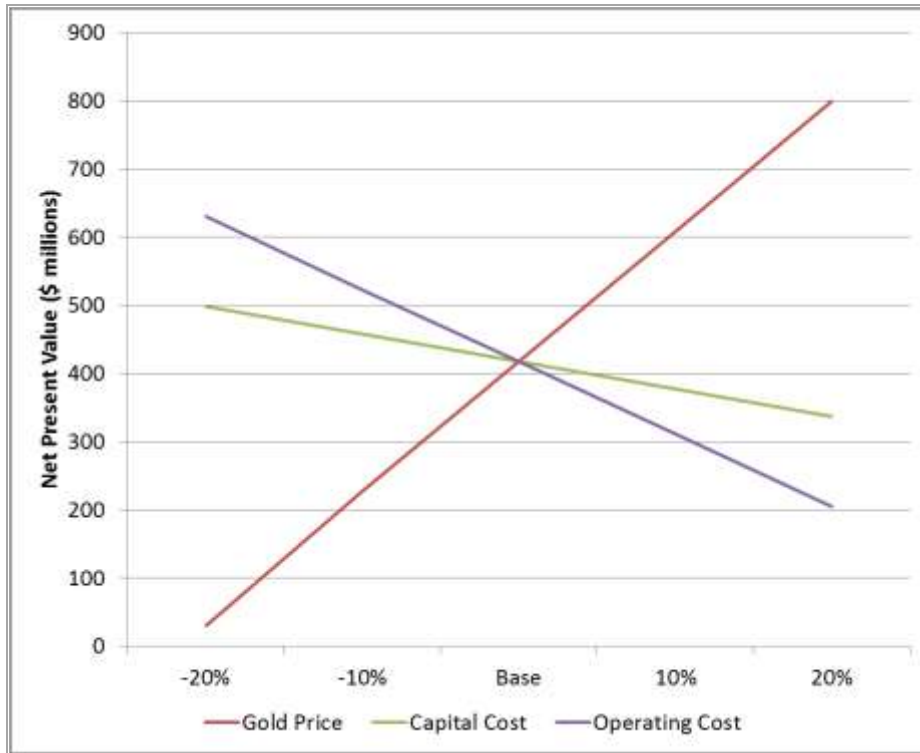
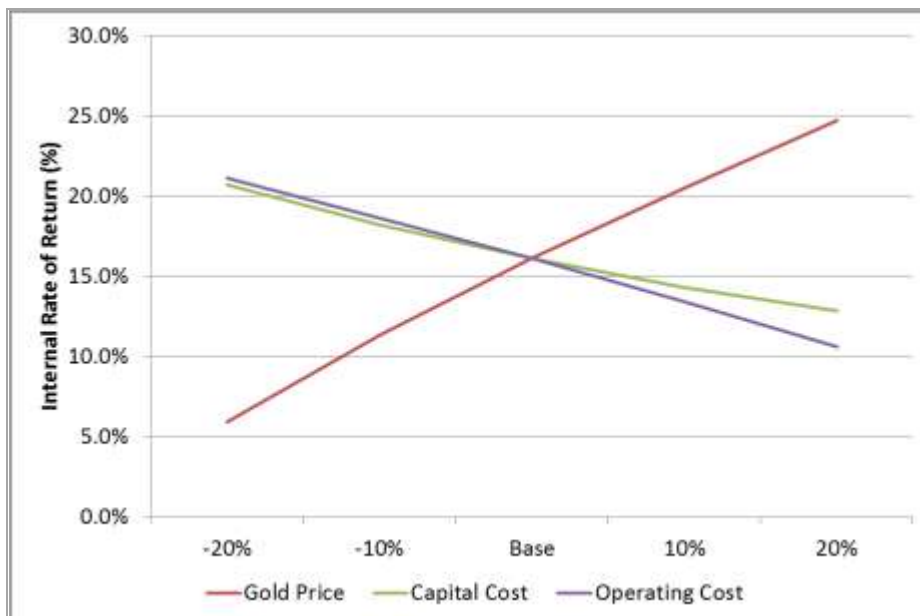


**Figure 1-4: IRR Sensitivity (Post-tax)**





The impact of discount rate was also considered; a comparison to gold prices is shown in Table 1-10.

**Table 1-10: Sensitivity to Gold Price and Discount Rate**

|               | Gold Price (\$/oz) |       |       |       |       |       |       |       |       |       |
|---------------|--------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| NPV (\$M)     |                    | 1,100 | 1,150 | 1,200 | 1,250 | 1,300 | 1,350 | 1,400 | 1,450 | 1,500 |
| Discount Rate | 0.0%               | 516   | 653   | 789   | 926   | 1,062 | 1,198 | 1,335 | 1,472 | 1,610 |
|               | 2.5%               | 274   | 373   | 472   | 571   | 670   | 768   | 867   | 966   | 1,065 |
|               | <b>5.0%</b>        | 123   | 197   | 271   | 344   | 418   | 491   | 564   | 637   | 711   |
|               | 7.5%               | 27    | 84    | 141   | 197   | 253   | 308   | 364   | 420   | 476   |
|               | 10.0%              | -33   | 11    | 55    | 99    | 142   | 186   | 229   | 272   | 316   |
|               | 12.5%              | -72   | -37   | -2    | 33    | 68    | 102   | 137   | 171   | 206   |

## 1.9 Environmental

In preparation for potential mining activities, Belo Sun retained Brandt Melo Ambiente (Brandt) in 2010 to undertake a baseline study of the proposed Project site. The property boundaries and the proposed mine site layout provided by other consultants were used to define the study area for the baseline aquatic and terrestrial studies. Considerable environmental study work has been completed for the Project, and mitigation measures have been incorporated in the development of the PEA Study layouts, designs, and operational practices to mitigate potential environmental risks. There have been discussions with the local villages and communities regarding the environmental protection measures Belo Sun proposes to undertake.

Consultations have also been held with the Federal and State regulatory departments on various aspects of the Project, and detailed discussions will continue throughout the permitting process and Project execution.

A Project risk assessment was carried out prior to the PEA Study to identify environmental sensitivities, and a constraints matrix will be developed to help guide Project planning. In addition, Environmental Resources Management Ltd (ERM) completed a Gap Analysis for Belo Sun in June 2013.

Belo Sun voluntarily adheres to certain international standards and guidelines, as well as to its corporate sustainable-development framework.

Discussions with the Pará state government in 2010 began prior to the advanced exploration program and are still ongoing. The lead agency is State Secretary of Environment of Pará (SEMA). Permits have been granted to enable site exploration and



related activities (such as hydrogeological investigations) to take place, and officials have been apprised of Project planning related to the feasibility studies.

Working closely with SEMA, Belo Sun has identified the key environmental licensing requirements. The environmental license is the document, with a set expiration date, in which SEMA establishes rules, conditions, restrictions and environmental control measures to be followed. Upon receiving the Environmental License, Belo Sun assumes the obligations for maintenance of environmental quality at the Project site and in surrounding areas.

The first stage of licensing, wherein the licensing agency evaluates the location and design of the Project, confirms its environmental viability, and establishes, the basic requirements for the next phases. The LP was approved in December 2013 and issued in February 2014. Certain conditions have been attached to the licence that Belo Sun is currently addressing.

## **1.10 Recommendations and Proposed Budget**

The following recommendations are made to assist in taking the Project to the next level of study.

### **1.10.1 Geology**

SRK recommends a work program that includes structural geology investigations, infill and delineation drilling, and geology and mineral resource modelling. The aim of the structural geology investigations is to study the controls on the distribution of the higher-grade gold mineralization, particularly along the Galo trend with the objective of understanding the distribution of the auriferous quartz vein field. Infill and step out drilling is recommended to improving the delineation of the gold mineralization in the Galo trend and the South Block with the aim to improve resource classification. Geology and mineral resource modelling efforts should focus on improving the delineation of the low grade domains defined at Ouro Verde and Grota Seca. The proposed work program comprises four components:

- structural geology investigations to study the controls on the distribution of the higher grade gold mineralization throughout the deposits and particularly along the Galo trend
- infill drilling to improve the delineation of the higher grade gold mineralization along the Galo trend and in the South Block



- infill and step-out drilling to improve the confidence in the continuity of the gold mineralization in the South Block
- geology and mineral resource modelling focussing on the low grade domains in Ouro Verde and Grota Seca areas.

#### **1.10.2 Open Pit Mining**

There are still some areas that require further definition prior to operation and can be handled as separate studies or part of a feasibility study.

- Ore control procedures – additional study is required to evaluate exact equipment for use in the grade control program and methodologies to be employed in mine operations.
- Wall Slopes – a closer examination of the wall slopes in Grota Seca is warranted as walls in the pit are designed to final design from the beginning. Ouro Verde with its concentric phase development is less prone to this and allows time to learn from operational experience.
- Ground Engaging Tools – high silica content of the mine rock is expected to be abrasive on parts in contact with it. Costs associated with ground engaging tools increase dramatically and/or affect availability of equipment.
- Suspended truck bodies – the use of suspended truck bodies is considered in the PEA study to reduce carry-back and abrasion in the standard boxes. The opportunity for increased payload for the same haulage configuration has the potential to reduce operating costs. This potential should be examined further and incorporated in later studies or mine operation.

#### **1.10.3 Metallurgy**

To complement the results presented here, additional metallurgical characterization of the Ouro Verde and Grota Seca deposits is recommended as follows:

- bench-scale, continuous detox testing by the INCO SO<sub>2</sub>-air process to develop more accurate estimates for parameters such as residence time and reagent consumption
- detailed final tailings characterization including multi-element scan by ICP, and ABA
- complete a CIP versus CIL trade-off study to determine the most economic leaching circuit based on latest modelling



#### **1.10.4 Infrastructure**

Advanced study has been completed with respect to the tailings designs, plant, and shops

As well, the use of more temporary structures during construction to manage the peak of labour force should be considered. A substantial cost has been allocated to the preparation of the waste management facilities and seepage / raw water ponds. Timing the construction of these with mining activities may help in lowering the initial cost of the project. A review of these items in detail is recommended.

Further geotechnical testing may be required in order to properly design equipment and building foundations.

#### **1.10.5 Environmental**

Belo Sun has advanced their environmental program well beyond what is normally associated with a PEA study. The program in place and the path forward as outlined should be continued to obtain all necessary permits and licences.

#### **1.10.6 Estimated Budget**

These costs would be in addition to the completion of a feasibility study if required for financing purposes.

**Table 1-11: Summary of Recommendations and Total Costs**

|                                     | <b>Recommended Budget<br/>(\$)</b> |
|-------------------------------------|------------------------------------|
| Geology – Ouro Verde and Grota Seca | 2,541,000                          |
| Geology – South Block               | 3,630,000                          |
| Mining                              | 735,000                            |
| Metallurgy                          | 70,000                             |
| Infrastructure                      | 300,000                            |
| Environmental                       | 300,000                            |
| Feasibility Study                   | 1,000,000                          |
| <b>Total</b>                        | <b>8,510,000</b>                   |



## **2 INTRODUCTION AND TERMS OF REFERENCE**

### **2.1 General**

This report was prepared at the request of Belo Sun Mining Corp. ("Belo Sun" or the "Company"). Belo Sun is an exploration and development company with its key assets located along the major mineralized belt of northern Brazil. The Company is focused on further exploring and advancing their 100% owned Project, approximately 60 km southeast of the town of Altamira in the northern region of Pará State, Brazil. Belo Sun's head office is based in Toronto and publicly trades on the Toronto Stock Exchange (TSX) Venture Exchange.

Belo Sun retained AGP Mining Consultants Inc. (AGP) to carry out a preliminary economic assessment (PEA) of their property. The study utilizes a phased development approach and incorporates the results of the updated National Instrument (NI) 43-101 compliant mineral resource estimation for the Project announced by Belo Sun on 3 October 2013.

### **2.2 Terms of Reference**

AGP independently prepared this NI 43-101 Technical Report on the Volta Grande Project (the Technical Report), to provide a PEA of the Project based on an updated mineral resource estimate for the property (the "October 2013 Mineral Resource Estimate" by SRK, publicly released on 3 October 2013).

This technical report conforms to the standards set out in NI 43-101, Standards and Disclosure for Mineral Projects, and pursuant to Form 43-101F.

All units used in this technical report are metric unless otherwise stated. Grid references are based on the UTM Adindan/Zone 30N projection coordinate system.

All monetary amounts are provided in United States dollars unless otherwise noted.

All illustrations are embedded within the body of the report.

### **2.3 Qualified Persons**

The Qualified Persons (QPs) responsible for the preparation of this technical report, as defined in NI 43-101, are the following:



- Dr. Oy Leuangthong, PhD., P.Geo, Principal Consultant, Geostatistics (SRK)
- Lars Weiershäuser, PhD., P.Geo., Senior Consultant, Geology (SRK)
- Jean-Francois Couture, PhD., P.Geo., Geology (SRK)
- Gordon Zurowski, P.Eng., Principal Mining Engineer (AGP)
- Lyn Jones, P.Eng., Senior Associate Metallurgist (AGP)
- Justin Taylor, P.Eng., Senior Mechanical Engineer, Associate Project Manager (AGP).

All QPs of AGP and SRK are independent of Belo Sun or of any company associated with Belo Sun.

## 2.4 Site Visits and Responsibilities

AGP and SRK have conducted site visits to the Project as shown in Table 2-1.

**Table 2-1: Date of Site Visits and Areas of Responsibility**

| QP Name               | Site Visit Dates                                 | Area of Responsibility                                                                                                                                                                                                                                                                                       |
|-----------------------|--------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Dr. Oy Leuangthong    | 2 – 5 May 2012<br>11 – 14 January 2013           | Sections 1.1, 1.2, 1.10.1, 4 to 12, 14, 23, 25.8, 26.2, and 27.1                                                                                                                                                                                                                                             |
| Lars Weiershäuser     | 28 – 30 April 2012 and<br>19 and 21 October 2012 | Sections 1.1, 1.10.1, 4 to 12, 25.1, 26.2.1, and 26.2.2                                                                                                                                                                                                                                                      |
| Jean-Francois Couture | No Site Visit                                    | Sections 1.1, 1.2, 1.10.1, 4 to 14, and 26.2                                                                                                                                                                                                                                                                 |
| Lyn Jones             | 18 – 20 July 2013                                | Sections 1.5, 1.10.3, 13, 17, 21.1.3, 21.1.4, 21.2.3, 25.3, 25.6 (metallurgy and processing portions) 26.4 and 26.7 (metallurgy portion)                                                                                                                                                                     |
| Gordon Zurowski       | 21 – 23 October 2012                             | Sections 1.3, 1.4, 1.7 to 1.9, 1.10.2, 1.10.5 to 1.10.6, 2, 3, 15, 16, 19, 20, 21.1.1, 21.1.2, 21.1.6 to 21.1.9, 21.2.1, 21.2.2, 21.2.4 to 21.2.7, 22 to 24, 25.2, 25.5, 25.6 (General, Geology, Mining, Economic Analysis) 26.1, 26.3, 26.6 and 26.7 (Geology, Mining, Environmental and Feasibility study) |
| Justin Taylor         | No Site Visit                                    | Sections 1.6, 1.10.4, 18, 21.1.5, 25.4, 25.6 (Infrastructure portions) and 26.5                                                                                                                                                                                                                              |

During the site visit, items such as logistics/transportation, mining site, infrastructure, geology, and geotechnical assessment of the drill core and mine staffing issues were assessed. Core for the metallurgical test program was observed by Lyn Jones prior to transport to the laboratory in Chile. This satisfies the condition of a site visit performed by independent qualified personnel for NI 43-101 regulations.



## **2.5 Effective Dates**

The effective date of the PEA for the Project is 31 March 2014.

The effective date of the Mineral Resource estimate at Volta Grande is 3 October 2013.

## **2.6 Previous Technical Reports**

Various previous NI 43-101 compliant technical reports were completed for the Project:

- NI 43-101 Report on the Volta Grande Gold Property, Brazil, for Verena, dated 31 May 2004 (Agnerian, 2004)
- Technical Report on the Volta Grande Gold Property, Brazil, for Verena, dated 12 December 2005 (Agnerian, 2005)
- NI 43-101 Preliminary Assessment on the Volta Grande Project, Pará, Brazil, for Verena, dated 23 September 2009 (Agnerian and Krutzelmann, 2009)
- NI 43-101 Technical Report on the Ouro Verde Deposit, Volta Grande Project, Pará, Brazil, for Belo Sun, dated 5 November 2010 (Agnerian, 2010)
- NI 43-101 Technical Report on the Volta Grande Project, Pará State, Brazil, for Belo Sun, dated 25 February 2011 (Agnerian, 2011)
- NI 43-101 Mineral Resource Technical Report for the Project, Pará, Brazil, dated 7 March 2012 (SRK, 2012a)
- NI 43-101 Mineral Resource Technical Report for the Project, Pará, Brazil, dated 8 June 2012 (SRK, 2012b)
- NI 43-101 Mineral Resource Technical Report for the Project, Pará, Brazil, dated 31 January 2013 (SRK, 2013)
- Prefeasibility Study Report on the Volta Grande Project, NI 43-101, Pará, Brazil, dated 21 June 2013 (AMEC, 2013).

These reports are filed on the SEDAR website ([www.sedar.com](http://www.sedar.com)).



### **3 RELIANCE ON OTHER EXPERTS**

AGP has followed standard professional procedures in preparing the content of this PEA. This report is based on information believed to be accurate at the time of its completion and the data used has been verified where possible.

AGP has not verified the legal status or legal title to any permit, or to the legality of any underlying agreements for the subject properties regarding mineral rights, surface rights, permitting, and environmental issues in sections of this technical report. AGP has relied on the expert advice of Azevedo Sette Advogados (10 October 2012) and information supplied by Departamento Nacional de Produção Mineral of Brazil for the explanation of Mineral Tenure, surface rights, and permitting

The QPs from AGP have also relied on information regarding environmental liabilities supplied by Belo Sun. This includes any information relating to the status of social and community impacts.

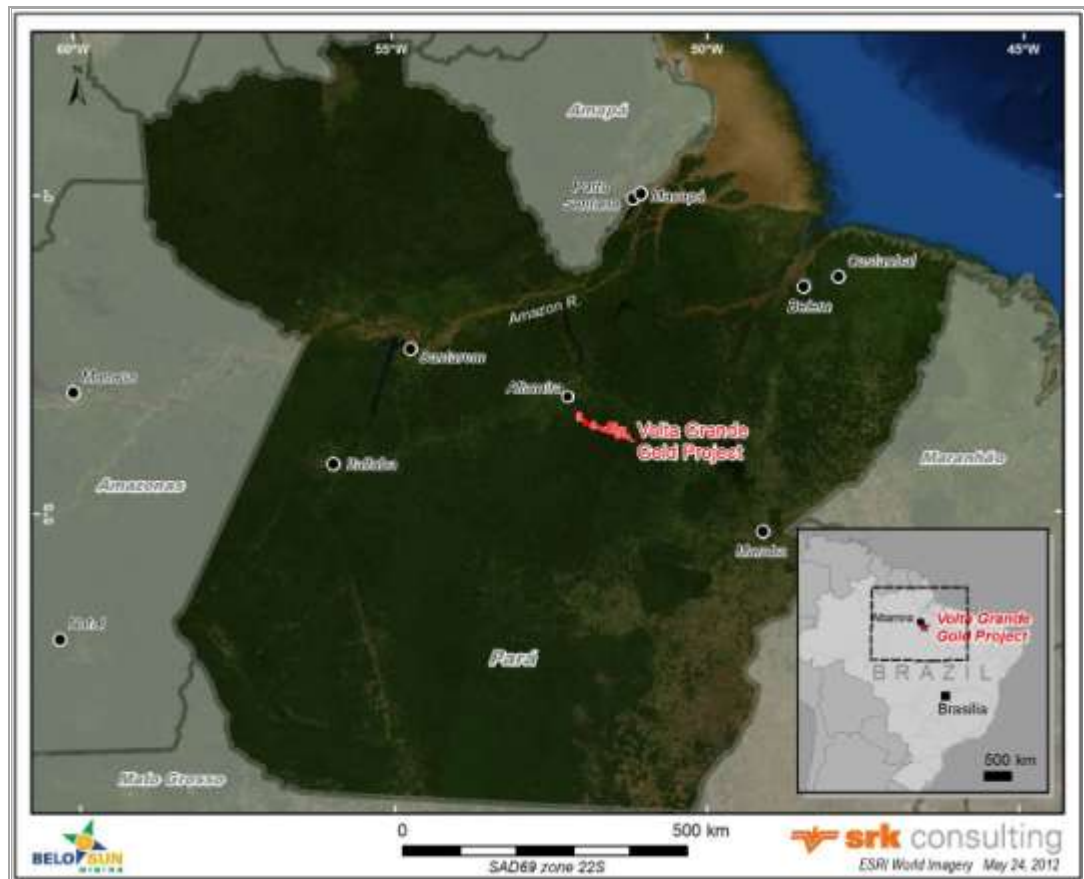
Taxation, as outlined in Section 22, was completed based on guidance from Belo Sun and L&M Advogados, Brasília, Brazil. AGP has relied on their information.

## 4 PROPERTY DESCRIPTION AND LOCATION

The Project comprises 18 contiguous exploration permits, four mining concession applications, and 23 exploration applications, covering a total area of 178,559.30 ha. It is located in the municipality of Senador José Porfírio in the northern region of Pará State in northern Brazil (Figure 4-1).

The Project is close to the Xingu River, north of the Carajás mineral province, approximately 60 km southeast of the city of Altamira.

Figure 4-1: Location Map





## **4.1 Mineral Tenure**

Belo Sun holds a 100% interest in the Project through its wholly owned subsidiary Belo Sun Mineração Ltda. The project comprises 18 exploration permits, covering an area of 99,168.68 ha; four mining concession applications, covering an area of 2,356.41 ha, 14 exploration applications for exploration in mineral rights, covering an area of 44,374.01 ha; and nine exploration applications for exploration in mineral rights in public tender, covering an area of 32,660.20 ha; five of the exploration applications in public tender are in a priority regime (Figure 4-2).

Exploration applications by public tender process are for lands that have been held by other landholders, but have been allowed to lapse. Table 4-1 summarizes the mineral tenure information for the exploration permits and exploration applications.

The *Departamento Nacional de Produção Mineral* (DNPM) (National Department of Mineral Production) is responsible for the management of exploration and mining activities in Brazil, and it is under the control of the Ministry of Mines and Energy (MME). Exploration permits do not have physical boundaries, but are issued based on digital geographic map staking, that is, they are not required to be legally surveyed and are subject to an annual rental fee of R\$2.36/ha (BRL 1.00  $\approx$  C\$0.50, October 2013) to the state government of Pará.

Even though the exploration permits have already expired, the mineral rights remain fully valid and in force during the period of analysis by the DNPM.

According to the legal opinion of Azevedo Sette Advogados (12 December 2012), the mineral rights for the exploration permits are all valid, regular, and in good standing. Belo Sun is in compliance with the mining regulation related to the mining rights, which includes meeting the requirements of the DNPM rules, the payment of the annual fee per hectare, or any other applicable fees.

No decisions have been received on the exploration applications in public tenders. Belo Sun is the only applicant in the public tender process.

No royalties are currently due since the Project mineral rights are currently in phases of exploration permit and exploration application.

The mineral rights are not located within buffer zones of environmental conservation units, indigenous areas, or areas dedicated to land reform purposes.

**BELO SUN MINING CORP.**

PRELIMINARY ECONOMIC ASSESSMENT, NI 43-101

VOLTA GRANDE PROJECT

PARÁ, BRAZIL



**Figure 4-2: Land Tenure Map**

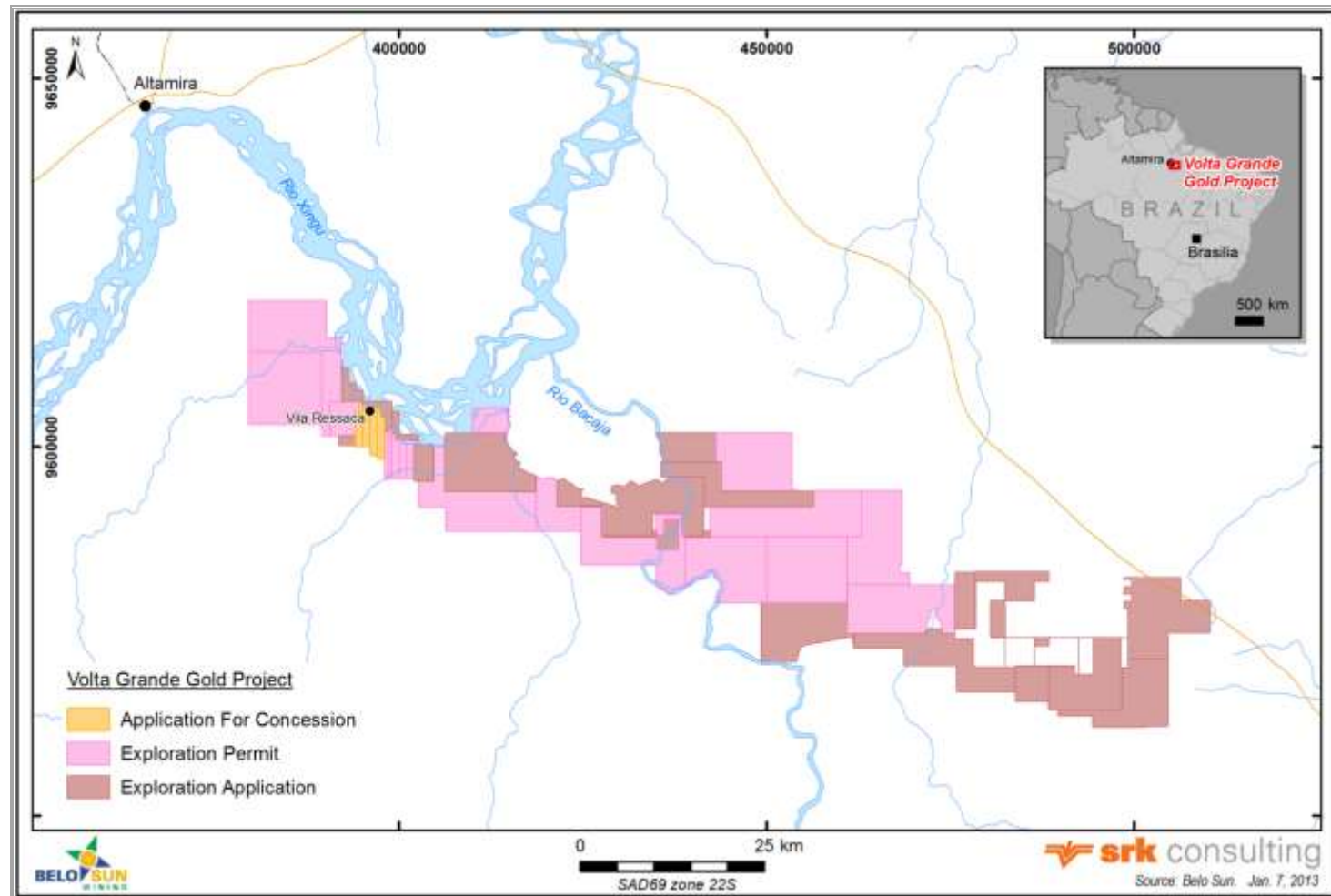




**Table 4-1: Mineral Tenure Information**

| DNPM-ID      | Area (ha) | Company                  | Phase             | Status                      | Expiry Date (dd/mm/yy) |
|--------------|-----------|--------------------------|-------------------|-----------------------------|------------------------|
| 850.253/01   | 481.83    | Oca Mineração Ltda.      | Exploration       | Permit                      | 28/06/14               |
| 850.507/11   | 311.99    | Belo Sun Mineração Ltda. | Exploration       | Permit                      | 28/06/14               |
| 850.249/01   | 1,730.86  | Belo Sun Mineração Ltda. | Exploration       | Extension Submitted         |                        |
| 850.250/01   | 1,256.96  | Belo Sun Mineração Ltda. | Exploration       | Permit Extension            | 05/07/14               |
| 850.977/06   | 2,311.62  | Belo Sun Mineração Ltda. | Exploration       | Permit Extension            | 05/07/14               |
| 850.439/08   | 324.98    | Belo Sun Mineração Ltda. | Exploration       | Extension Submitted         |                        |
| 850.312/10   | 9,884.05  | Belo Sun Mineração Ltda. | Exploration       | Permit, Extension Submitted | 30/12/13               |
| 850.311/10   | 7,731.66  | Belo Sun Mineração Ltda. | Exploration       | Permit                      | 21/06/14               |
| 850.315/10   | 8,750.81  | Belo Sun Mineração Ltda. | Exploration       | Permit                      | 21/06/14               |
| 850.316/10   | 3,114.04  | Belo Sun Mineração Ltda. | Exploration       | Permit                      | 21/06/14               |
| 850.702/11   | 8,358.97  | Belo Sun Mineração Ltda. | Exploration       | Permit                      | 05/08/14               |
| 850.698/11   | 7,937.24  | Belo Sun Mineração Ltda. | Exploration       | Permit                      | 05/08/14               |
| 850.699/11   | 7,995.43  | Belo Sun Mineração Ltda. | Exploration       | Permit                      | 05/08/14               |
| 850.700/11   | 9,246.10  | Belo Sun Mineração Ltda. | Exploration       | Permit                      | 05/08/14               |
| 850.701/11   | 9,900.00  | Belo Sun Mineração Ltda. | Exploration       | Permit                      | 05/08/14               |
| 850.696/11   | 8,448.89  | Belo Sun Mineração Ltda. | Exploration       | Permit                      | 05/08/14               |
| 850.697/11   | 9,728.63  | Belo Sun Mineração Ltda. | Exploration       | Permit                      | 05/08/14               |
| 850.314/10   | 1,654.62  | Belo Sun Mineração Ltda. | Exploration       | Permit                      | 03/10/14               |
| Subtotal (1) | 99,168.68 |                          |                   |                             |                        |
| 805.657/76   | 522.02    | Belo Sun Mineração Ltda. | Mining Concession | Application                 |                        |
| 805.658/76   | 552.02    | Belo Sun Mineração Ltda. | Mining Concession | Application                 |                        |
| 805.659/76   | 645.07    | Belo Sun Mineração Ltda. | Mining Concession | Application                 |                        |
| 812.559/76   | 637.3     | Belo Sun Mineração Ltda. | Mining Concession | Application                 |                        |
| Subtotal (2) | 2,356.41  |                          |                   |                             |                        |
| 850.313/10   | 1,359.04  | Belo Sun Mineração Ltda. | Exploration       | Application                 |                        |
| 850.013/11   | 8,139.23  | Belo Sun Mineração Ltda. | Exploration       | Application                 |                        |
| 851.668/11   | 10.38     | Belo Sun Mineração Ltda. | Exploration       | Application                 |                        |
| 850.265/12   | 5,081.59  | Belo Sun Mineração Ltda. | Exploration       | Application                 |                        |
| 850.266/12   | 283.92    | Belo Sun Mineração Ltda. | Exploration       | Application                 |                        |
| 850.624/12   | 25.12     | Belo Sun Mineração Ltda. | Exploration       | Application                 |                        |
| 850.625/12   | 145.97    | Belo Sun Mineração Ltda. | Exploration       | Application                 |                        |
| 850.626/12   | 109.48    | Belo Sun Mineração Ltda. | Exploration       | Application                 |                        |
| 851.220/12   | 565.32    | Belo Sun Mineração Ltda. | Exploration       | Application                 |                        |
| 850.692/11   | 1,284.54  | Belo Sun Mineração Ltda. | Exploration       | Priority Application        |                        |
| 850.693/11   | 8,656.74  | Belo Sun Mineração Ltda. | Exploration       | Priority Application        |                        |
| 850.694/11   | 8,070.12  | Belo Sun Mineração Ltda. | Exploration       | Priority Application        |                        |
| 850.695/11   | 2,992.62  | Belo Sun Mineração Ltda. | Exploration       | Priority Application        |                        |
| 850.703/11   | 7,649.94  | Belo Sun Mineração Ltda. | Exploration       | Priority Application        |                        |



| DNPM-ID      | Area (ha)         | Company                  | Phase       | Status                    | Expiry Date (dd/mm/yy) |
|--------------|-------------------|--------------------------|-------------|---------------------------|------------------------|
| Subtotal (3) | 44,374.01         |                          |             |                           |                        |
| 850.214/04   | 696.6             | Belo Sun Mineração Ltda. | Exploration | Application Public Tender |                        |
| 850.092/01   | 1,000.01          | Belo Sun Mineração Ltda. | Exploration | Application Public Tender |                        |
| 850.632/08   | 2,088.17          | Belo Sun Mineração Ltda. | Exploration | Application Public Tender |                        |
| 850.633/08   | 1.72              | Belo Sun Mineração Ltda. | Exploration | Application Public Tender |                        |
| 850.633/08A  | 2,168.26          | Belo Sun Mineração Ltda. | Exploration | Application Public Tender |                        |
| 850.635/08   | 3,598.74          | Belo Sun Mineração Ltda. | Exploration | Application Public Tender |                        |
| 850.636/08   | 7,007.65          | Belo Sun Mineração Ltda. | Exploration | Application Public Tender |                        |
| 850.637/08   | 9,007.66          | Belo Sun Mineração Ltda. | Exploration | Application Public Tender |                        |
| 850.639/08   | 7,091.39          | Belo Sun Mineração Ltda. | Exploration | Application Public Tender |                        |
| Subtotal (4) | 32,660.20         |                          |             |                           |                        |
| <b>Total</b> | <b>178,559.30</b> |                          |             |                           |                        |

The tenements containing the mineral resources at the Ouro Verde and Grota Seca areas of the project are 805.657/1976, 805.658/1976, 805.659/1976, and 812.559/1976. On 12 September 2012, the DNPM approved the final exploration report for the Volta Grande project. As a result, Belo Sun has made an application to the DNPM (Application for Concession) to convert the four exploration permits that contain the mineral resource to mining leases by August 2013, or earlier. By 19 October 2013, the DNPM had not reached a decision on this application.

## 4.2 Underlying Agreements

In February 2004, Verena Minerals Corporation (Verena) entered into an agreement with *Oca Mineração Ltda.* (Oca), whose controlling shareholder is Confab Industrial S.A., a member of the Tenaris Group, to acquire a 100% interest in the Project. Under terms of the agreement, Verena would acquire 100% of the Project by making payments totalling \$3 million over four years. In September 2005, an agreement was signed modifying the terms of the acquisition of the Project. Under the modified agreement, Verena would pay Confab a total of \$600,000, of which \$62,500 had been paid. The balance outstanding would be paid in six months from the signing of the modified acquisition agreement. In addition, Verena would pay to the Bank of Pará approximately \$1,500,000 on favourable terms. The loan would be paid beginning in two years, only if Verena has produced a bankable feasibility study. Principal and interest can be paid over 10 years on a quarterly basis.

In June 2006, Verena completed an agreement with the *Companhia de Pesquisa de Recursos Minerais* (CPRM), a Brazilian state-owned geological survey company, to replace CPRM's corporate guarantee on the Project. Verena committed to paying



approximately \$1.5 million to CPRM if a mineable deposit is defined on the property, and to investing a minimum of \$1.5 million at the Project over two years.

In October 2006, Verena closed the acquisition of the Project by putting \$1,722,708 on deposit; being the total amount outstanding that would be owed by Verena to CPRM should the company produce a bankable feasibility study for the Project.

In March 2008, Verena renegotiated the terms of the security held by CPRM. Under the new terms, CPRM agreed to release to Verena approximately \$2,035,738 of the total term deposit of approximately \$2,467,708 held in security to cover the company's debt owed to CPRM. In addition, the company allocated the balance of the original term deposit that was not released, amounting to approximately \$430,000, to be retained in an interest-bearing term deposit to cover the next eight quarterly payments, starting with the March 2008 quarter.

In February 2010, Forbes & Manhattan Inc. (F&M), a private investment firm based in Toronto, Canada, invested in Verena through a private placement of C\$6 million in Verena. Subsequently, Verena was renamed Belo Sun Mining Corp. (Belo Sun).

The Project is located in an area comprising three farms: Fazenda Ouro Verde, Fazenda Ressaca, and Fazenda Galo de Ouro, which are currently under the domain of squatters. Between 15 May and 22 May 2012, Belo Sun acquired the properties, and thus surface rights. Under the agreement, the squatters had until the end of April 2013 to vacate the properties. According to Belo Sun, all squatters have vacated the premises and Belo Sun erected fencing around the *garimpos* (illegal mining sites) in order to secure them. To ensure compliance, Belo Sun paid 50% of the agreed purchase price to the landowners; the remaining 50% of the purchase price was paid once all squatters had vacated the properties.

### **4.3 Permits and Authorization**

The following has been extracted from the legal title option by Azevedo Sette Advogados (7 December 2012):

*Mineral rights in exploration phase or public tender processes require no environmental operation licences at the federal level, except in the case of exploration activities that involve deforestation or the use of significant quantity of water resources. The current exploration activities at the Volta Grande gold project do not involve deforestation and the use of water, and thus do not require a specific environmental authorization at the federal level.*



*Pará State environmental law sets forth that drilling activities shall be licenced by the Pará State Environmental Authority (Secretaria de Estado de Meio Ambiente – SEMA). Belo Sun has received an operating licence (License Number 4115/2010) for exploration permits 805.657-659/1976, 812.559/1976, 805.249/2001, and 850.250/2001. The operating licence was issued on 27 January 2010 with an expiry date of 27 January 2012. Belo Sun filed a renewal application with the environmental agency on 8 August 2011, within the statutory period required by law. According to Belo Sun, the application is under consideration but no final response has been received by Belo Sun. As such, the old operating license is considered valid until a formal reply has been received by Belo Sun. Furthermore, the application for renewal also includes a request for the respective environmental license to perform drilling activities on ground covered by exploration permits 850.253/2001, 850.439/2008, and 850.507/2011, in addition to exploration permits discussed above.*

*Belo Sun has requested a preliminary license from SEMA, which is necessary to carry out exploitation activities on exploration permits 805.657-659/1976 and 812.559/1976, once exploitation permits are approved and issued by the DNPM.*

*A public hearing was held by SEMA on 13 September 2012. The execution of such public hearing is established by federal environmental regulation (CONAMA Administrative Rules 01/1986 and 09/1987) and by the Law 5.887/1995 of the State of Pará. The public hearing is part of the standard preliminary licensing process and involves the analysis of the EIA/RIMA submitted by Belo Sun. Thus, the execution of the public hearing indicates that the environmental licensing procedure has been conducted according to the applicable regulations.*

*Belo Sun has all environmental licences necessary for the current stage of the Volta Grande gold project. The operation licence granted to Belo Sun is fully valid and in force and its terms and conditions have been fulfilled by Belo Sun. Any drilling activities recommended on the other exploration permits will require an operating license.*

#### **4.4 Environmental Considerations**

The following has been extracted from the legal title opinion by Azevedo Sette Advogados (2012):

*Title holders are responsible for any environmental damages to the area even if the damages were caused by third parties prior to Belo Sun acquiring and carrying out exploration work on the properties. Belo Sun may be liable for environmental damages eventually caused by irregular small-scale miners (garimpeiros) that operate minor illegal mining activities in some areas within the limits of the Volta Grande gold project. Belo Sun has not received any infraction notice or summons regarding eventual environmental liabilities pursuant to the Volta Grande gold project.*



## 4.5 Mining Rights in Brazil

The following has been extracted from the legal tile opinion provided by Azevedo Sette Advogados (2012):

*As set forth in Article 14 of the Mining Code (Law Decree # 227/1967) and in Article 18 of its Regulation (Regulatory Decree n. 62.934/1968), mineral exploration comprises the necessary work performed in order to measure and evaluate a mine and its technical and economic feasibility. The DNPM grants the authorization to an interested party to perform mineral exploration works by means of a specific title named exploration permit (Alvará de Pesquisa). Such document allows the performance of exploration works in the mineral rights' areas.*

*In order to obtain the exploration permit, the mining company shall submit an application to the DNPM, the so termed exploration application (Requerimento de Pesquisa), according to the provisions set forth in Article 16 of the Mining Code. The Brazilian Mining Code does not define a time frame for the DNPM to analyze and approve the exploration application, including in public tenders. Applicants will have priority over the mineral right area according to the date their application was submitted and until the DNPM's decision over the exploration application such titleholder priority right shall be valid and in force. After the analysis of the exploration application, the DNPM shall issue the exploration permit that shall be valid for a period of one to three years. As established in Article 22, III, of the Mining Code, this period may be extended, subject to the analysis and approval of the exploration reports by DNPM.*

*Article 22 of the Mining Code also sets forth that the holder of the exploration permit (i) may assign or transfer it, provided that the assignee fulfills the legal conditions to hold the title; (ii) may, at any time, relinquish the exploration permit; (iii) shall be exclusively responsible for damages caused to third parties as a result of the performance of the mineral exploration works; (iv) shall submit to DNPM a detailed report on the exploration works prior to the final term of the exploration permit, the mineral exploration report (Relatório de Pesquisa); and (v) pay to DNPM the annual fee per hectare (Taxa Anual por Hectare) once a year, in January or July, depending on the semester that the exploration permit was issued by DNPM, until the end of the exploration works.*

*By means of the mineral exploration report, the mining company shall decide if the exploitation of the mineral right is technically and economically feasible or not. The mineral exploration report shall be submitted to the analysis of DNPM, which shall approve it, according to the mineral exploration report and under objective criteria.*

*It is worth mentioning that the Brazilian Mining Code does not define a time frame for the DNPM to analyze and approve the mineral exploration report, therefore, the DNPM may issue the mining concession at its own time. During the period in which the report is under DNPM's analysis, the mining company continues to be the sole and lawful*



*titleholder of the exploration permit, which remains valid and in force. Meanwhile, the mining company has all the rights and interests connected to such mineral right protected.*

*If the mineral exploration report is approved by the DNPM, the holder of the exploration permit shall then, according to Article 31 of the Mining Code, have the right to apply for the exploitation permit (Concessão de Lavra) within one year. This one year period may be extended by DNPM once, for another year, in case the titleholder requires the extension prior to the expiration of the first year term.*



## **5 ACCESSIBILITY, CLIMATE, LOCAL RESOURCES, INFRASTRUCTURE, AND PHYSIOGRAPHY**

### **5.1 Accessibility**

The Project is located approximately 60 km southeast of the City of Altamira.

Accessing the Project takes approximately two hours, and it can be done either by river, in a small motorboat along the Xingu River, or by land first by crossing the Xingu River by barge, and taking a dirt road (BR-158) to the stretch of river known as the Big Bend (or *Volta Grande*) of the Xingu River where the exploration camp is situated near the river's right bank. Due to the construction of the Belo Monte hydroelectric dam, the road access from Altamira to the dam construction site is being paved. From the construction site, approximately halfway between Altamira and the Project, the road is unpaved, but in good condition.

Belo Sun does not have information on changes to river travel times once damming of the Xingu River is complete.

Altamira can be accessed by road via the *Rodovia Transamazônica* (Transamazon Highway) (BR-2300) in Brazil or by plane via Altamira's airport that is served on a daily basis by a number of regional airlines.

### **5.2 Local Resources and Infrastructure**

The city of Altamira is situated along the Xingu River, in the north of the municipality of Altamira, which has a population of approximately 100,000. Infrastructure for mining equipment and experienced mining personnel are available in Altamira. Altamira is linked to the Pará State power grid.

The property is located north of the Carajás mineral province, which has a long mining history. However, local infrastructure is poor for mining activities since the property is located in a remote area.

Two main diesel generators operating alternately during the day and night provide electric power at the property. A third generator is dedicated to the operation of rock saws. Water is available from wells on the property, as well as from the Xingu River, which drains the general area. Well water is treated on-site continuously with chlorine,



and stored in a water tower outside of the camp perimeter. Telephone communication and internet service are available on the property.

Since mid-2012, a mechanics shop has been set up, primarily to maintain the vehicle fleet on site. A small carpentry shop is equipped to produce and maintain most wooden implements at the camp. Core storage is being built on the site, as the need arises with ongoing drilling.

Recently, the Brazilian federal government completed the planning for the construction of the Belo Monte hydroelectric power dam. Construction is now ongoing. The dam will be situated approximately 2 km north from the western property boundary and 15 km upriver from the property campsite. When the dam is completed, it will generate approximately 11000 MW and will supply electric power to the property campsite. Construction of the dam will also provide better quality road access from Altamira.

There are a number of small settlements within the property, including the village of Ressaca, along the Xingu River, and the village of Itatá, which is approximately 3 km south-southeast of the Project. Irregular small-scale miners (*garimpeiros*) who undertake illegal mining activities on the property predominantly inhabit both of these villages.

### **5.3 Climate**

The climate in northwestern Brazil is tropical, with a rainy season from January to April and a dry season extending from June to December. The mean temperature is nearly the same (25°C to 30°C) throughout the year. The relative humidity ranges from about 65% to 85%.

### **5.4 Physiography**

The Project is in an area of low topographic relief, generally on the order of 50 m. The dominant topographic feature is the valley of the meandering and northeast flowing Xingu River, and the Itatá River, which drains into the Xingu River in the eastern part of the property. The topographic elevation of the low-lying areas ranges from 100 masl to 120 masl.

The Project is moderately forested. Land in neighbouring areas is used for agriculture, mainly cattle grazing.

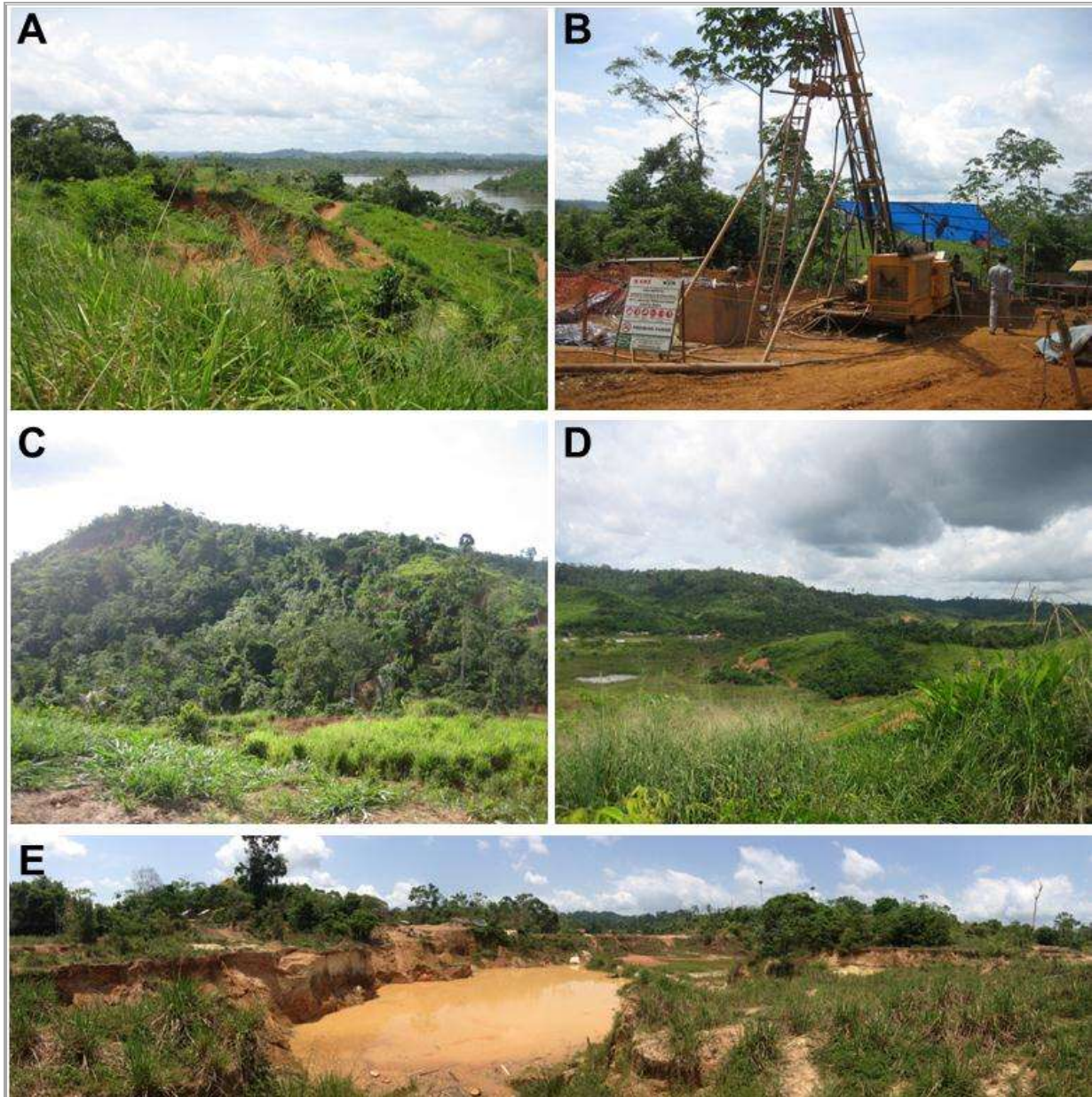
The area around the Project comprises a number of small hills separated by north and northwest trending valleys in a tropical rainforest, with occasional outcrops. On hilltops



and flanks of hills, occasional tall Brazil nut trees are present, and are reported to be exempt from harvesting by the Brazilian government. Vegetation in low-lying areas consists predominantly of tall grass and fern, typical of tropical rainforests.

Occasional outcrops of saprolitic material are present on the property; overburden thickness ranges from 3 m to more than 10 m. Typical lateritic and saprolitic profiles are observed in the many small open pits, as well as in the collars of the diamond drill boreholes. For general impressions of the project area, refer to Figure 5-1 A to E.

**Figure 5-1: Typical Landscape in the Project Area**



- Notes:**
- A)** View to the northeast across the southeast end of the Ouro Verde deposit, forming locally eroded ridge in middle ground, Xingu River in the background.
  - B)** Drilling operation at Borehole VVGD 387.
  - C)** View from Borehole 225 across main area of Grota Seca.
  - D)** View toward the east, the small knoll in middle ground forms the connecting zone between the Ouro Verde and Grota Seca deposits; houses belong to village of Ressaca.
  - E)** View toward the west showing the Grande Garimpo, near Itatá village in the South Block area.

## 6 HISTORY

Extraction of gold in the eastern Amazon region dates back to Portuguese colonization in the 17<sup>th</sup> century. The discovery of gold along the stretch of the Xingu River known as the Big Bend, or *Volta Grande*, where the Project is located, occurred in the early 20<sup>th</sup> century. Since the 1950s, irregular small-scale miners (*garimpeiros*) have worked in small alluvial deposits in the Project area, especially in the area of the South Block. In the 1990s, the *garimpeiros* started to exploit saprolite and fresh rock deposits, constructing shafts that appear to reach considerable depths (Figure 6-1 A and B). Early research was undertaken in the 1970s, and systematic exploration started in the late 20<sup>th</sup> century.

The Project is also located within the Três Palmeiras Greenstone Belt, which hosts numerous gold occurrences.

**Figure 6-1: Typical Garimpeiro Operation in Saprolite and Hard Rock**



**Notes:** A) "Headframe"  
B) View into shaft showing the considerable depth of the operation.

### 6.1 Prior Ownership and Changes

*Oca Mineração Ltda.* (Oca) owned the Project in the 1970s.

From 1996 to 1998, a company created in partnership between Oca and the EBX Group (*TVX Participações S.A.* [TVX] and *Battle Mountain Gold Mineração* [BMG] in a joint venture with *Companhia Nacional de Mineração* [CNM]), *Volta Grande Mineração Ltda.* (VGML) acquired interests in the Project. In 1998, TVX and BMG terminated their joint venture agreement with CNM and transferred all their interests back to Oca. In 2004,



TVX merged with Kinross Gold Corporation, and Newmont Mining Corporation acquired BMG.

Verena Minerals Corporation (Verena) acquired a 100% interest in the Project under an agreement with Oca in 2004. Verena was renamed Belo Sun Mining Corp. in February 2010. Since 2004, Verena and Belo Sun have carried out systematic exploration on the Project (refer to Section 8 for exploration by Belo Sun).

## **6.2 Previous Exploration Work**

Historical exploration since the 1970s has been divided into work done by Oca (1970s), VGML (1996 to 2004), and Verena (2004 to 2009).

Exploration work reportedly also included lithological sampling (totalling 95 samples), construction of underground workings, sampling, and mining on one level, as well as bulk sampling (Belo Sun, 2011). No details or results are available.

### **6.2.1 Oca Mineração Ltda., 1970s**

Oca performed preliminary research on the project property in the 1970s. Prospecting work, including field observations and sampling, confirmed the existence of gold at varying levels of concentration.

Initial work by Oca determined areas of interest. The company did a literature study aimed at better understanding the regional geology. This work included the interpretation and review of aerial photographs at a 1:60,000 scale, dated 1976, and was aimed at identifying areas with alluvial potential. Further aerial photography was flown over areas of interest. These aerial photographs were used to produce base maps at 1:50,000 and 1:25,000 scales to support field work.

Once favorable areas were defined, a grid (800 m x 200 m) was established. Exploration wells in the alluvium were completed, using two machines from Maquesonda with 4" diameter drill bits. Oca carried out sampling of veins and geological mapping on the 1:10,000 scale. Oca built a base camp in the area to support this work.

### **6.2.2 Volta Grande Mineração Ltda., (1996 to 2004)**

From 1996 to 1998, systematic exploration was carried out by VGML covering what was later defined as the South and North blocks.

VGML's exploration work on the Project outlined approximately nine target areas based on significant gold results. These target areas were combined into four groups. Diamond



drilling results (refer to Section 9) were used to complete a historical mineral resource estimate for which preliminary pit designs were produced.

The exploration work carried out by VGML and its results are discussed below.

### ***Regional Exploration***

Prospecting by stream sediment and rock sampling covered an area of 64 km<sup>2</sup> with 41 sampling stations, sampling on average every 1.5 km<sup>2</sup>. Samples were analyzed for copper, zinc, lead, arsenic, and gold. Two regional anomalies were outlined and named South Block and North Block.

### ***Soil Geochemistry***

Soil sampling was executed on a grid of 200 m x 200 m; 1,711 samples were collected and analyzed.

Samples were collected from the B-horizon, some 50 cm below the A-horizon, which is rich in humus material. Sample preparation methods included drying and screening. The -80-mesh aliquot was sent for geochemical analyses by atomic absorption (AA). The samples were sent to NOMOS, a laboratory owned by Rio Tinto Mining in Brazil. Analytical procedures included acid digestion, and gold, copper, lead, zinc, and nickel determinations using the AA method. In addition, arsenic determination was carried out on the samples using the colorimetric method.

Results outlined an anomalous area coinciding with the regional northwest–southeast trend, and extending 5 km along strike with an average width of 1.2 km.

Results outlined two narrow anomalies, named Area 1 and Area 2, within the North Block (Agnerian, 2004). Area 1 is defined by a contour line of 400 ppb gold. It is 200 m to 300 m wide and approximately 2 km long, located at the contact zone between metasedimentary rocks in the south, and syntectonic diorite in the north. Area 2, situated approximately 1 km north of Area 1, is 50 m to 100 m wide and approximately 1.2 km long. Area 2 is underlain by mafic metavolcanic rock, close to the northern contact zone with diorite. Agnerian (2004) also reported that an additional 1,282 samples were taken.

### ***Geological Mapping***

Geological mapping detected the main lithologic contact between a syntectonic diorite in the north and an assemblage of metasedimentary and metavolcanic rock in the south. Geological mapping also identified several northeast-trending cross faults.



### ***Auger Drilling***

Auger drilling was executed on grids of 200 m x 20 m and 100 m x 20 m. A total of 874 boreholes were drilled, comprising 5,943 m.

Auger drill samples were taken on 1-m intervals, yielding a total of 2,923 samples that were collected and analyzed. The sampling preparation methods included drying, splitting using a Jones splitter, and pulverizing:

- collecting of a 7.5-kg (1 m long) sample. If the sample was wet, then it was dried
- crushing the sample to 20 mesh, thoroughly mixing it and splitting it using a Jones splitter, and separating a 2-kg aliquot for processing
- pulverizing the 2-kg subsample to 200 mesh using a Ring mill
- thoroughly mixing the sample and splitting it again using a Jones splitter
- separating a 250-g aliquot for assay, and keeping the remaining 1.75-kg reject in temporary storage for further processing
- sending the 250-g sample to NOMOS for gold assays. At NOMOS, this sample was further separated into 50-g and 200-g portions, fire assaying was carried out on the 50-g portion; the 200-g portion was archived.

Results also detected an anomalous zone similar to the soil geochemical anomaly, and delineated a narrow zone of 100 m x 750 m containing a concentration greater than 1,000 ppb of gold.

### ***Channel Sampling***

Channel sampling was done at 1-m intervals, yielding 989 samples that were collected and analyzed. The methods for sample preparation are similar to the auger drilling sampling.

### ***Mineralogical Studies***

In August 1996, a petrographic study was carried out on six thin sections of rocks from the Project. Results of this study indicated that three samples were composed of monzodiorite, two samples were of rhyolitic composition, and one sample was of dacitic composition (Agnerian, 2004).

In November 1996, CNM carried out a petrographic study on four polished sections of rocks from the Project. The rocks were brecciated, and exhibited intense hydrothermal alteration with boron enrichment (tourmaline alteration). Results of this study indicated that two samples (VPS-01 and VPS-03) consisted of tourmaline–scorodite rock and tourmaline–scorodite–arsenopyrite rock. Nineteen grains of native gold were detected, ranging in size from 5 µm to 75 µm, mostly in the transparent gangue of sample VPS-03.



Gold particles were mostly string like, possibly filling small fractures (Agnerian, 2004). Sample VPS-04 was classified as tourmaline quartzite and sample VPS-02 was classified as mylonitic tonalite.

### 6.2.3 *Verena Minerals Corporation, (2004 to 2009)*

Starting in 2004, Verena carried out systematic exploration on the Project, including testing the various anomalies and/or target areas outlined by VGML. Exploration work carried out and the results are discussed below.

#### ***Airborne Geophysical Survey***

From 21 May to 7 June 2007, *Fugro/Engenharia e Prospecções S.A. (Fugro)* of Rio de Janeiro, Brazil carried out a combined airborne magnetic and radiometric survey over the entire property. Flight lines (north–south) were spaced 200 m apart, with control lines (east–west) 2,000 m apart; ground clearance was 50 m. The objective of this survey was to obtain baseline data and associated parameters in relation to gold mineralized areas that have been (and still are being worked) by *garimpeiros*. A further goal was to identify possible locations for infrastructure for conceptual development of the area. In total, approximately 3,087 line km were flown, covering an area of 55 km<sup>2</sup>. Results of the airborne geophysical survey indicated that linear magnetic highs correspond to areas underlain by intrusive rocks.

#### ***Geochemical Surveys***

In 2007, Verena carried out soil sampling, totalling 4,427 samples. As a result of this work seven previously unknown anomalous areas in the South Block and one previously unknown anomalous area in the North Block were identified.

## 6.3 Previous Mineral Resources Estimates

A historic mineral resource estimate was prepared by VGML in 1998 (Agnerian, 2004) considering the core drilling data. At a cutoff grade of 0.80 g/t Au the unclassified mineral resources were estimated at 17,050,743 tonnes grading an average of 2.34 g/t Au, or 1.4 Moz of gold. The historical mineral resource was estimated using polygonal methodology on vertical sections. Densities of 2.795 g/cm<sup>3</sup> for dry rock and 1.225 g/cm<sup>3</sup> for saprolitic material were applied in the estimation. The reader is cautioned that this historical resource estimate was prepared before the development of NI 43-101 guidelines and therefore should not be relied upon. The historical resource estimate is superseded by the Mineral Resource Statement discussed herein.

Since 2004, nine independent technical reports have been prepared for the Project for Verena and Belo Sun. These are listed in chronological order:



- Report on the Volta Grande Gold Property, Brazil, for Verena, dated 31 May, 2004 (Agnerian, 2004)
- Technical Report on the Volta Grande Gold Property, Brazil, for Verena, dated 12 December, 2005 (Agnerian, 2005)
- Preliminary Assessment on the Volta Grande Project, Pará, Brazil, for Verena, dated 23 September, 2009 (Agnerian and Krutzelmann, 2009)
- Technical Report on the Ouro Verde Deposit, Volta Grande Project, Pará, Brazil, for Belo Sun, dated 5 November, 2010 (Agnerian, 2010)
- Technical Report on the Volta Grande Project, Pará State, Brazil, for Belo Sun, dated 25 February, 2011 (Agnerian, 2011)
- Mineral Resource Technical Report for the Project, Pará, Brazil, dated 7 March, 2012 (SRK, 2012a)
- Mineral Resource Technical Report for the Project, Pará, Brazil, dated 8 June, 2012 (SRK, 2012b)
- Mineral Resource Technical Report for the Project, Pará, Brazil, dated 31 January, 2013 (SRK, 2013)
- Pre-feasibility Study on the Volta Grande Project, Pará, Brazil, dated 21 June, 2013 (AMEC, 2013).

## 6.4 Historical Production

Many parts of the Project have been mined in the past by *garimpeiros*. From the 1960s to the late 1990s, the average grade of the material extracted from numerous small alluvial gold deposits in the area was reported to be up to 3 oz/t Au. These included the Ouro Verde, Gaúcho, Canela, Serrinha, Grota Seca, Galo, Japão, and Nobelino deposits, and other workings by *garimpeiros* near the village of Itatá.

Until the change in land ownership early in 2013, small-scale mining was still being carried out by *garimpeiros* in several areas of the North and South blocks of the property. Belo Sun's "best guess estimates" of total gold production from *garimpeiros*-run underground workings in the Grota Seca and Ouro Verde deposit areas total approximately 340 kg of gold, and are based on the size of surveyed waste stockpiles and an assumed gold grade of approximately 20 g/t Au.



## **7 GEOLOGICAL SETTING AND MINERALIZATION**

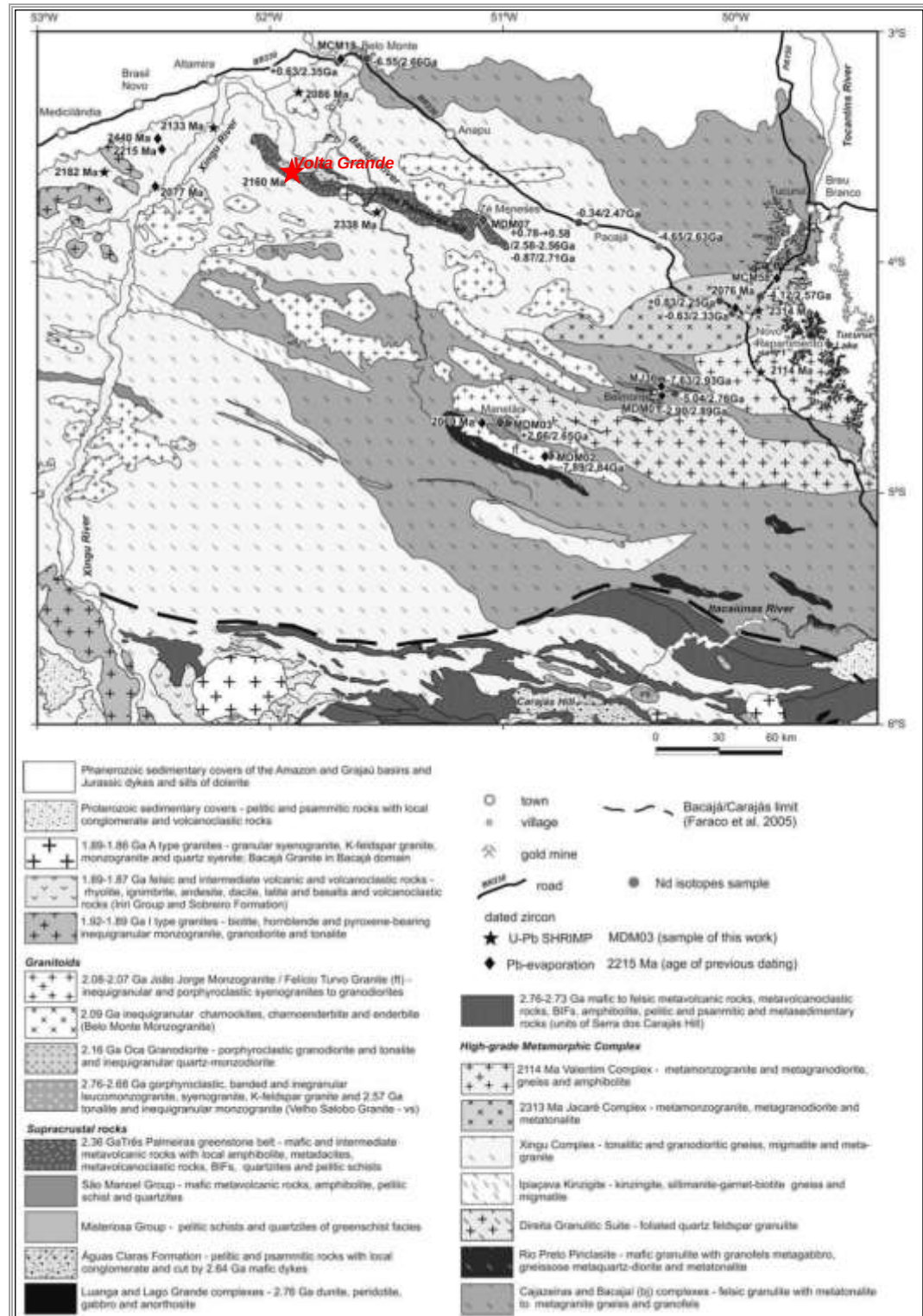
The following subsections are extracted from Agnerian (2004).

### **7.1 Regional Geology**

The Project area is situated along the northern boundary of the Carajás-Iricoumé Block of the Eastern Amazonian Craton (Figure 7-1). In this part of the Amazonian Craton, the regional structures have a northwesterly trend. In the area west of Belém, the southern segment of the Amazonian Craton is underlain by east-northeast-trending Phanerozoic cover rocks of the Amazon Basin. The Project area is located in the western portion of the west-northwest-trending Três Palmeiras Greenstone Belt, which is surrounded by the Xingu Complex in central Pará State of the Brazilian Shield (Figure 7-1). The greenstone belt is 3 km to 10 km wide and extends approximately 120 km along strike (Figure 7-1). It comprises Upper Proterozoic metavolcanic and metasedimentary rock enveloping linear, granodioritic to dioritic domes, interpreted to be syntectonic plutons of Proterozoic age.

Rocks of the Xingu Complex are predominantly Archean basement granitic gneisses, originating from tonalite, trondhjemite, and granodiorite. In places, they may be migmatitic. The Xingu Complex is subdivided into different groups, including the Igarapé Salobo, Igarapé Pojuca, Igarapé Bahia, Grão Pará, Buritirama, and Rio Fresco groups. All of the above Archean-age rocks are intruded by anorogenic granitic bodies, which have an approximate age of 1.86 Ba. All rocks in the area exhibit strong foliation with a number of mylonitic zones and a steeply-dipping attitude to the south. Other structures in the area include northeast-, north-northeast-, north-northwest-, and east-trending faults.

**Figure 7-1: Regional Geology Setting (Source: Belo Sun)**





## **7.2 Local Geology**

The Volta Grande area is situated along a major ductile deformation zone within the Três Palmeiras Greenstone Belt. It is underlain by west-northwest-trending and steeply south-dipping gneisses of metasedimentary and/or metavolcanic origin and syntectonic diorite (Figure 7-2). Occasional chert horizons (chemical sedimentary rock) and banded iron formations (BIFs) are included within the metasedimentary sequence. A number of anorogenic granitic plutons are also present along the southern contact of the Greenstone Belt.

In the Volta Grande area, the Três Palmeiras Greenstone Belt is interpreted to consist of a basal portion of predominantly metasedimentary rock in the southern part of the belt, and predominantly mafic volcanic rock in the northern part of the belt, as well as synvolcanic intrusions. The sedimentary assemblage includes thin units of chemical sediments (chert, graphitic sedimentary rock, and oxide-facies iron formation), which serve as marker horizons in the interpretation of the local geology. Both assemblages commonly exhibit strong penetrative fabric (foliation and lineation), as well as metamorphic banding. In places where the rock has undergone migmatization, mylonitic zones, with associated silicification, are commonly observed.

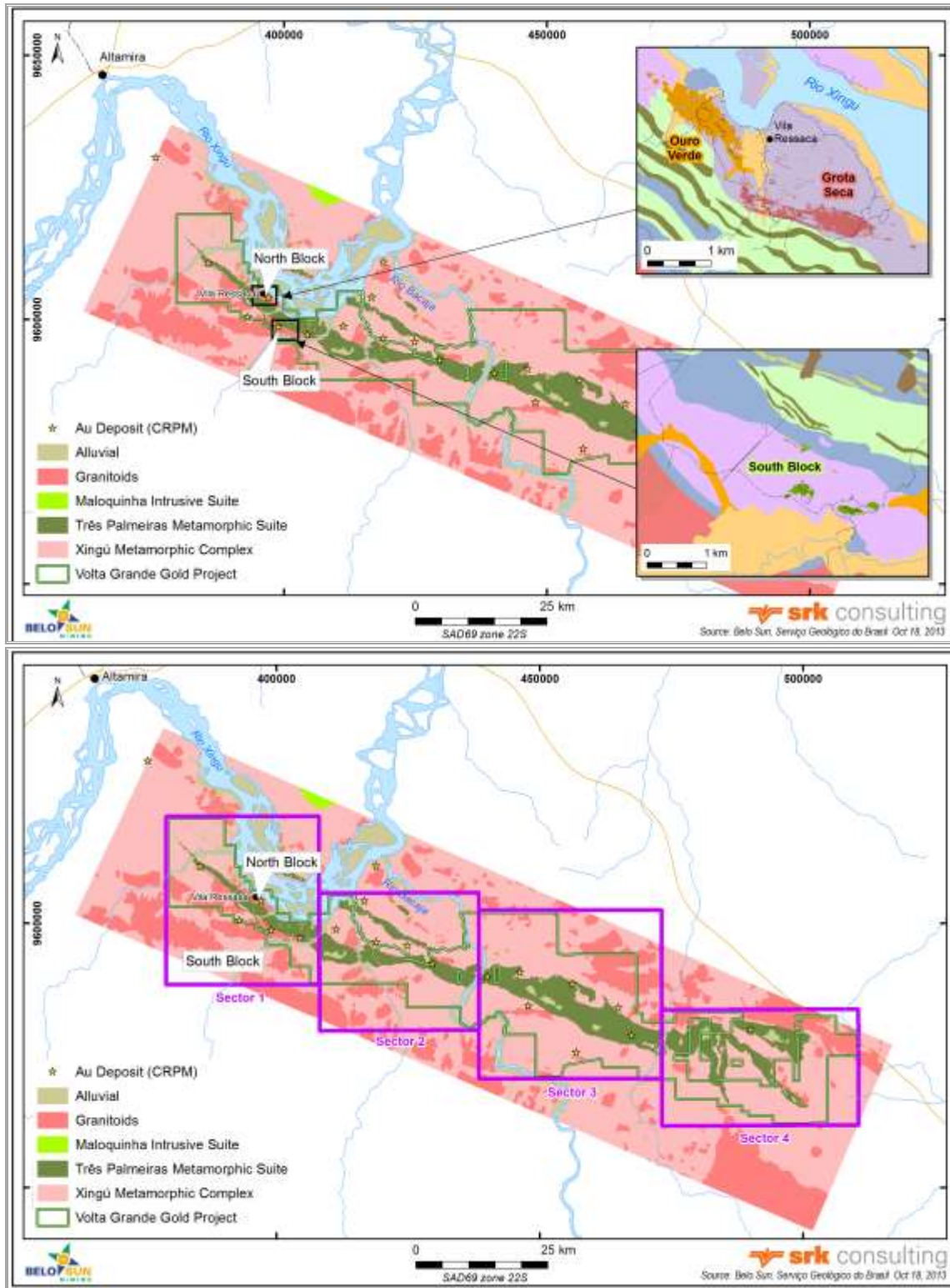
The volcanic, sedimentary, and syntectonic rocks of the Project have been affected by a widespread hydrothermal alteration event. Surficial alteration is present in an extensive layer of red saprolite, which covers the entire property, including topographic highs and lows.

In general, the subsurface geology can be interpreted from the subtle colour differences of the overlying saprolitic material, as follows:

- dark brick-red to brown colour, resulting from the weathering of underlying metavolcanic and metasedimentary rocks
- red to brown colour, resulting from the weathering of underlying granodioritic rocks
- pale brown to beige colour, resulting from the weathering of underlying gneisses of the Xingu Complex.

Observations on outcrops and drill core as well as mineralogical (thin section) work show that the alteration assemblage within the red saprolite consists of clay minerals, opaque minerals (mainly pyrite and chalcopyrite), iron oxides, such as limonite, and quartz.

**Figure 7-2: Local Geology Setting**





### 7.3 Property Geology

The Project contains two target areas, named the North and South Blocks. The former contains two large mineralized areas: the Ouro Verde area, in the northwestern part of the North Block; and the Grota Seca area, which contains the Grota Seca West, Grota Seca, and Grota Seca East areas, along the southern part of the North Block. The South Block comprises three target areas: Pequi in the northern part of the South Block, Grande in the southern part of the South Block, and Itatá in the southeastern part of the South Block. Both the North Block and the South Block include old and new *garimpeiros* workings.

In the central part of the North Block, a north-northwest-trending lineament separates the southeastern mineralized zones of the Grota Seca from the northwestern zones at Ouro Verde. This lineament is parallel to other regional lineaments, with similar orientation.

There is a complicated contact relationship between auriferous bedrock and the overlying saprolitic material. At Grota Seca, near the current *garimpeiros* workings, almost fresh diorite is in sharp contact with saprolitic material, which is at least 8 m thick. This juxtaposition indicates that the saprolite is not made up of regular regolithic material developed on top of bedrock, but is transported by faulting parallel to the major shear zone that hosts the gold mineralization.

There are a number of north-northwest-trending regional structures present in the area. One of these is parallel to the segment of the Xingu River flowing from Altamira to the Project exploration camp. Other structures with similar orientation are present in the area west of Ouro Verde, one of which cuts a northeast-trending structure.

In the South Block, mineralization is primarily hosted in granodiorite; however, the Pequi target is located at the northern contact of the granodiorite body with an amphibolite body to the north. While mineralization in the North Block is controlled by northwest-striking structural features, mineralization in the South Block appears to occur primarily where northwest-striking structures intersect with north-striking faults. Drilling, as well as exposure in a large pit dug by *garimpeiros*, show two distinct mineralization directions (Figure 7-3). The first is steep, subvertical, with a northeast strike. The second direction is shallow, dipping approximately 20 degrees to the southwest. These two directions can be seen in core as well and strongly influenced the modelling of the boundaries of the gold mineralization for the Grande deposit, which changed significantly from the previous model. SRK expects that future drilling will refine further the understanding of the geology of the South Block.

**Figure 7-3: Grande Artisanal Mine, showing Sub-vertical and Shallow-Dipping Quartz Veins; View to the South**



## 7.4 Mineralization

There are two types of gold mineralization at Volta Grande: primary gold in intrusive rock and secondary gold in saprolitic rock. Both types of gold mineralization occur within a major shear zone. In general, the gold mineralization in bedrock occurs in zones of intense hydrothermal replacement, and is associated with up to approximately 5% sulphides (pyrite and/or arsenopyrite) at Grota Seca and Ouro Verde. Sulphide content in the South Block can be higher, and is associated with regional north-striking cross faults. Specifically, mineralization styles are:

- intense silicification, with up to 5% fine-grained sulphide (predominantly arsenopyrite) within strongly sheared diorite, such as at the Grota Seca area
- weak to moderate silicification in diorite, with minor sulphides (mainly pyrite), such as at the Ouro Verde area
- intense silicification overprinted by sulphide alteration (pyrite) and potassium alteration (sericitization and potassic feldspar formation), such as in the South Block area.



In all cases, the distribution of alteration assemblages and the replacement textures suggest evolution of fluid-rock alteration. The initial hydrothermal alteration involved silicification (quartz flooding) of the host diorite. Subsequent alteration included replacement by pyrite and/or arsenopyrite, followed by potassium feldspar alteration and sericitization.

Finally, all of the rocks in the area were subjected to carbonate alteration. This alteration is evidenced by the presence of numerous calcite veinlets in the diorite and in the metavolcanic rock.

Gold deposition is interpreted to be related to changes in local chemical conditions of mineralizing fluids in response to progressive fluid-rock interaction, which triggered sulphide precipitation. The sulphide content of the gold mineralization is low.

#### **7.4.1 Primary Gold Mineralization**

Gold mineralization at the Project occurs primarily in intrusive rock, while subordinate mineralization occurs in saprolitic rock. Primary gold mineralization is associated with altered diorite within a 300 m-wide alteration zone, which straddles the contact zone between the intrusive and the metasedimentary rock. Gold occurs in a stack of mineralized zones with true thickness ranging up to 50 m.

The dip of the mineralized zones is generally moderate to steep (50° to 85°) to the south. Two large mineralized areas occur in the North Block: Ouro Verde, in the northwestern portion of the block, and Grota Seca in the southern portion.

Mineralization in the Ouro Verde area extends for approximately 1,500 m along an approximate northwest - southeast strike and extends to a vertical depth of 540 m below surface.

Mineralization in the Grota Seca area extends for approximately 2,900 m along a west-northwest trend and extends to a vertical depth of 400 m below surface. Examples of Ouro Verde mineralization are provided in Figure 7-5 to Figure 7-6.

Recent drilling in the area between the Ouro Verde and Grota Seca has intersected mineralization, suggesting a continuous zone of mineralization.

**Figure 7-4: Drilling Program Overview**

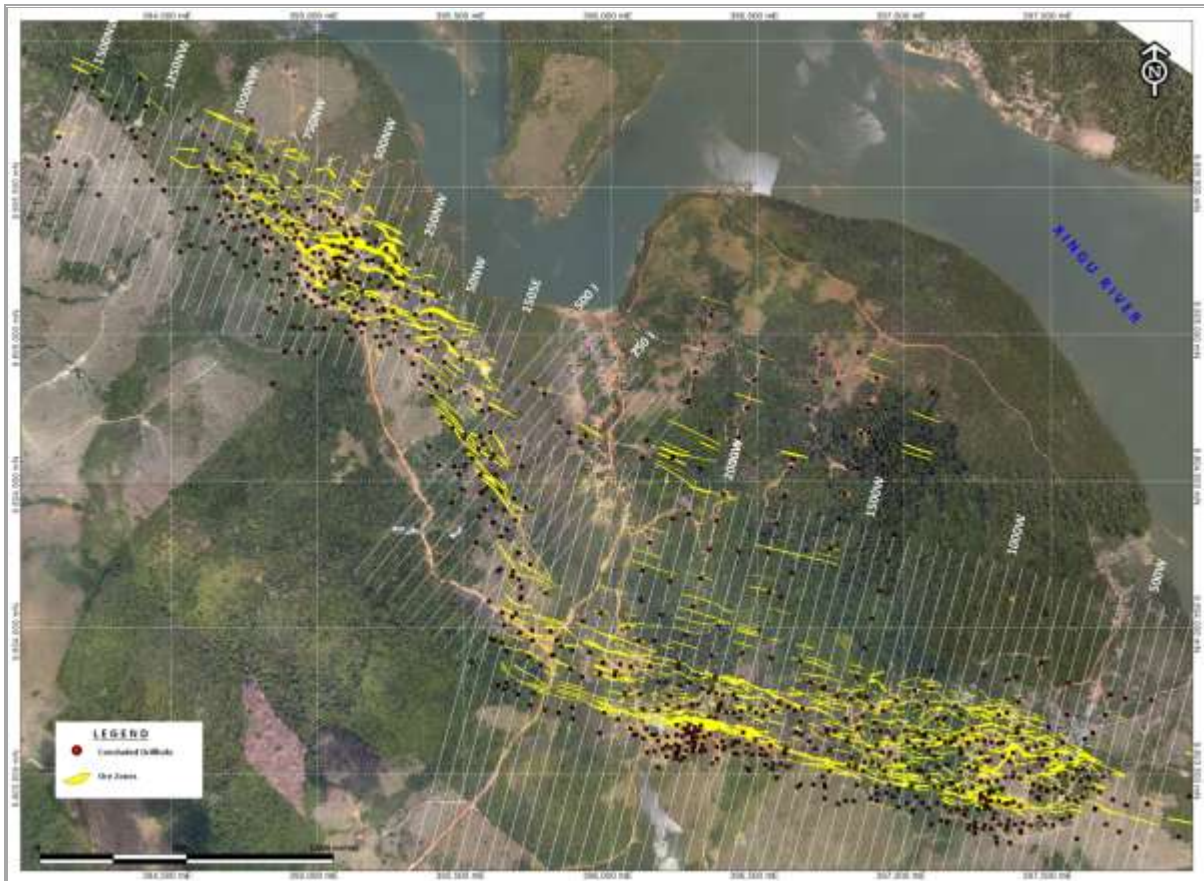
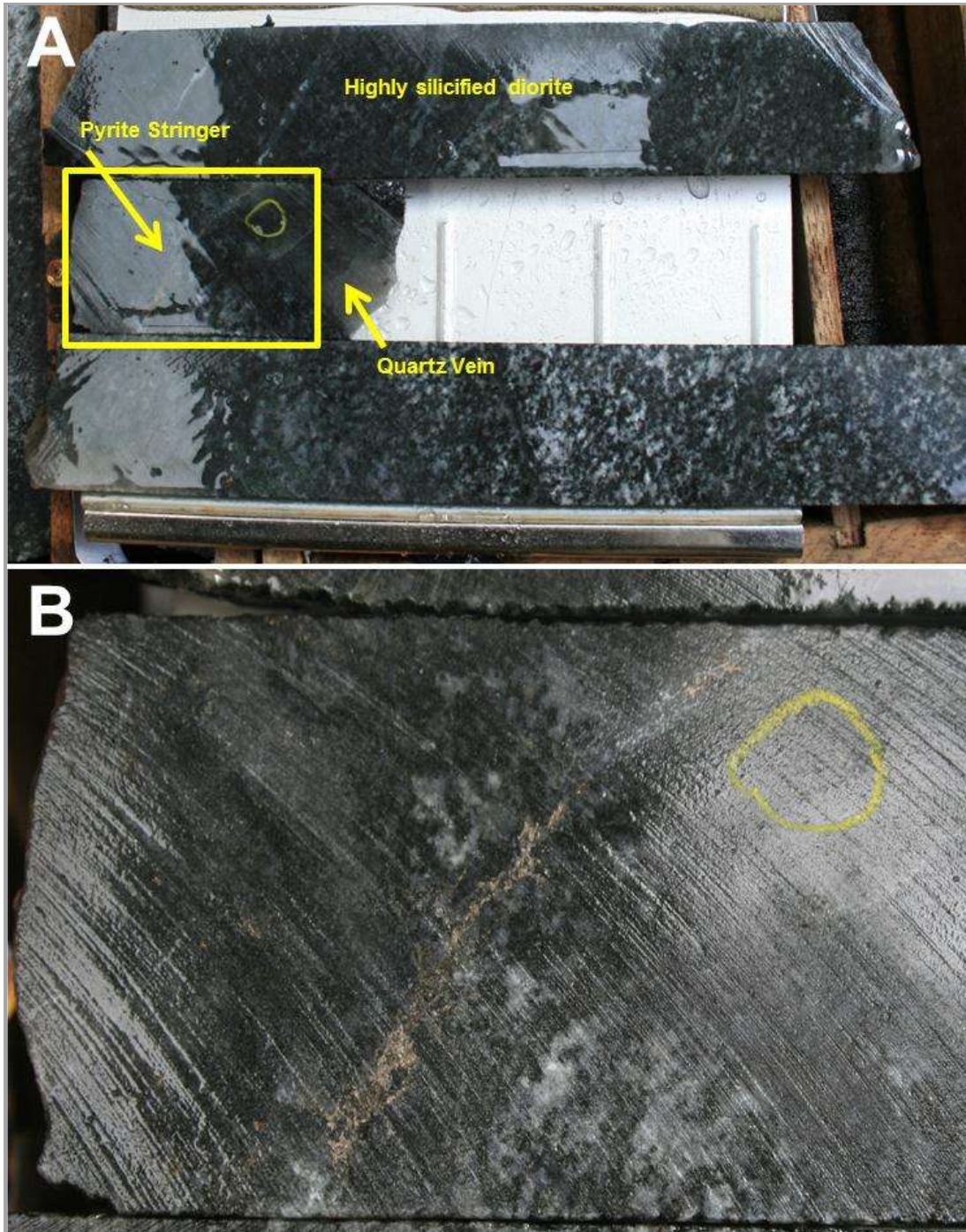
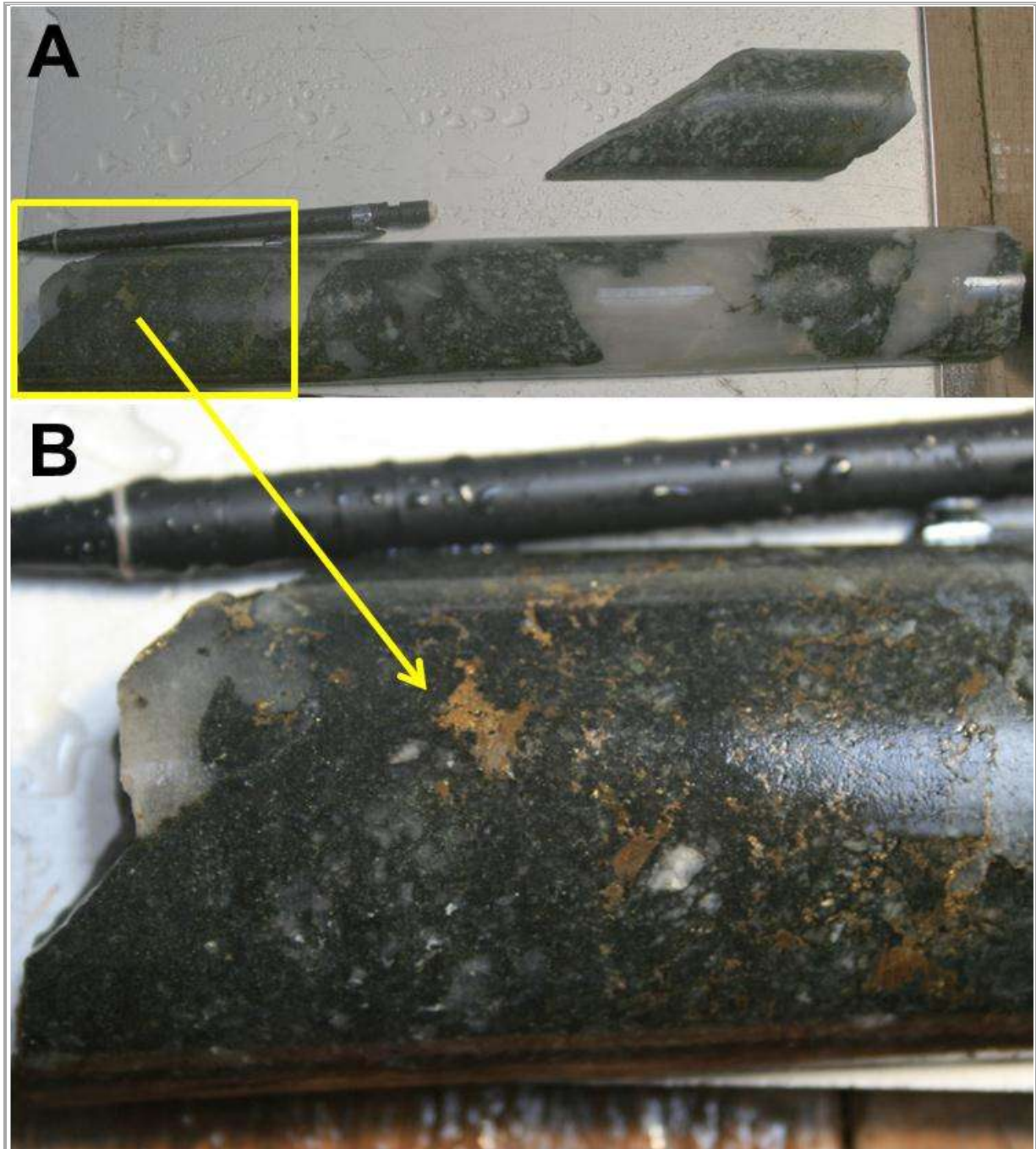


Figure 7-5: Typical Gold Mineralization of the Ouro Verde Deposit in Highly Silicified Diorite with Moderate Sheared Texture



**Notes:** A) Borehole VVGD-066, 268.4 m to 268.95 m; mineralization associated with quartz veining and sulphide stringers. Sampled interval was assayed at 38.0 g/t Au.  
B) Close-up of quartz-pyrite stringer in A.

**Figure 7-6: Ouro Verde Gold Mineralization**



**Notes:** Borehole VVGD-008, 271.0 m to 271.3 m.

**A)** Silicified porphyritic diorite, brecciated quartz veins, fine to coarse disseminations of pyrite and pyrite veinlets, 15% to 20% pyrite. Sampled interval was assayed at 3.8 g/t Au.

**B)** A close-up of pyrite stringer zone.



#### **7.4.2      *Saprolite Gold Mineralization***

Surficial weathering has resulted in an extensive saprolitic profile overlying the primary mineralization at the Project. In general, the thickness of the saprolitic material ranges from 3 m to 20 m. Locally, the thickness can reach up to 45 m, as in the Ouro Verde area. Occasional outcrops of saprolitic material occur in the project area.

Overburden thicknesses range from 3 m to more than 10 m. Typical lateritic and saprolitic profiles with gold mineralization are observed in the many small open pits, as well as in diamond drill core.

The lateral transport of the gold in the surficial environment is caused by frequent changes in the water table in the rock, and by surficial alteration of the sulphides and the gangue minerals in the rock.

In general, the average grade of the lateritic material is lower than that of the saprolitic material, which is also lower grade than the primary mineralization underlying the saprolite. Occasionally, however, the saprolite may also contain high-grade intersections. These occurrences are generally due to mineralized quartz vein material, which is more resistant than the enclosing saprolitic rock; the quartz becomes enriched in the saprolite, leading to increased gold values.

Typically, gold anomalies in laterite/saprolite extend beyond underlying mineralization in hard rock; however, in the Volta Grande area, the saprolitic zone gold mineralization does not appear to be much larger than the underlying primary mineralization in bedrock.



## **8 DEPOSIT TYPES**

The Project is situated along a major ductile deformation zone within the west-northwest–trending Três Palmeiras Greenstone Belt. It is underlain by west-northwest–trending and steeply south-dipping gneisses of metasedimentary and/or metavolcanic origin, and syntectonic diorite. Gold mineralization is hosted by a major west-northwest–trending shear zone within the diorite.

Shear zone hosted gold deposits, also known as orogenic gold deposits, are common in most Archean granitoid-greenstone terranes. Shear-zone hosted gold deposits have formed throughout geological history and are associated with regionally metamorphosed terranes, where they exhibit a strong relationship with regional arrays of major shear zones. Mineralization occurs often in second- or third-order structures in close association to crustal-scale structures.

Exploration work indicates that the Project is situated in a geological environment similar to other gold deposits in this part of South America, such as the oxide zones of several gold and copper-gold deposits in the Carajás region of Brazil, and other gold deposits in neighbouring countries, such as the Las Cristinas and El Callao gold deposits in Venezuela, the Wenot Zone of the Omai gold mine in Guyana, and the Gross Rosebel gold deposit in Suriname.

Lateritic and saprolitic gold deposits are typically situated in tropical environments, such as the northern part of South America, the Caribbean islands, Central Africa, Australia, and Southeast Asia. In these environments, gold is mechanically transported and distributed in a volume of lateritic material overlying the mineralized structures in bedrock.

In the Amazon Basin of Brazil, alluvial gold deposits generally occur in material overlying primary mineralization, with very little, if any, lateral transport. In general, the creeks along which alluvial mining is carried out coincide with structures associated with zones of hydrothermal alteration that host gold deposits.



## **9 EXPLORATION**

### **9.1 Belo Sun Mining Corp. (2010 – Present)**

#### *9.1.1 Reinterpretation of Airborne Geophysical Survey*

From March to September 2010, Belo Sun reinterpreted the 2007 magnetic and radiometric airborne geophysical survey data.

The reinterpretation indicated that the mineralized area at the Grota Seca deposit coincides with a linear magnetic anomaly (first vertical derivative) as well as an area of anomalous radiometric responses in terms of total counts and potassium channels.

The reinterpretation also identified a possible contact zone approximately 300 m south of the southern part of the Ouro Verde deposit.

#### *9.1.2 Preliminary Studies*

In October 2010, VOGBR Recursos Hídricos e Geotecnia conducted preliminary geotechnical, hydrogeological, and hydrological studies required for the development of the Project.

#### *9.1.3 IP Survey*

In the period between 18 October and 26 November 2010, a spectral induced polarisation survey was completed by Fugro Brazil over the Project. During this time, 31,950 line m were surveyed using the pole-dipole array in the time domain with 50-m spacing.

#### *9.1.4 Photogeological and Landsat Lithostructural Interpretation*

In July 2011, an exploration-oriented Landsat 7ETM/TM image interpretation at a 1:100,000 scale was carried out over 6,000 km<sup>2</sup> of the Project and surrounding areas by Barry McGrail & Associates, Australia. In addition, a 1:60,000 scale photogeological interpretation, compiled at 1:50,000 scale over a 1,000-km<sup>2</sup> area, within the Landsat project area, was also completed. The final results were presented as lithostructural maps in MapInfo format.



#### *9.1.5 LIDAR and Aerophotographic Survey*

In August 2011, a light detection and ranging (LIDAR) and aerophotographic survey was carried out over the Volta Grande gold project by Topografia Engenharia e Aerolevantamentos S.S. Ltda. (Topocart), Brazil.

#### *9.1.6 Regional Summary*

The Geological Survey of Brazil database covering the Três Palmeiras Greenstone Belt was reviewed and regional field reconnaissance, including rock and soil sampling, as well as mapping, was undertaken. There are 27 gold occurrences covered by Belo Sun claims along approximately 100 km of the belt.

This work was expanded on during 2013 when Belo Sun identified drilling targets from earlier geophysical data and began reconnaissance geological mapping as well as soil and rock sampling in Sectors 1, 2, and 3 (Figure 7-2). In total 89 km (Sector 1: 24, Sector 2: 13, and Sector 3: 52 km) of line were cut in preparation for the sampling programs.

#### *5.1.1. Structural Study*

The interpretation of radiometric and magnetic airborne data was aimed at understanding the signature of the Volta Grande gold deposit. This work resulted in a preliminary structural study of the gold-bearing shear zone at the Project. The work was completed in September 2010.

Belo Sun started to acquire structural data from oriented core. For this purpose, Belo Sun used a Reflex ACT RD 2 tool. To date, core from 19 boreholes has been oriented and approximately 290 structural measurements have been acquired: 125 measurements from Grota Seca, 74 measurements from Ouro Verde, and 88 measurements from the South Block. Data from these measurements are being integrated into the structural model of Volta Grande to understand better the structural control on mineralization.

In early 2012, Belo Sun commissioned independent consultant Dr. Roberto Viseu Lima Pinheiro to complete a structural study of the Ouro Verde, Grota Seca, and South Block areas to aid in the understanding of the spatial and temporal relations between the structural fabric of the rocks and the mineralization within the regional tectonic framework (Pinheiro, 2012).

#### *5.1.2. Airborne Geophysical Survey*

In August 2012, Belo Sun completed an airborne magnetic and gamma survey over the entire contiguous tenement area. The survey was carried out by Prospectors

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Aerolevantamentos e Sistemas Ltda., from Rio de Janeiro, Brazil. The survey comprised 15,542 line km; survey lines were spaced 200 m apart, while control lines were flown with a line spacing of 2,000 m. Survey lines were oriented at 23°, approximately perpendicular to the general strike of the greenstone belt. Nominal terrain clearance was 100 m.



## 10 DRILLING

### 10.1 Introduction

VGML, Verena, and Belo Sun drilled a combined total of 667 core boreholes (approximately 168,136 m and 59 reverse circulation (RC) boreholes (11,225 m) at Ouro Verde and Grota Seca in the North Block of the Project. A total of 62 core boreholes (14,274 m) have been drilled in the South Block.

The distribution of drilling is summarized in Table 10-1 and Figure 10-7 through Figure 10-9. Belo Sun drilling data contributes about 80% of the total drilling information (measured by drilled metres).

**Table 10-1: Project Drilling Summary**

| Company                                         | Period | Type* | Target Area | No. of Boreholes | Total Length (m) |
|-------------------------------------------------|--------|-------|-------------|------------------|------------------|
| Volta Grande Mineração Ltda.<br>(TVX Gold Inc.) | 1995   | DDH   | South Block | 2                | 245              |
|                                                 | 1996   | DDH   | South Block | 4                | 450              |
|                                                 |        | DDH   | Grota Seca  | 24               | 3,533            |
|                                                 | 1997   | DDH   | Grota Seca  | 41               | 7,003            |
|                                                 |        | RC    | Grota Seca  | 11               | 1,696            |
|                                                 |        | DDH   | Ouro Verde  | 5                | 852              |
|                                                 | 1998   | DDH   | Grota Seca  | 34               | 6,041            |
|                                                 |        | DDH   | Ouro Verde  | 10               | 2,175            |
| Verena Minerals Corp.                           | 2006   | DDH   | Grota Seca  | 23               | 5,000            |
|                                                 | 2007   | DDH   | South Block | 16               | 2,675            |
|                                                 |        | DDH   | Grota Seca  | 6                | 1,240            |
|                                                 |        | DDH   | Ouro Verde  | 5                | 1,351            |
|                                                 | 2008   | DDH   | Grota Seca  | 1                | 217              |
|                                                 |        | DDH   | Ouro Verde  | 26               | 4,083            |
| Belo Sun Mining Corp.                           | 2010   | DDH   | Grota Seca  | 23               | 5,617            |
|                                                 |        | DDH   | Ouro Verde  | 36               | 9,123            |
|                                                 | 2011   | DDH   | South Block | 21               | 5,575            |
|                                                 |        | DDH   | Grota Seca  | 142              | 37,330           |
|                                                 |        | RC    | Grota Seca  | 42               | 8,328            |
|                                                 |        | DDH   | Ouro Verde  | 82               | 23,287           |
|                                                 | 2012   | DDH   | South Block | 30               | 8,552            |
|                                                 |        | DDH   | Grota Seca  | 173              | 47,827           |
|                                                 |        | DDH   | Ouro Verde  | 128              | 39,099           |

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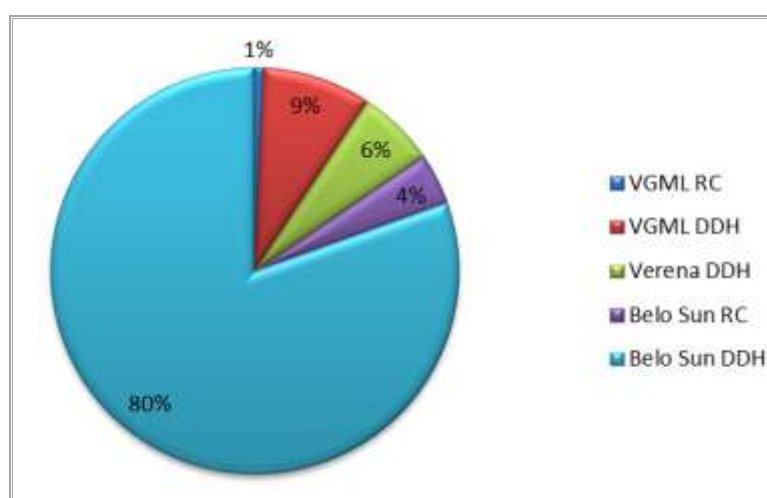
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| Company      | Period | Type* | Target Area | No. of Boreholes | Total Length (m) |
|--------------|--------|-------|-------------|------------------|------------------|
|              | 2013   | RC    | Grota Seca  | 6                | 1,201            |
|              |        | DDH   | South Block | 35               | 6,413            |
|              |        | DDH   | Grota Seca  | 7                | 1,799            |
|              |        | DDH   | Ouro Verde  | 22               | 5,340            |
| <b>Total</b> |        |       |             | <b>955</b>       | <b>236,052</b>   |

Notes: DDH = core; RC = reverse circulation

**Figure 10-1: Drilling Data by Company**

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**Figure 10-2: Drilling in Ouro Verde and Grota Seca**

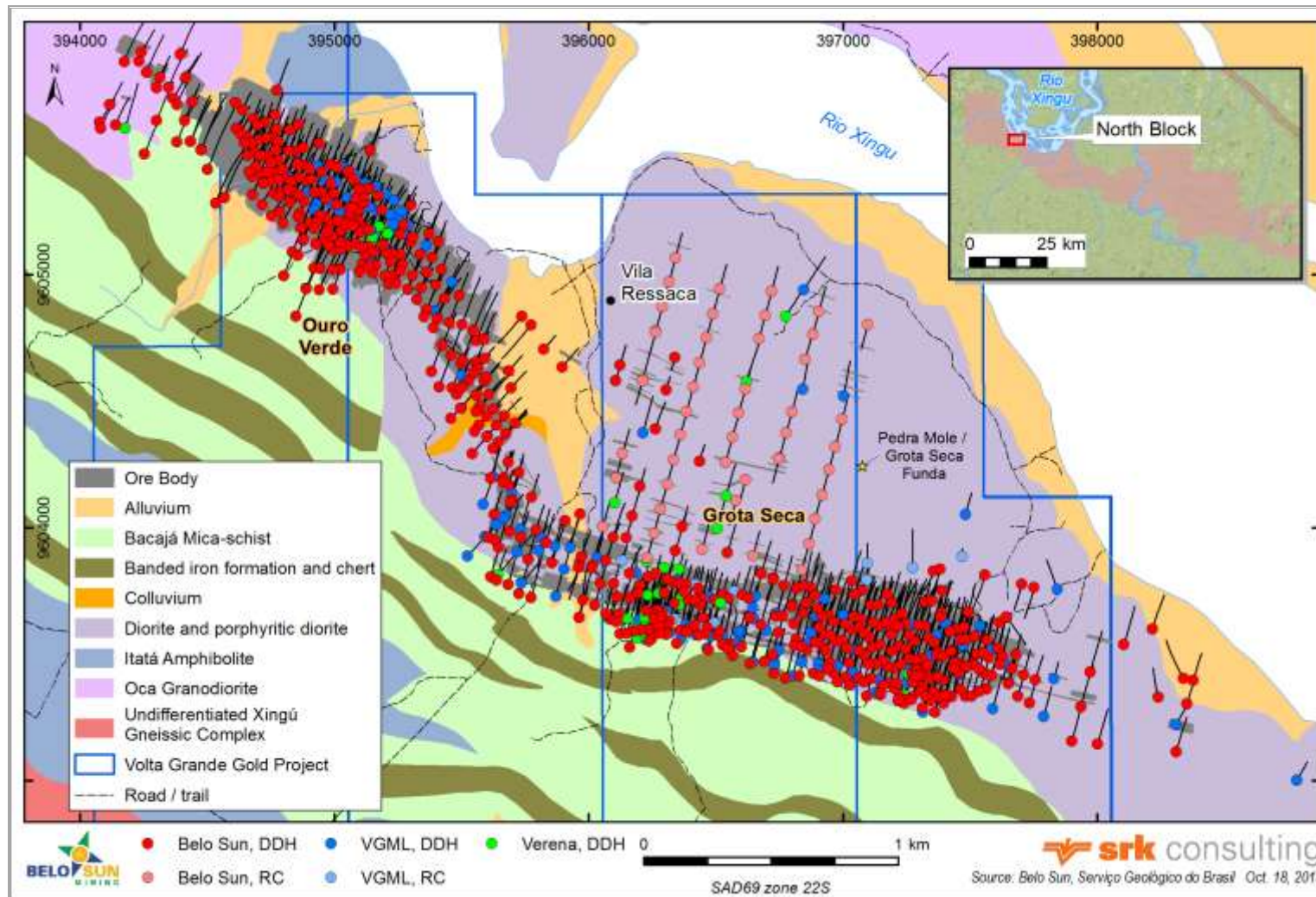
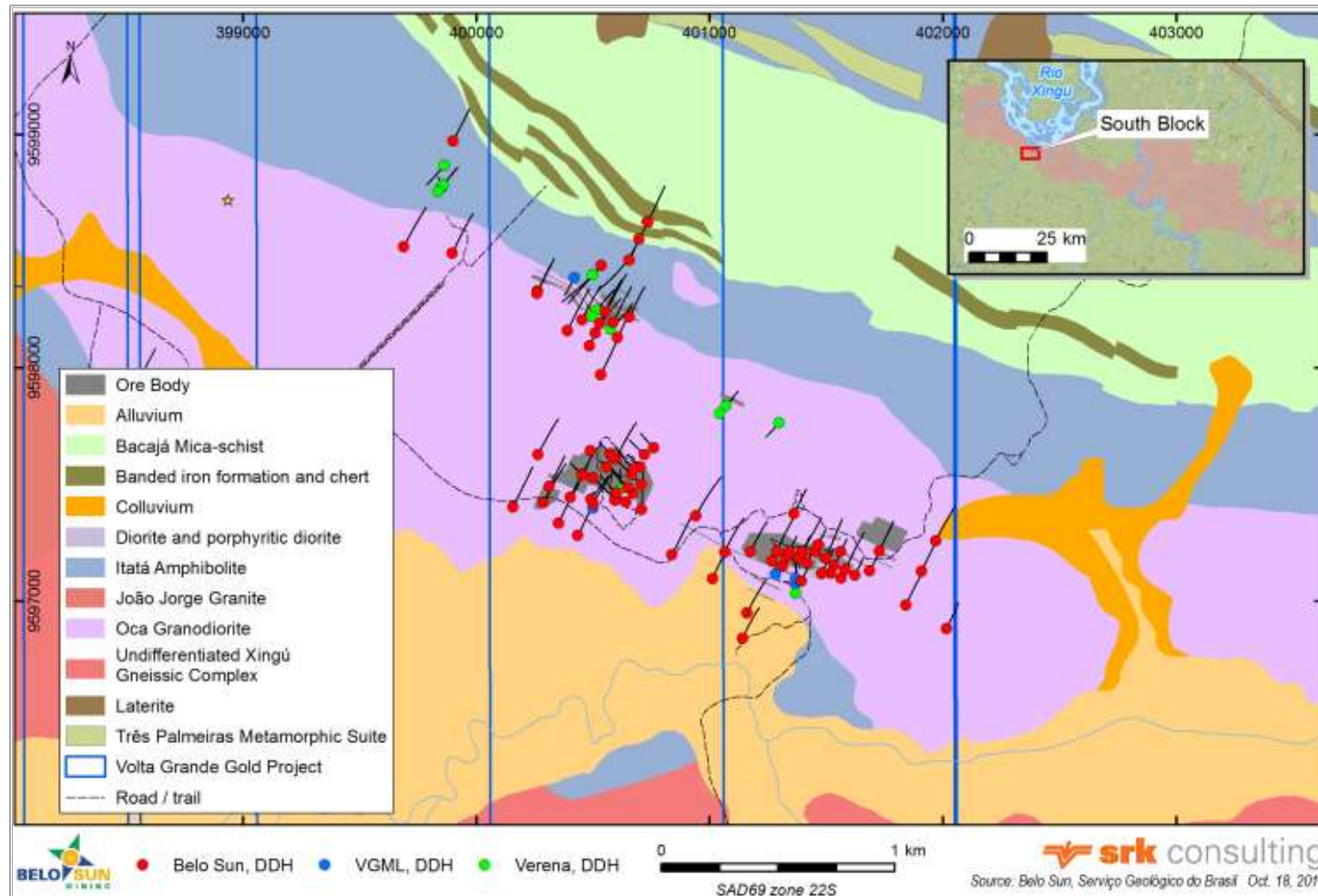


**Figure 10-3: Drilling in the South Block**





## **10.2 Drilling Procedures and Sampling Method and Approach**

### **10.2.1 *Volta Grande Mineração Ltda. (1996 to 2004)***

The drilling was undertaken by Diana Drill Ltda. of Sao Paulo, Brazil. Core boreholes were drilled with Diakore VI, Longyear 38, and Maquesonda 700 drill rigs. The RC boreholes were drilled with a Rocky-300 drill rig. During the core drilling, the saprolite and the weathered rock were drilled using HW diameter (101.6 mm core diameter), and reduced to northwest diameter (76.2 mm core diameter) when fresh rock was reached. Agnerian (2004) reported that core drilling recovered BQ, NQ, and HQ core diameter sizes. During the RC drilling, a 5.5-inch diameter was used. Core boreholes were surveyed using a Tropari instrument.

According to Agnerian (2004), core was logged using logging forms marking lithological contacts, structural features and alteration, and/or mineralization assemblages. Core recovery and core orientation were noted as part of the borehole logging to determine the true orientation of planar and other structural features, such as bedding and fractures, intersected in core. Boreholes were then plotted, and manual checking was done by the project geologist for any errors in the plots. Logging, sampling, and assaying procedures for RC rock chips were similar to the ones used during the diamond drilling program.

Core is stored in core sheds at the Project exploration camp.

### **10.2.2 *Verena Minerals Corporation (2004 to 2009)***

Core drilling was undertaken by Geoserv Pesquisas Geológicas S.A. (Geoserv) of Rio de Janeiro, Brazil. Drilling used HQ equipment for weathered material and NQ for unweathered rock.

All borehole collar locations were surveyed and marked in the field using a global positioning system (GPS) instrument. Downhole surveys were performed at 50 m intervals using Maxibore equipment. Verena-authorized exploration personnel brought in core one or more times per shift from the drill rig directly to a drill logging and sampling area, which is fenced within the Volta Grande exploration camp. The latter also has an outside fence. Within 48 hours, the material core intervals (for example, potentially mineralized intervals) were photographed, logged, and sampled. Samples were only handled by Verena personnel.

Logging was completed by documenting all downhole data, including assay values. All information was recorded on handwritten logs, including:

- lithological contacts
- descriptive geology



- Intensity of various alteration types
- structural features, such as foliation, fractures, and brecciated zones
- core angles
- core diameter
- downhole inclination
- percent core recovery record (in general, this was 98%)
- geotechnical data, such as the numbers of fractures per metre
- RQD measurements, and
- photographic records of the core were maintained with a digital camera. Photographs were taken of all exploration drill core, and key information was summarized in a digital database.

Mineralized core intervals to be sampled were identified and marked. Sample lengths were usually approximately 1 m. Visual indicators of the intervals to be sampled included lithological contacts and altered rock, such as hematitic, silicified, sericitic, and sulphide zones. The sampling procedure was as follows:

- the entire core was sampled with individual sample lengths of 1 m
- sample intervals were marked by metal tags in the core box, and were normally extended for several metres into unmineralized rock
- prior to sampling, core was marked by a line drawn along the core axis, so that one side of the core (with hatched lines) was sampled systematically
- sample tags were inserted at the beginning of each sample
- sample tags were inserted in the same bags only after the samples were collected
- sample bags were numbered prior to sampling
- marked sample intervals were cut in half using a diamond saw; one half-core was sent for assay to SGS Geosol Laboratories (SGS), Belo Horizonte, Minas Gerais, Brazil, and the other half-core was retained for future reference or metallurgical tests
- samples were collected and sealed in medium-sized 25 cm by 40 cm clear polyethylene bags.

The second half of the split core was stored at the Volta Grande exploration camp as a control sample, available for review and resampling, as required.



### 10.2.3 *Belo Sun Mining Corp. (2010 to Present)*

Drilling was conducted by Geologia e Sondagens S.A. (Geosol) of Belo Horizonte, Minas Gerais, Brazil; Rede Engenharia e Sondagem S.A. (Rede) of Lagoa Santa, Minas Gerais, Brazil; and Boart Longyear Ltd. (Longyear) of Belo Horizonte, Minas Gerais, Brazil. Drilling used HQ equipment for weathered material, and NQ for unweathered rock. All borehole collars were surveyed according to the local UTM coordinates (SAD69 datum, Zone 22S), using differential GPS equipment, before drilling started, once the drilling equipment was in position, and once drilling had been completed and concrete markers had been set. Downhole surveys were completed at 3 m intervals using a Maxibore downhole survey tool. Core recovery exceeds 95% in unweathered rock. All core was logged by geologists, with direct digital entry of data into a comprehensive database program.

Core intervals to be sampled were identified and marked by Belo Sun's geologists. Sample intervals range between 0.4 m and 1.6 m in length, averaging 1.0 m. Visual indicators of the intervals to be sampled included lithological contacts and hydrothermal alteration zones (sulphidation, silicification, and quartz veining) that can modify the 1 m sampling interval. The sampling procedures were as follows:

- Authorized exploration personnel brought in core one or more times per shift from the drill rig directly to a fenced-in drill logging and sampling area within the Volta Grande exploration camp, which also has an outside fence. Within 48 hours, the material core intervals were photographed, logged, and sampled.
- Sample intervals were marked with metal tags in the core box.
- Prior to sampling, core was marked by a line drawn along the core, so that systematically one side of the core (with hatched lines) was sampled. The other half core was retained for future reference.
- Sample tags were inserted at the end of each sample.
- Sample tags were inserted in the same bags only after the samples were collected.
- Sample bags were numbered prior to sampling.
- Each sample was assigned a unique sample number that allowed it to be traced through the sampling and analytical process for validation against the original sample site.
- Marked sample intervals were cut in half using a diamond saw, and the half core was sent to the preparation laboratory (Acme) on site or to Acme's preparation laboratory in Itaituba, Brazil, where the samples were prepared for sending for analysis to Acme Laboratory in Santiago, Chile.



Sample tags and quality control (QC) samples were generated by a database program that automatically generated QC sample numbers in sequence with the core samples. Belo Sun has implemented an innovative colour code system for the QC of the samples to reduce errors made by technical staff in selecting certified reference material and other QC samples.

### **10.3 SRK Comments**

Procedures undertaken by Belo Sun at the Project for RC and core drilling, chip and core handling, logging, and maintenance of the Project database are well managed, documented, and undertaken with a well-defined set of procedures that exceed industry standard practices.

SRK considers that the exploration data collected by Belo Sun and previous project operators are of sufficient quality to support mineral resource evaluation.

Figure 10-4: Detailed Drilling Plan for Ouro Verde Deposit with Grid

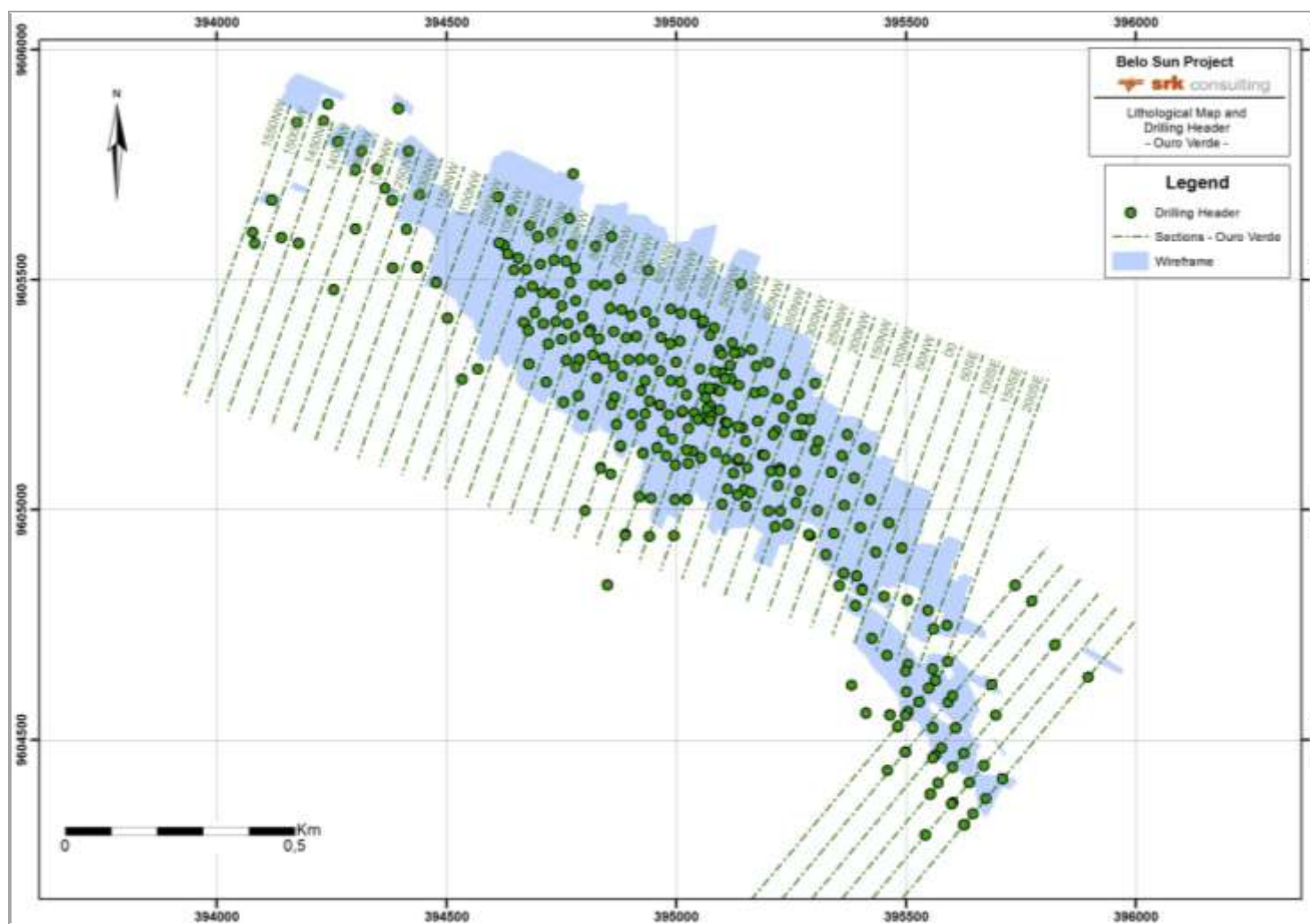


Figure 10-5: Detailed Drilling Plan for Grota Seca Deposit with Grid

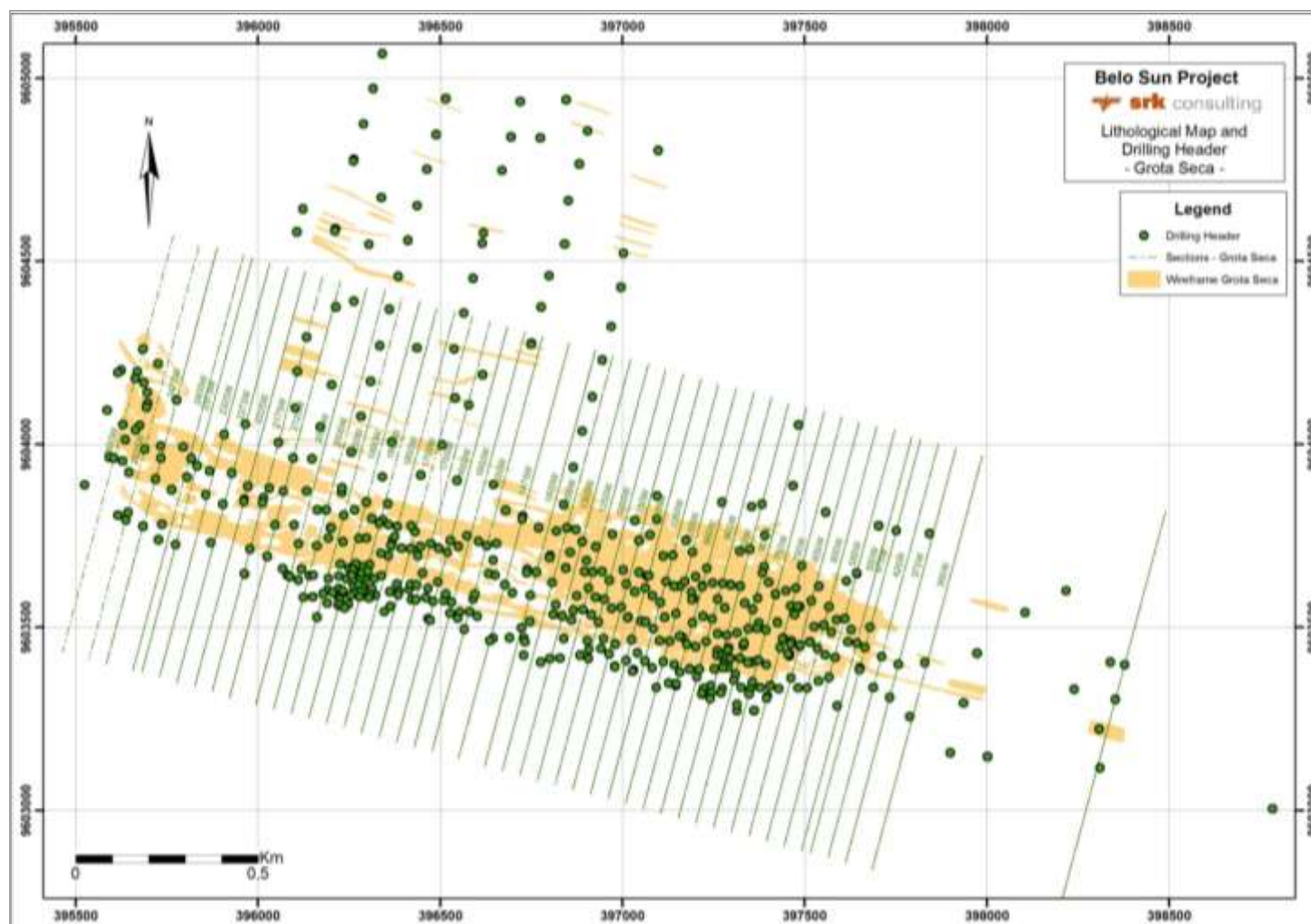
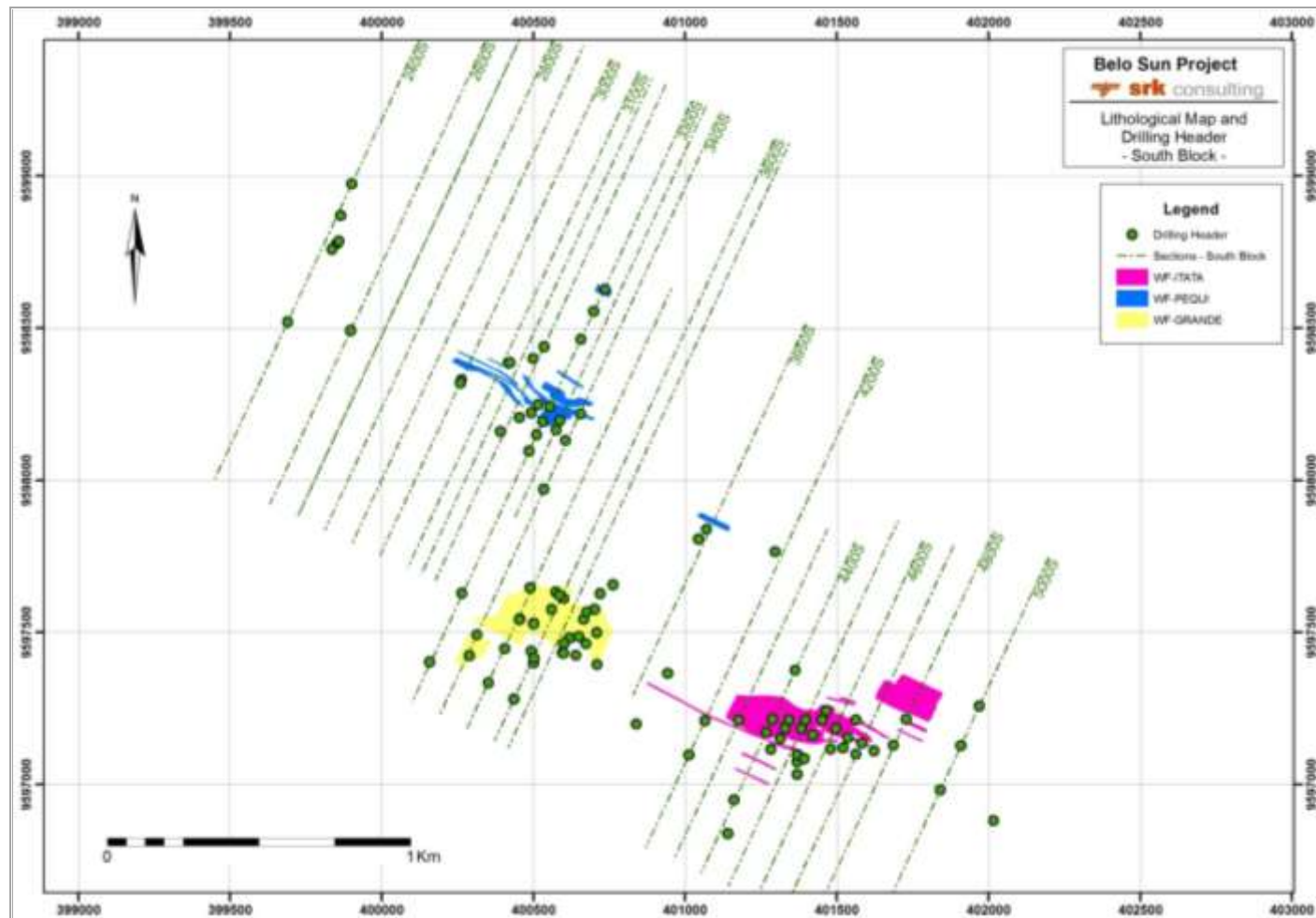


Figure 10-6: Detailed Drilling Plan for the South Block Deposit with Grid



**Note:** There are six boreholes in the South Block that are not shown on the plan



**Table 10-2: Summary of Drilling on the Volta Grande Project**

| Company                                         | Period | Type* | Target Area | No. of Boreholes | Total Length (m) |
|-------------------------------------------------|--------|-------|-------------|------------------|------------------|
| Volta Grande Mineração Ltda.<br>(TVX Gold Inc.) | 1995   | DDH   | South Block | 2                | 245              |
|                                                 | 1996   | DDH   | South Block | 4                | 450              |
|                                                 |        | DDH   | Grota Seca  | 24               | 3,533            |
|                                                 | 1997   | DDH   | Grota Seca  | 41               | 7,003            |
|                                                 |        | RC    | Grota Seca  | 11               | 1,696            |
|                                                 |        | DDH   | Ouro Verde  | 5                | 852              |
|                                                 | 1998   | DDH   | Grota Seca  | 34               | 6,041            |
|                                                 |        | DDH   | Ouro Verde  | 10               | 2,175            |
| Verena Minerals Corp.                           | 2006   | DDH   | Grota Seca  | 23               | 5,000            |
|                                                 | 2007   | DDH   | South Block | 16               | 2,675            |
|                                                 |        | DDH   | Grota Seca  | 6                | 1,240            |
|                                                 |        | DDH   | Ouro Verde  | 5                | 1,351            |
|                                                 | 2008   | DDH   | Grota Seca  | 1                | 217              |
|                                                 |        | DDH   | Ouro Verde  | 26               | 4,083            |
| Belo Sun Mining Corp.                           | 2010   | DDH   | Grota Seca  | 23               | 5,617            |
|                                                 |        | DDH   | Ouro Verde  | 36               | 9,123            |
|                                                 | 2011   | DDH   | South Block | 21               | 5,575            |
|                                                 |        | DDH   | Grota Seca  | 142              | 37,330           |
|                                                 |        | RC    | Grota Seca  | 42               | 8,328            |
|                                                 |        | DDH   | Ouro Verde  | 82               | 23,287           |
|                                                 | 2012   | DDH   | South Block | 30               | 8,552            |
|                                                 |        | DDH   | Grota Seca  | 173              | 47,827           |
|                                                 |        | DDH   | Ouro Verde  | 128              | 39,099           |
|                                                 |        | RC    | Grota Seca  | 6                | 1,201            |
|                                                 | 2013   | DDH   | South Block | 35               | 6,413            |
|                                                 |        | DDH   | Grota Seca  | 7                | 1,799            |
|                                                 |        | DDH   | Ouro Verde  | 22               | 5,340            |
| <b>Total</b>                                    |        |       |             | <b>955</b>       | <b>236,052</b>   |

**Note:** \*DDH = core; RC = reverse circulation



**Figure 10-7: Drilling Data by Company**

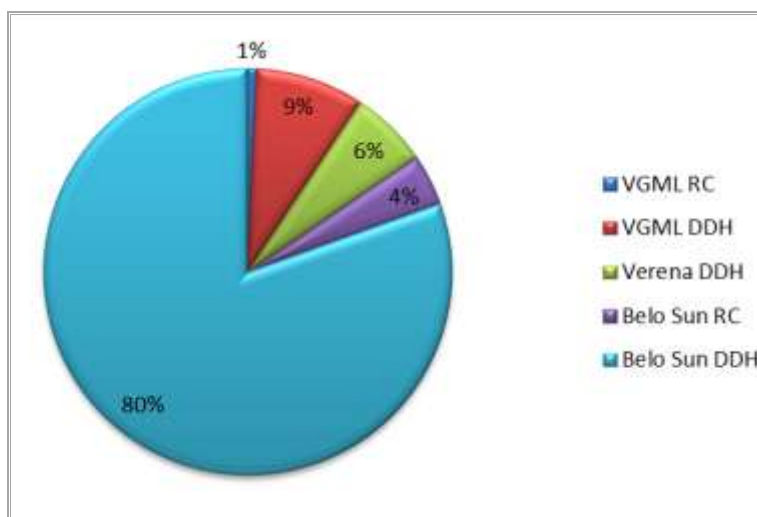


Figure 10-8: Drilling in Ouro Verde and Grota Seca

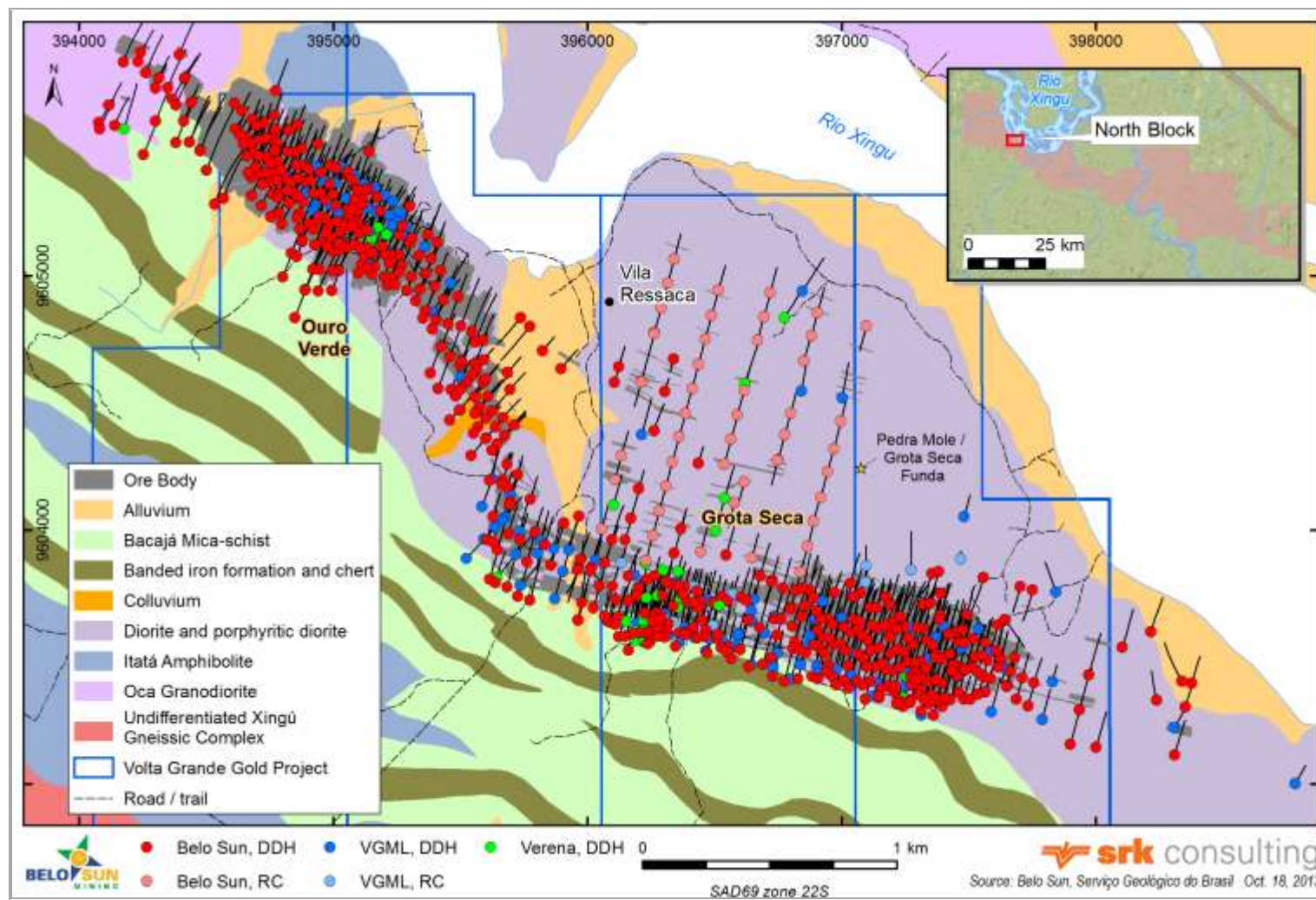
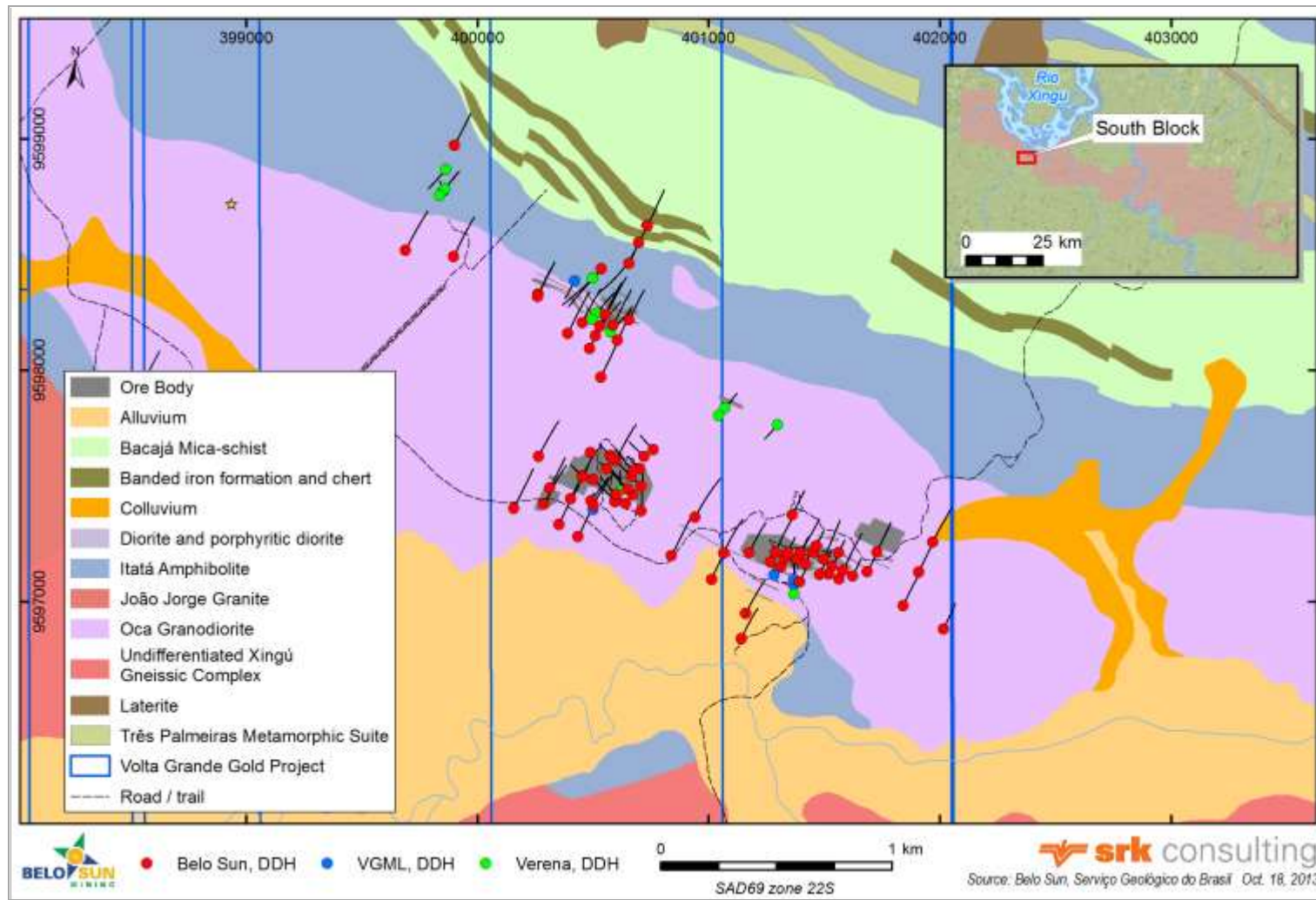


Figure 10-9: Drilling in the South Block





## 11 SAMPLE PREPARATION, ANALYSES, AND SECURITY

### 11.1 Volta Grande Mineração Ltda. (1996 to 2004)

Sample preparation for core and RC samples was done at a sample preparation laboratory at site. The security measures taken to ensure the validity and integrity of the samples are unknown (Agnerian, 2004).

Samples were sent to NOMOS, a laboratory owned by Rio Tinto Mining in Brazil. This laboratory was the primary laboratory used for assaying. Gold was analyzed using fire assay with atomic absorption finish. Further information about assaying methods and procedures were not available to SRK. Assaying and analytical procedures used by NOMOS are not well documented. Agnerian and Krutzelmann (2009) reported that rejects were stored on site.

Umpire check assaying was performed on drill core samples at secondary laboratories Bondar-Clegg and SGS in Canada, and Metais Especiais in Brazil (Agnerian, 2004).

Sample preparation methods and known analytical procedures for each sampling program are described below. Information is taken from Agnerian (2004).

#### 11.1.1 *Drill Core Sampling*

Mineralized and altered core intervals were split and sent for assaying. In general, sample lengths were 1 m. Core samples were taken by splitting or sawing the core longitudinally in half. Half of the core was sent to an assay laboratory, and the other half was retained for reference. Samples were assayed by the fire assay method.

Procedures for core sample preparation included the following:

- crushing the 2 kg to 3 kg assaying sample to ¼ inch size using a jaw crusher
- grinding the sample to 20 mesh, and subsequently pulverizing it to 200 mesh using a ring mill
- thoroughly mixing the sample and separating it using a Jones splitter; separating a 250 g aliquot for assay, and keeping the remaining 1.75 kg reject in temporary storage for further processing; and
- carrying out fire assays with atomic absorption finish on a 50 g aliquot of the sample.



### **11.1.2 Reverse Circulation Chip Sampling**

The sampling preparation methods included drying, splitting using a Jones splitter, and pulverizing, as follows:

- collecting a 30 kg to 40 kg sample. If the sample was wet, it was dried first
- thoroughly mixing the sample and splitting it using a Jones splitter, and separating a 2 kg aliquot for processing
- pulverizing the 2 kg subsample to 200 mesh using a ring mill
- thoroughly mixing the sample and splitting it again using a Jones splitter
- separating a 250 g aliquot for assaying, and keeping the remaining 1.75 kg reject in temporary storage for further processing
- sending the 250 g sample to NOMOS for gold assaying; at NOMOS, this sample was separated into a 50 g portion and a 200 g portion; the 50 g portion was assayed for gold by fire assay, while the 200 g portion was kept for reference.

## **11.2 Verena Minerals Corp. (2004 to 2009)**

Sample preparation and assaying was undertaken by SGS-Geosol in Belo Horizonte, Minas Gerais, Brazil. SGS-Geosol is ISO 14001:2004 and ISO 9001:2008 accredited, and is independent of Belo Sun.

Agnerian and Krutzelmann (2009) stated that sample preparation procedures at SGS-Geosol were similar to those used at SGS, Canada, and reported the following for SGS-Geosol. The samples were dried in paper bags or metal pans in a dryer at 60°C. The samples were crushed to 90% to 95% passing 2 mm. Samples were split using a Jones riffle splitter to 200 g, and milled using a ring and puck, made of either hardened chrome steel or mild steel material, to 90% to 95% passing 200 mesh.

Samples were then assayed for gold by fire assay with an atomic absorption spectrometry finish, using analysis method FAA 313 for 30 g aliquots or FAA505 for 50 g aliquots.

## **11.3 Belo Sun Mining Corp. (2010 to Present)**

Sample preparation was undertaken by the preparation laboratory adjacent to the Volta Grande exploration camp. The preparation laboratory was independently managed by Acme Labs. Sample preparation was also undertaken by the Acme preparation laboratory in Itaituba, Brazil, when the sample volume was too large for the on-site laboratory to manage.



All core sample and QC samples were delivered to the Acme preparation laboratory in sealed plastic barrels, with samples in zip strap-sealed plastic bags. Samples were logged into the laboratory and assigned barcodes. Sample pulps were shipped to the Acme Laboratory in Santiago, Chile, (independently of Belo Sun) for assaying. Acme Laboratory S.A in Santiago, Chile, was accredited by the Standards Council of Canada (accredited laboratory No. 764) in November 2012 for the determination of gold by lead collection fire assay with atomic absorption spectrometry and gravimetric finish, conforming to the requirements of ISO/IEC 17025:2005.

The samples were weighed (2.5 kg/m to 3 kg/m) and dried for four hours at 60°C. Samples were crushed to 80% passing 10 mesh (2 mm). A 1 kg split was pulverised to 85% passing 200 mesh (75 µm). A 150 g split (pulp) was analyzed by 50 g fire assay with atomic absorption spectrometry finish. Samples that yielded greater than 10 g/t Au were re-analyzed by 50 g fire assay with gravimetric finish.

Replicate pulp assays (duplicates) were analyzed by Acme Laboratory in Santiago, Chile, and check assays were performed by ALS Chemex S.A. in Lima, Peru (ALS Peru). ALS Peru is accredited by the Standards Council of Canada (accredited laboratory no. 670) for the determination of gold by lead collection fire assay and atomic absorption spectrometry and gravimetric finish, conforming to the requirements of ISO/IEC 17025:2005. Rejects were sent back to site and stored. SRK notes that the place names of these laboratories are incorrect in the SRK reports dated 8 June 2012, and 7 March 2012.

## **11.4 Specific Gravity Data**

Specific gravity (SG) was not measured by VGML or Verena. Belo Sun carried out SG determinations during the 2010 and 2011 drilling programs.

SG was measured by Belo Sun at site on core samples, using the standard weight-in-air and weight-in-water procedure, from complete sample intervals. Split core was used for the measurements. The entire split core from one sample interval was used for each determination. One sample interval per box was measured. In cases where the sample interval consisted of numerous individual split core pieces, the weight of all pieces was measured at the same time. SG standards were used informally by Belo Sun. The scale was certified and recertified at manufacturer-suggested intervals. Following earlier recommendations by SRK, Belo Sun uses a set of certified weights to check the accuracy of the scale.

If SG was lower than 2.50, or greater than 3.20, the test was repeated for validation.

A total of 826 and 1,269 SG measurements were taken from unweathered material at Ouro Verde and Grota Seca, respectively. A total of 124 SG measurements were taken



from fresh rock in the South Block. A total of 48 measurements were obtained from saprolite material for all deposits combined. While the saprolite SG data are scarce, the bulk of the mineralization occurs in fresh rock; hence, the risk associated with saprolite SG is considered low.

Following past recommendations by SRK, Belo Sun also measured SG using an in situ sand-replacement method. For this method, a flat surface is prepared on the ground in which a hole is dug with known dimensions. The excavated soil is weighed. A bottle with measuring sand of known SG is weighed, then the hole is filled with sand and the bottle weighed again. From the weight difference of the sand bottle, the volume of excavated soil can be determined. From the known weight and volume of the soil, its SG can be determined.

Furthermore, Belo Sun implemented SRK's suggestion to check the scale routinely using a certified set of weight standards and several core samples as standards for the scale as part of a QC program for measuring SG.

## **11.5 Quality Assurance and Quality Control Programs**

QC measures are typically set in place to ensure the reliability and trustworthiness of the exploration data. These measures include written field procedures and independent verifications of aspects such as drilling, surveying, sampling and assaying, data management, and database integrity. Appropriate documentation of QC measures and regular analysis of QC data are important as a safeguard for project data, and form the basis for the quality assurance (QA) program implemented during exploration.

Analytical control measures typically involve internal and external laboratory control measures implemented to monitor the precision and accuracy of the sampling, preparation, and assaying. They are also important to prevent sample mix-up and to monitor the voluntary or inadvertent contamination of samples.

Assaying protocols typically involve regularly duplicating and replicating assays and inserting QC samples to monitor the reliability of assaying results throughout the sampling and assaying process. Check assaying is normally performed as an additional test of the reliability of assaying results; it generally involves re-assaying a set number of sample rejects and pulps at a secondary umpire laboratory.

### **11.5.1 Volta Grande Mineração Ltda.**

Check assaying was performed at Bondar Clegg (now ALS Chemex) and SGS laboratories in Canada, and at Metais Especiais laboratory in Brazil. A total of 794 check assays were



assayed: 206 check assays were assayed by Bondar Clegg, 264 check assays were assayed at SGS, and 324 check samples were assayed by Metais Especiais (Agnerian, 2004). This number of check assays amounts to approximately 4.2% of the samples assayed at NOMOS between 1995 and 1998 by VGML. Agnerian and Krutzelmann (2009) stated that the check assays were done on different batches of samples and not on the same batch.

Assaying protocols, other than the check assaying described above, are not available to SRK.

#### **11.5.2 Verena Mineral Corporation**

Verena relied partly on the internal analytical control measures implemented by SGS. In addition, Verena implemented external QC measures on all sampling, consisting of control samples, blanks, standards, and duplicates, in all sample batches submitted for assaying. Standards consisted of a high-grade standard (Standard 1) with expected value of 14.89 g/t Au and a low-grade standard (Standard 2) with an expected value of 1.29 g/t Au. Duplicates consisted of mineralized rock.

Control samples were inserted every 20 samples. A total of 203 standard samples were assayed: 115 of Standard 1 and 88 of Standard 2; 381 pairs of duplicate samples were assayed (Belo Sun, 2011).

Other assaying protocols for quality control and quality assurance (QA/QC) programs are not available to SRK.

#### **11.5.3 Belo Sun Mining Corp.**

The following review considers QA/QC procedures by Belo Sun for all drilling results from the South Block, Ouro Verde, and Grota Seca deposits between September 2012 and May 2013. Refer to previous technical reports discussions about QA/QC programs for prior periods (SRK 2012a, 2012b, and 2013).

Belo Sun relied partly on the internal analytical QC measures implemented by Acme. In addition, Belo Sun implemented external analytical control measures on all sampling. This involved using control samples, including blanks and certified reference materials (standards), in all sample batches submitted for assaying.

Two sample blanks were used: a non-certified coarse material, consisting of building stone or sand sourced from gneiss of the Xingu Complex in Brazil (Coarse Blank), and a certified fine blank (GF-02 Blank) consisting of a fine powder derived from gneiss of the



Xingu Complex in Brazil, which was prepared and certified by Instituto de Tecnologia August Kekulé (ITAK), Brazil.

Twelve commercial certified gold reference materials (standards) sourced for Belo Sun from ITAK in João Monlevade, Mina Gerais, Brazil, were used. They are listed in Table 11-1.

**Table 11-1: Specification of Certified Reference Materials used by Belo Sun for the Project between August 2012 and June 2013**

| Certified Reference Material | Source | Certified Value (Au g/t) | Standard Deviation (g/t) | Number of Samples |
|------------------------------|--------|--------------------------|--------------------------|-------------------|
| QF 04 BLANK                  | ITAK   | <0.005                   | -                        | 670               |
| ITAK 542                     | ITAK   | 0.243                    | 0.020                    | 57                |
| ITAK 549                     | ITAK   | 0.257                    | 0.020                    | 216               |
| ITAK 561                     | ITAK   | 0.242                    | 0.018                    | 310               |
| ITAK 535                     | ITAK   | 0.90                     | 0.060                    | 5                 |
| ITAK 544                     | ITAK   | 1.34                     | 0.082                    | 48                |
| ITAK 546                     | ITAK   | 1.40                     | 0.061                    | 109               |
| ITAK 559                     | ITAK   | 1.12                     | 0.540                    | 340               |
| ITAK 534                     | ITAK   | 2.13                     | 0.110                    | 42                |
| ITAK 558                     | ITAK   | 2.23                     | 0.077                    | 142               |
| ITAK 539                     | ITAK   | 17.20                    | 0.420                    | 11                |
| ITAK 540                     | ITAK   | 11.91                    | 0.35                     | 48                |
| ITAK 541                     | ITAK   | 22.9                     | 0.609                    | 4                 |

**Note:** The coarse blank is not included in the table, as it was not certified.

Control samples were inserted every 20 samples, and replicate pulp assays (duplicates) of mineralized rock were also taken. The pulp duplicates were shipped at the same time as the original samples. In addition, umpire laboratory testing was performed on approximately 5% of the samples.

## 11.6 SRK Comments

Based on SRK's review, the Acme analytical laboratory used procedures and equipment that were adequate for the analysis of gold samples from the Project.

In the opinion of SRK, Belo Sun personnel used care in the collection and management of field and assaying exploration data. The analysis of the analytical QC data is presented in Section 12. In the opinion of SRK, the sampling preparation, security, and analytical procedures used by Belo Sun are consistent with generally accepted industry best practices, and are therefore adequate. SRK considers that the exploration data collected by Belo Sun and previous project operators are of sufficient quality to support a Mineral Resource evaluation.



## **12 DATA VERIFICATION**

### **12.1 Verifications by Volta Grande Mineração Ltda**

Verifications by VGML are not well documented. Quality control measures on sampling and assaying involved a standard and umpire check assaying.

### **12.2 Verifications by Verena**

According to Agnerian (2004), Verena carried out compilation and verification of historical data on the project as part of its due diligence prior to acquiring the Project. This work included site visits and collection of samples of mineralized material, both from old artisanal underground workings and from surface operations and diamond drill core.

Agnerian (2004), and Agnerian and Krutzelmann (2009) reported that samples were collected for independent verification by Roscoe Postle Associates Inc. (RPA), who was requested by Verena to prepare an independent technical report on the Project. As part of this work, RPA confirmed the presence of gold in grab samples from *garimpeiros* sites, and in core samples drilled by VGML and Verena.

Agnerian and Krutzelmann (2009) also reported that RPA verified a number of borehole collar locations drilled by Verena.

Quality control measures were set in place by Verena and included independent verifications on sampling and assaying, and involved external quality control measures on all sampling, including field blanks, standards, and replicate pulp assays.

### **12.3 Verifications by Belo Sun Mining Corp.**

Belo Sun has undertaken due diligence, database verifications, quality assurance, and quality control programs (Agnerian, 2010).

Belo Sun set in place quality control measures, including independent verifications of assaying that involve external quality control measures on all sampling. Assaying protocols involve replicating assays (pulp duplicates), inserting certified quality control samples (blanks and standards), and check assaying.



Belo Sun undertakes regular analysis of quality control data using the following acceptance criteria:

- if one standard fails between two standard deviations and three standard deviations, and no other failure occurs in the batch, the batch is accepted
- if a standard fails beyond three standard deviations, the standard is classified as:
  - accepted: If another standard (same type) was classified as approved, and all of the others control samples were approved in the same batch
  - accepted: If a high grade standard assayed via gravimetric finish failed, and any other sample was not analyzed, the batch is approved
  - accepted: If the moving average stays between two standard deviations, and all of the others control samples were approved in the same batch
  - failure: If above conditions were not applicable
- if two or more standards fail between two standard deviations and three standard deviations in a batch, the batch is classified as a failure
- if a standard and the nearest blank fail in a batch, the batch is classified as a failure
- if both blanks (coarse and fine) fall over the warning line, the batch is classified as a failure until the next and/or the previous blank sequence.

According to Agnerian (2010), Belo Sun has carried out unscheduled visits to the Acme preparation laboratory in Itaituba, Brazil to check on sample preparation techniques and methodology.

## **12.4 Verifications by SRK**

### **12.4.1 First Site Visit (April 2011)**

SRK's first audit of the Project consisted of an initial site visit from 28 April to 1 May 2011, followed by discussions at the Belo Sun offices in Belo Horizonte, Brazil from 2 May to 6 May 2011 (SRK, 2011).

SRK observed drilling, core handling, and logging undertaken by Belo Sun. SRK re-logged 18 boreholes drilled by Verena and Belo Sun. SRK also observed procedures for sampling core, assigning sample numbers, and collecting assay quality control samples developed by Belo Sun and implemented in all aspects of the sampling process.

SRK visited the Acme sample preparation laboratory also located on the Project site. SRK considers the laboratory equipment and procedures appropriate for crushing and



pulverizing core samples. Moreover, SRK considers that the laboratory is appropriately managed and independent of Belo Sun.

SRK also visited Acme Analytical Laboratories S.A. located in Santiago, Chile, on 30 June 2011. SRK reviewed the fire assay and analytical portions of the laboratory used for gold analysis. Pamela Muñoz, Quality Control Manager for the Acme laboratory, and her staff were very knowledgeable and provided SRK with details on the laboratory operations. SRK reviewed procedures and equipment used for gold fire assays including:

- sample pulp handling and electronic sample tracking systems
- fire assay procedures including automated addition of flux to samples
- cupellation and digestion procedures
- gravimetric determination of gold
- atomic absorption determination of gold.

#### 12.4.2 Second Site Visit (April 2012)

In April 2012, SRK returned to the Project site to inspect the additional exploration work completed by Belo Sun since April 2011. Dr. Lars Weiershäuser, of SRK Toronto, completed this site visit between 28 April and 30 April 2012. Ricardo Lopez, Exploration Manager of Belo Sun, accompanied Dr. Weiershäuser. SRK inspected new drilling sites and reviewed core from several boreholes. Furthermore, SRK inspected the equipment used to measure specific gravity of fresh rock and saprolite. SRK verified the location of 11 boreholes using a handheld GPS receiver. Typically, the results are within approximately 5 m of the location determined by Belo Sun using a DGPS receiver (Table 12-1), suggesting that collar coordinates determined by Belo Sun are reliable.

**Table 12-1: Borehole Collar Location Verified by SRK (April 2012 site visit)**

| Hole ID  | Deposit | SRK Handheld GPS |           | Belo Sun Database |           | Differential |          |
|----------|---------|------------------|-----------|-------------------|-----------|--------------|----------|
|          |         | Easting*         | Southing* | Easting*          | Southing* | Easting      | Southing |
| VVGD 071 | GS      | 397,327          | 9,603,338 | 397,326           | 9,603,334 | -0.66        | -3.73    |
| VVGD 211 | GS      | 397,396          | 9,603,311 | 397,397           | 9,603,307 | 0.57         | -4.37    |
| VVGD 214 | GS      | 396,205          | 9,603,598 | 396,206           | 9,603,595 | 0.72         | -2.66    |
| VVGD 225 | GS      | 397,360          | 9,603,276 | 397,361           | 9,603,272 | 1.37         | -4.09    |
| VVD 128  | GS      | 396,222          | 9,603,609 | 396,222           | 9,603,606 | -0.16        | -3.20    |
| VVGD 002 | OV      | 395,162          | 9,605,039 | 395,162           | 9,605,037 | 0.06         | -1.73    |
| VVGD 030 | OV      | 395,056          | 9,605,408 | 395,056           | 9,605,404 | 0.11         | -3.88    |
| VVDG 097 | OV      | 394,965          | 9,605,303 | 394,965           | 9,605,301 | 0.46         | -1.87    |
| VVGD 125 | OV      | 395,059          | 9,605,415 | 395,059           | 9,605,411 | -0.41        | -3.83    |
| VVGD 202 | OV      | 395,011          | 9,605,280 | 395,010           | 9,605,278 | -0.95        | -2.39    |
| VVGD 265 | OV      | 395,027          | 9,605,103 | 395,026           | 9,605,101 | -1.39        | -1.83    |

**Note:** \* SAD69 datum, Zone 22S



### 12.4.3 Third Site Visit (October 2012)

In October 2012, SRK returned to the Project site to inspect the additional exploration work completed by Belo Sun after April 2012 visit. Dr. Lars Weiershäuser conducted this visit with Camila Passos, from SRK's Belo Horizonte office, between 28 April and 30 April 2012. SRK staff was accompanied by Ricardo Lopez, Belo Sun Exploration Manager, and Thiago Bonás, Belo Sun Resource Geologist. SRK inspected new drilling sites and reviewed core from several boreholes. SRK verified the location of 35 boreholes using a handheld GPS receiver. Once more, the results were within approximately 5 m of the location determined by Belo Sun using a DGPS receiver (Table 12-2), again suggesting that collar coordinates determined by Belo Sun are reliable. Five collars presented difference bigger than 5 m.

**Table 12-2: Borehole Collar Location Verified by SRK (October 2012 site visit)**

| Hole ID  | Deposit | SRK Handheld GPS |           | Belo Sun Database |           | Differential |          |
|----------|---------|------------------|-----------|-------------------|-----------|--------------|----------|
|          |         | Easting*         | Southing* | Easting*          | Southing* | Easting      | Southing |
| VVGD-336 | OV      | 394,827          | 9,605,374 | 394,831           | 9,605,371 | -4.35        | 2.64     |
| VVGD-340 | OV      | 394,779          | 9,605,381 | 394,780           | 9,605,377 | -1.00        | 4.53     |
| VVGD-369 | OV      | 395,301          | 9,605,280 | 395,302           | 9,605,277 | -0.90        | 5.15     |
| VVGD-371 | OV      | 395,260          | 9,605,167 | 395,261           | 9,605,162 | -0.56        | 5.17     |
| VVGD-376 | OV      | 395,085          | 9,605,129 | 395,086           | 9,605,124 | -0.98        | 4.72     |
| VVGD-399 | OV      | 395,108          | 9,605,115 | 395,108           | 9,605,109 | -0.32        | 5.99     |
| VVGD-417 | OV      | 394,782          | 9,605,315 | 394,783           | 9,605,310 | -0.54        | 4.58     |
| VVGD-429 | OV      | 394,819          | 9,605,340 | 394,819           | 9,605,336 | 0.33         | 3.57     |
| VVGD-433 | OV      | 394,761          | 9,605,329 | 394,761           | 9,605,324 | 0.01         | 4.77     |
| VVGD-498 | OV      | 395,112          | 9,605,050 | 395,112           | 9,605,045 | 0.31         | 4.78     |
| VVGD-101 | GS      | 397,392          | 9,603,400 | 397,395           | 9,603,397 | -2.96        | 2.60     |
| VVGD-144 | GS      | 397,330          | 9,603,454 | 397,332           | 9,603,450 | -1.76        | 3.70     |
| VVGD-159 | GS      | 397,330          | 9,603,460 | 397,333           | 9,603,457 | -3.24        | 3.13     |
| VVGD-286 | GS      | 397,493          | 9,603,670 | 397,493           | 9,603,667 | 0.09         | 3.36     |
| VVGD-326 | GS      | 397,493          | 9,603,670 | 397,493           | 9,603,667 | -0.05        | 2.85     |
| VVGD-370 | GS      | 396,279          | 9,603,635 | 396,280           | 9,603,632 | -1.15        | 3.45     |
| VVGD-373 | GS      | 396,274          | 9,603,622 | 396,276           | 9,603,617 | -2.28        | 4.72     |
| VVGD-377 | GS      | 396,256          | 9,603,647 | 396,257           | 9,603,642 | -1.01        | 5.12     |
| VVGD-383 | GS      | 396,282          | 9,603,653 | 396,285           | 9,603,648 | -2.62        | 4.59     |
| VVGD-447 | GS      | 397,289          | 9,603,448 | 397,291           | 9,603,444 | -1.97        | 4.07     |
| VVGD-467 | GS      | 396,736          | 9,603,654 | 396,738           | 9,603,649 | -1.89        | 4.79     |
| VVGD-477 | GS      | 396,238          | 9,603,557 | 396,238           | 9,603,553 | -0.26        | 4.34     |
| VVGD-489 | GS      | 396,067          | 9,603,876 | 396,069           | 9,603,871 | -2.32        | 5.01     |
| VVGD-500 | GS      | 395,969          | 9,603,888 | 395,973           | 9,603,886 | -3.86        | 2.47     |
| VVGD-507 | GS      | 395,969          | 9,603,888 | 395,973           | 9,603,885 | -3.71        | 2.91     |



| Hole ID  | Deposit | SRK Handheld GPS |           | Belo Sun Database |           | Differential |      |
|----------|---------|------------------|-----------|-------------------|-----------|--------------|------|
| VVGD-533 | GS      | 397,290          | 9,603,440 | 397,289           | 9,603,438 | 0.63         | 2.17 |
| VVGD-561 | GS      | 397,371          | 9,603,413 | 397,373           | 9,603,410 | -1.72        | 2.76 |
| VVGD-078 | BS      | 401,289          | 9,597,217 | 401,288           | 9,597,214 | 0.86         | 2.92 |
| VVGD-233 | BS      | 400,943          | 9,597,366 | 400,943           | 9,597,364 | 0.50         | 1.81 |
| VVGD-329 | BS      | 400,494          | 9,597,439 | 400,493           | 9,597,437 | 0.79         | 1.58 |
| VVGD-351 | BS      | 400,289          | 9,597,425 | 400,289           | 9,597,423 | -0.04        | 1.94 |
| VVGD-357 | BS      | 401,386          | 9,597,188 | 401,384           | 9,597,184 | 2.15         | 4.41 |
| VVGD-365 | BS      | 400,157          | 9,597,404 | 400,158           | 9,597,402 | -0.86        | 1.84 |
| VVGD-412 | BS      | 400,503          | 9,597,417 | 400,502           | 9,597,416 | 1.12         | 1.45 |
| VVGD-451 | BS      | 400,455          | 9,597,544 | 400,454           | 9,597,543 | 0.52         | 1.18 |

**Note:** \* SAD69 datum, Zone 22S

#### 12.4.4 Database Verifications

SRK conducted a series of routine verifications to ensure the reliability of the electronic data provided by Belo Sun. These verifications included checking the digital data against original assay certificates. More than 10% of the new assay data were audited for accuracy against assay certificates, including 1,846 samples from the Grota Seca area, 1,887 samples from the Ouro Verde area, and 724 samples from the South Block. Only certificates from Acme Analytical laboratories were reviewed, as older certificates were not available. No input errors were detected in the Belo Sun data.

#### 12.4.5 Verifications of Analytical Quality Control Data

Analyses of analytical quality control data produced by Belo Sun before 2013 have been discussed in previous technical reports by SRK (2012a, 2012b, and 2013) and are not repeated here.

SRK analyzed the analytical quality control data that Belo Sun accumulated from August 2012 to June 2013 in the South Block, Ouro Verde, and Grota Seca.

Belo Sun provided SRK with external analytical control data containing the assay results for the quality control samples for the Project. All data were provided in Microsoft Excel spreadsheets. SRK aggregated the assay results of the external analytical control samples for further analysis. Control samples (blanks and certified reference materials) were summarized on time series plots to highlight the performance of the control samples. Paired data (pulp duplicate and umpire check assays) were analyzed using bias charts, quantile-quantile, and relative precision plots.



The external analytical quality control data produced for the Project are summarized in Table 12-3. The external quality control data produced on this project represent 8% of the total number of samples assayed.

**Table 12-3: Summary of Analytical Quality Control Data Produced by Belo Sun on the Volta Grande Project**

|                                       | <b>Total</b> | <b>(%)</b>  | <b>Comment</b>         |
|---------------------------------------|--------------|-------------|------------------------|
| Sample Count                          | 45,931       |             |                        |
| Blanks                                | 1,323        | 2.88        |                        |
| COARSE BLANK                          | 653          |             | Building stone or sand |
| BLANK QF 04                           | 670          |             | ITAK (<0.005 g/t Au)   |
| Standards                             | 1,332        | 2.90        |                        |
| ITAK 542                              | 57           |             | ITAK (0.243 g/t Au)    |
| ITAK 549                              | 216          |             | ITAK (0.257 g/t Au)    |
| ITAK 561                              | 310          |             | ITAK (0.242 g/t Au)    |
| ITAK 535                              | 5            |             | ITAK (0.90 g/t Au)     |
| ITAK 544                              | 48           |             | ITAK (1.34 g/t Au)     |
| ITAK 546                              | 109          |             | ITAK (1.40 g/t Au)     |
| ITAK 559                              | 340          |             | ITAK (1.12 g/t Au)     |
| ITAK 534                              | 42           |             | ITAK (2.13 g/t Au)     |
| ITAK 558                              | 142          |             | ITAK (2.23 g/t Au)     |
| ITAK 539                              | 11           |             | ITAK (17.2 g/t Au)     |
| ITAK 540                              | 48           |             | ITAK (11.91 g/t Au)    |
| ITAK 541                              | 4            |             | ITAK (22.9 g/t Au)     |
| Pulp Duplicates                       | 1,000        | 2.18        |                        |
| <b>Total QC Samples</b>               | <b>3,655</b> | <b>7.96</b> |                        |
| Check Assays                          |              |             |                        |
| ACME (Santiago) and ALS Chemex (Lima) | 752          | 1.64        |                        |

Analyses of all blank samples (including coarse and fine blanks) yielded gold values significantly below the warning limit of 0.05 g/t Au, as defined by SRK (equivalent to 10 times the detection limit of 0.005 g/t Au). With the exception of a single sample, all blank samples yielded gold values below 0.02 g/t Au.

Belo Sun used 12 certified reference materials (standards). All standards performed within expected ranges and mean grades are similar to expected values. Analyses of 11 of the 12 standards indicate that 15% or less of analyzed samples yield values beyond two standard deviations. In all, 23% of analyzed samples for standard ITAK 549 were beyond two standard deviations. Analyses of standard ITAK 549 also yielded values consistently below the expected value for this standard. With the exception of two



analyses (one for ITAK 549, and one for ITAK546), all analyses of standard materials are within three standard deviations.

Paired assay data examined by SRK show that Acme's assay results can be reproduced with high confidence from duplicate pulp (i.e., correlation coefficient of 0.99). High confidence is also confirmed when examining the rank half absolute difference (HARD) plots, which show that 70.9% of the samples have HARD below 10%.

Belo Sun also submitted sample pulps originally assayed at Acme, Santiago to ALS Chemex, MG-Brazil for umpire laboratory testing. A total of 65.4% of the check assay pairs tested have a HARD below 10%. Bias chart-check assay pair-plots yield a correlation coefficient of 0.9856. This indicates that results from analyses at Acme, Santiago, can be reproduced with high confidence by ALS Chemex, Lima.

In general, SRK considers that the analytical quality control data SRK reviewed attest that the assay results delivered by Belo Sun's primary laboratory are sufficiently reliable for the purpose of resources estimation. The data sets examined by SRK do not present obvious evidence of analytical bias.



## **13 MINERAL PROCESSING AND METALLURGICAL TESTING**

### **13.1 Introduction**

Preliminary metallurgical testwork on samples from the Volta Grande deposit was carried out at Lakefield Research Chile (now SGS) in 1997 and at SGS-Lakefield in 2008. The testwork examined several potential flow sheet options, including gravity recovery, flotation, and heap and vat leaching.

Results indicated that 93% Au recovery could be achieved to a flotation concentrate for the hard rock samples from the deposit. Saprolite samples run under the same conditions resulted in a viscous pulp and poor gold recovery, due to the presence of clays. Conversely, the saprolite material demonstrated better amenability to direct cyanidation at a coarser crush size, and subsequently a split flow sheet was proposed, with the hard rock material going to a conventional crush/grind/gravity/float/carbon-in-leach (CIL) circuit, and the saprolites being crushed to -1/4" and heap leached.

Bottle roll testing also indicated that high gold extractions were achievable from both hard rock and saprolite samples. Ouro Verde diorite and saprolites demonstrated gold extractions of over 97%, whereas a Grota Seca hard rock sample achieved 91% Au extraction.

Subsequent follow-up programs focused more closely on a gravity concentration/tailings leach flowsheet, and consisted of a feasibility level study in 2012 and additional supporting testwork in 2013. A review of this work is given below.

### **13.2 SGS Chile – 2012**

A comprehensive metallurgical test program was undertaken at SGS Minerals S.A. in Santiago, Chile, on samples from the Volta Grande deposit, beginning in June 2012. Testwork consisted of a grindability study and a flow sheet development program, including cyanidation, gravity concentration, carbon adsorption, tailings detoxification and settling testwork.

#### **13.2.1 Sample Selection**

Metallurgical composites representing the Ouro Verde and Grota Seca deposits were received at the SGS Laboratory in Santiago, Chile, in June 2012. In total, more than



3 tonnes of core sample was submitted for testwork, and combined to form six grindability composites and six metallurgical composites.

Head analysis results of the metallurgical composites are summarized in Table 13-1. Three composites were produced from each of the Ouro Verde and Grota Seca deposits, consisting of low-grade (LG), high-grade (HG), and run-of-mine (ROM).

**Table 13-1: Head Assay Results for the 2012 Volta Grande Metallurgical Composites**

| Composite      | Au g/t | Ag g/t | S%   | C <sub>TOT</sub> % | C <sub>org</sub> % | Cu %  | Fe % | As %  |
|----------------|--------|--------|------|--------------------|--------------------|-------|------|-------|
| Ouro Verde LG  | 0.47   | 0.5    | 0.20 | 0.30               | 0.05               | 0.017 | 2.86 | 0.039 |
| Ouro Verde HG  | 3.8    | 1.6    | 0.19 | 0.24               | 0.05               | 0.034 | 2.53 | 0.007 |
| Ouro Verde ROM | 1.17   | 0.4    | 0.20 | 0.31               | <0.05              | 0.020 | -    | 0.020 |
| Grota Seca LG  | 0.39   | 0.3    | 0.30 | 0.64               | 0.05               | 0.012 | 3.21 | 0.053 |
| Grota Seca HG  | 3.9    | 0.6    | 0.27 | 0.58               | <0.05              | 0.010 | 3.65 | 0.057 |
| Grota Seca ROM | 1.06   | 0.4    | 0.37 | 0.57               | <0.05              | 0.012 | 3.59 | 0.067 |

Gold head grades for the metallurgical composites ranged from 0.39 g/t (Grota Seca LG) to 3.9 g/t (Grota Seca HG). In comparison, sulphur grades were relatively constant, ranging from 0.19% to 0.37%. Total carbon was found to be higher in the Grota Seca composites than those from the Ouro Verde zone were, but the majority of carbon is contained as carbonate, rather than organic carbon.

Diagnostic leaching was carried out on the six composite head samples to determine the approximate deportment of the contained gold. The test was broken into three sequential steps, with the first identifying the proportion of direct, cyanide-soluble gold in the sample. The leach residue was then subjected to sulphuric acid digestion, followed by cyanide leaching, to determine the quantity of gold contained in carbonates or secondary sulphides. Finally, the residue from this test was leached in nitric acid to dissolve primary sulphides and any associated gold was recovered by cyanide leach. The gold contained in the residue is considered “locked” in silicates and would be unavailable to commercial oxidative technologies.

The results of the diagnostic leach tests are presented in Table 13-2 and indicate that, for five of the six composites, more than 90% of the gold is readily leachable by cyanidation. The exception is the Grota Seca LG, which also has the lowest gold head grade of any composite. The fraction of gold locked in carbonates and sulphides ranges from 1.4% Au for the Ouro Verde HG to 12.9% Au for the Grota Seca LG.



**Table 13-2: Diagnostic Leach Results for the 2012 Volta Grande Metallurgical Composites**

| Composite      | Direct NaCN Leach (%) | H <sub>2</sub> SO <sub>4</sub> Soluble (%) | HNO <sub>3</sub> Soluble (%) | Lost to Residue (%) |
|----------------|-----------------------|--------------------------------------------|------------------------------|---------------------|
| Ouro Verde LG  | 90.4                  | 1.9                                        | 2.1                          | 5.6                 |
| Ouro Verde HG  | 96.2                  | 0.7                                        | 0.7                          | 2.5                 |
| Ouro Verde ROM | 94.2                  | 0.8                                        | 1.8                          | 3.1                 |
| Grota Seca LG  | 81.4                  | 3.1                                        | 9.8                          | 5.7                 |
| Grota Seca HG  | 96.9                  | 1.2                                        | 1.0                          | 1.0                 |
| Grota Seca ROM | 91.9                  | 2.2                                        | 4.0                          | 1.9                 |

### 13.2.2 Grindability Testing

Six comminution composites were generated from core material from the Ouro Verde and Grota Seca deposits. The composite samples were submitted for standard grindability testing, including JKTech Drop-Weight testing, Crushing Work Index (CWi), SAG Power Index (SPI), Abrasion Index (Ai), Bond Rod Work Index (BRWi), and Bond Ball Work Index (BBWi). Results are summarized in Table 13-3.

**Table 13-3: Grindability Test Results for the 2012 Volta Grande Comminution Composites**

| Composite | DWi (kWh/m <sup>3</sup> ) | Axb  | ta   | CWi | SPI (min.) | Ai    | BRWi (kWh/t) | BBWi (kWh/t) |
|-----------|---------------------------|------|------|-----|------------|-------|--------------|--------------|
| 1         | 8.8                       | 31.3 | 0.30 | 3.1 | 123.7      | 0.383 | 14.3         | 16.2         |
| 2-3       | 9.0                       | 30.6 | 0.29 | 0.9 | 133.2      | 0.286 | 16.0         | 16.5         |
| 4-6       | 11.6                      | 24.0 | 0.22 | 1.7 | 206.2      | 0.444 | 16.6         | 14.8         |
| 5-7       | 10.7                      | 26.0 | 0.24 | 3.8 | 173.9      | 0.458 | 16.2         | 15.5         |
| 8         | 9.5                       | 29.6 | 0.27 | 2.1 | 147.8      | 0.496 | 15.6         | 15.5         |
| 9         | 11.4                      | 25.6 | 0.23 | 2.5 | 199.8      | 0.282 | 17.0         | 14.2         |

The JK Drop-Weight Axb results are low, compared to a typical average value of around 50. This indicates that the material is more competent, i.e. harder, at a coarse particle size than other samples of this type. In addition, the abrasion indices for the samples indicate that moderate to high media consumption can be expected. Both BRWis and BBWis are slightly higher than the database average values but are still within the normal range.

### 13.2.3 Whole Ore Leaching

Direct cyanidation tests were carried out on the six metallurgical composites using a standard bottle testing procedure. Ground test charges of each sample were re-pulped



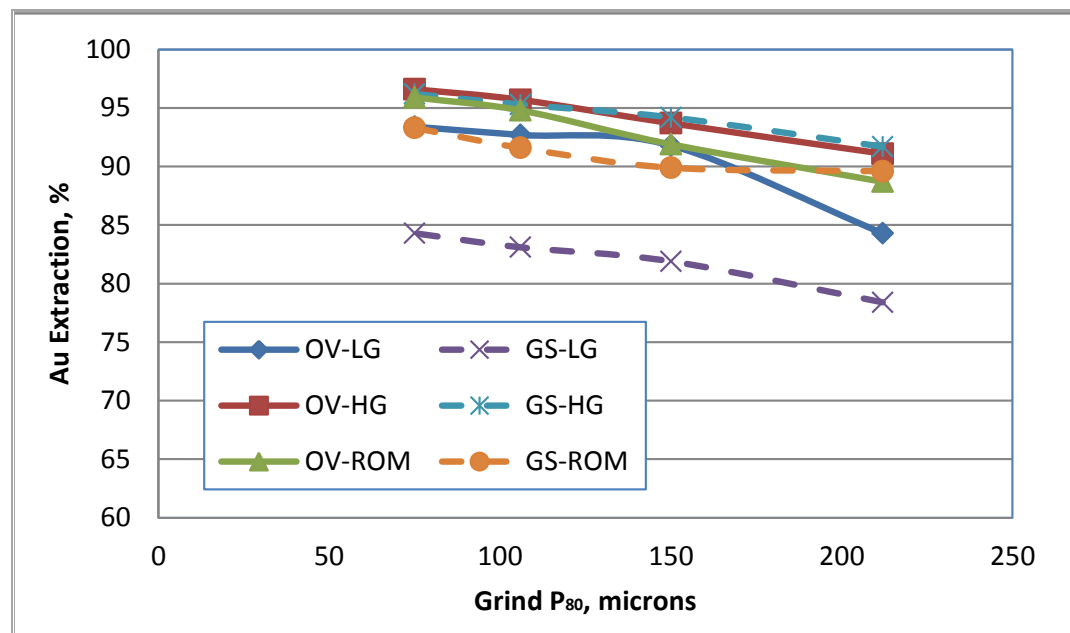
to a target density, pH was adjusted to 10.5, sodium cyanide (NaCN) was added to maintain a set concentration, and kinetic samples were taken at specified intervals. After 32 hours, the test products were filtered, washed, and assayed to provide an overall metallurgical balance.

Key variables investigated in the leaching tests included:

- Grind size: P<sub>80</sub>s of 212 µm, 150 µm, 106 µm, and 75 µm
- NaCN concentration: 1.0 g/L, 0.5 g/L, and 0.3 g/L
- Pulp densities of 40% and 50%
- Carbon addition
- Oxygen sparging
- PbNO<sub>3</sub> addition.

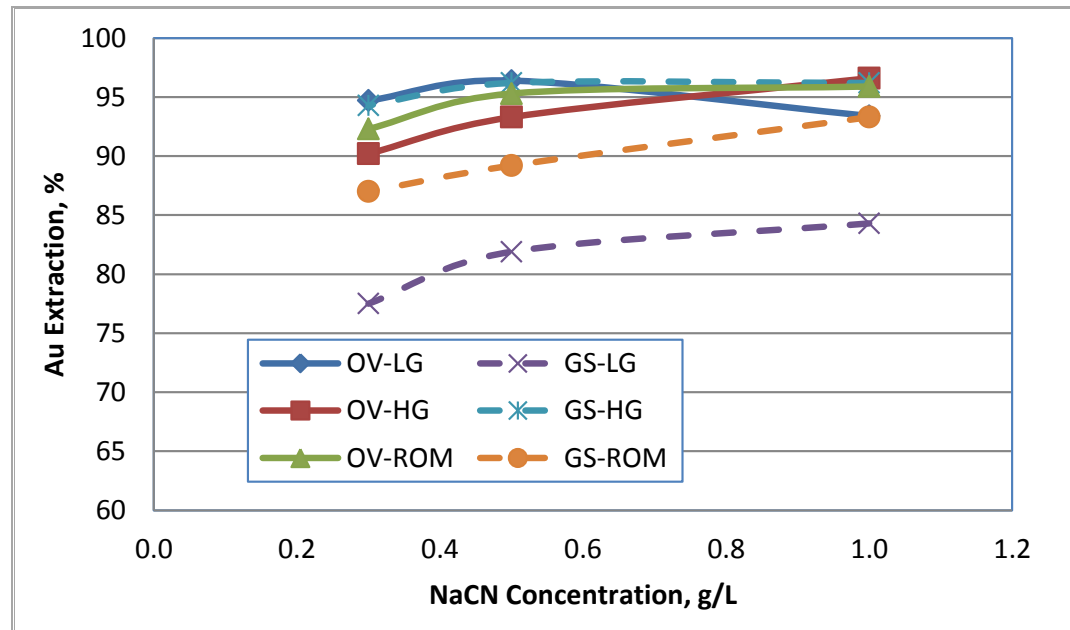
The effect of grind size on gold extraction was investigated at four separate target grinds as summarized in Figure 13-1. For these tests, the pulp density and NaCN concentration was held constant at 40% and 1.0 g/L, respectively. All of the composites showed improved gold extraction at finer grind sizes with the finest grind P<sub>80</sub> of 75 µm demonstrating the best extractions for all samples tested.

**Figure 13-1: Effect of Grind Size on Cyanide Gold Extraction for the Metallurgical Composites**



The effect of cyanide concentration on gold extraction was evaluated at three maintained reagent concentrations: 1.0 g/L, 0.5 g/L, and 0.3 g/L. Figure 13-2 presents the relationship between NaCN concentration and final extraction for each of the composites. The general trend is towards increased extraction at higher concentration, particularly between 0.3 g/L NaCN and 0.5 g/L NaCN.

**Figure 13-2: Effect of Cyanide Concentration on Gold Extraction for the Metallurgical Composites**



The influence of pulp density on leach extraction was less clear. Overall, higher extractions were achieved at 40% solids as compared to 50% solids, but the difference was very small; less than 0.5% on average. Based on the results of the initial series of tests, all subsequent cyanide leach tests were run at a grind  $P_{80}$  of 75  $\mu\text{m}$ , 0.5 g/L NaCN maintained and 40% pulp density.

Oxygen addition to the leach pulp to maintain an  $\text{O}_2$  concentration between 10 ppm and 20 ppm was shown to improve leach extractions slightly. In particular, for the Grota Seca ROM and LG composites, where gains of 2% to 3% Au extraction were achieved compared to similar tests with no sparging. Increasing the  $\text{O}_2$  concentration to between 20 ppm and 30 ppm had no additional benefit.

Leaching in the presence of activated carbon did not improve overall extractions for any of the composites. Similarly, the addition of 200 g/t  $\text{PbNO}_3$  was not observed to result in any positive benefit.



#### **13.2.4 Gravity Separation**

A bench-scale Knelson centrifugal concentrator was used to conduct a series of gravity recovery tests on each of the metallurgical composites. Individual 5 kg test charges were ground to  $P_{80}$  of 600  $\mu\text{m}$ , 300  $\mu\text{m}$ , and 106  $\mu\text{m}$  before a single pass through a 3" bowl concentrator. Results indicated that for all samples tested higher gold recoveries were achieved at the finer grind sizes. At a  $P_{80}$  of 106  $\mu\text{m}$ , gold recovery ranged from 31% for the Grota Seca LG to 65% for the Grota Seca HG.

Gravity concentrates were upgraded by superpanner, with the superpanner tails subjected to gold extraction by intensive cyanide leach. For five of the six composites, the intensive leach extractions were about 98% to 99%. The exception was the Grota Seca LG, which only reached 83%. This is probably due to the presence of gold locked in sulphides in this composite and the tendency for the heavier sulphide minerals to report to the superpanner tails.

Overall, gold recoveries for the gravity/cyanidation flowsheet were comparable to (if slightly lower than) the best results of the whole-ore leach tests, due to the coarser grind size used in this series.

#### **13.2.5 Detox**

Batch testwork was conducted to determine the amenability of Ouro Verde and Grota Seca leach tailings to cyanide destruction by the Inco  $\text{SO}_2$ -air process. The results indicated that weak acid dissociable cyanide ( $\text{CN}_{\text{WAD}}$ ) concentration in a leach pulp at 40% solids could be reduced below 1 ppm through the addition of sodium metabisulphite in the presence of air sparging.

Tests were also carried out that indicated  $\text{CN}_{\text{WAD}}$  concentrations below 1 ppm could also be achieved through treatment with Caro's acid ( $\text{H}_2\text{SO}_5$ ).

#### **13.2.6 Settling Testwork**

Scoping-level settling tests were carried out on ground samples of the ROM composites from Ouro Verde and Grota Seca. In total six different flocculants at three different dosages were tested. Results indicated that typical settling rates can be achieved with moderate flocculant dosages.



### 13.3 SGS Chile – 2013

A follow-up metallurgical program was conducted at SGS Minerals in Santiago, Chile in June 2013. The purpose of the program was to provide additional definition in the areas of gravity concentration, cyanide leaching, gold adsorption, and tailings detoxification.

#### 13.3.1 Sample Selection

Two metallurgical composites were prepared from quarter-core samples from the Ouro Verde and Grota Seca deposits. The composites were labelled as Ouro Verde ROM and Grota Seca ROM. A summary of the head analysis for these composites is provided in Table 13-4. Gold grades for both composites are comparable to the ROM composites produced in the 2012 program, which are summarized in Table 13-1.

**Table 13-4: Head Assay Results for the 2013 Volta Grande Metallurgical Composites**

| Composite      | Au g/t | Ag g/t | S%   | CTOT % | CO <sub>3</sub> % | Cu%   | Fe%  | As ppm | Hg ppm |
|----------------|--------|--------|------|--------|-------------------|-------|------|--------|--------|
| Ouro Verde ROM | 1.17   | 0.3    | 0.09 | 0.21   | 0.96              | 0.020 | 3.20 | 86     | 1.6    |
| Grota Seca ROM | 1.00   | 1.1    | 0.45 | 0.61   | 2.90              | 0.010 | 3.58 | 739    | 3.4    |

#### 13.3.2 Grindability Testing

Eight comminution composites were generated from PQ core material from the Ouro Verde and Grota Seca deposits. The composite samples were submitted for grindability testing, including JKTech Drop-Weight testing, CWi, Ai, BRWi, and BBWi. Results are summarized in Table 13-5.

**Table 13-5: Grindability Test Results for the 2013 Volta Grande Comminution Composites**

| Composite No. | DWi (kWh/m <sup>3</sup> ) | Axb  | ta   | ta   | Ai    | BRWi (kWh/t) | BBWi (kWh/t) |
|---------------|---------------------------|------|------|------|-------|--------------|--------------|
| 1             | 9.14                      | 28.0 | 0.19 | 0.19 | 0.595 | 14.2         | 15.8         |
| 2             | 8.60                      | 27.0 | 0.27 | 0.27 | 0.567 | 14.2         | 14.7         |
| 3             | 6.59                      | 33.8 | 0.26 | 0.26 | 0.599 | 13.3         | 15.2         |
| 4             | 8.05                      | 32.9 | 0.42 | 0.42 | 0.438 | 13.1         | 14.0         |
| 5             | 6.57                      | 36.5 | 0.34 | 0.34 | 0.452 | 13.1         | 14.2         |
| 6             | 8.42                      | 29.0 | 0.28 | 0.28 | 0.593 | 13.8         | 13.8         |
| 7             | 9.28                      | 30.3 | 0.37 | 0.37 | 0.358 | 14.3         | 14.9         |
| 8             | 10.19                     | 27.6 | 0.35 | 0.35 | 0.429 | 14.5         | 14.9         |

The results were found to be comparable to data collected in the 2012 program.



### 13.3.3 Gravity Concentration / Tailings Cyanidation

A series of bench-scale Knelson centrifugal concentrator tests, similar to those of the 2012 program, was conducted on each of the ROM composites. For this testwork, 40 kg test charges were ground to  $P_{80}$  of 150  $\mu\text{m}$ , 106  $\mu\text{m}$ , 75  $\mu\text{m}$ , and 53  $\mu\text{m}$  before a single pass through a 3" bowl concentrator. Results are summarized in Table 13-6.

**Table 13-6: Gravity Concentration Results for the 2013 ROM Composites**

| Test No. | $P_{80}$ ( $\mu\text{m}$ ) | OV-ROM      |             | GS-ROM      |             | OV-GS Conc. Grade (g/t) |
|----------|----------------------------|-------------|-------------|-------------|-------------|-------------------------|
|          |                            | Grade (g/t) | Au Rec. (%) | Grade (g/t) | Au Rec. (%) |                         |
| 1        | 53                         | 1.17        | 53.9        | 1.00        | 46.1        | 496.3                   |
| 2        | 75                         | 1.17        | 49.7        | 1.00        | 43.1        | 246.9                   |
| 3        | 106                        | 1.17        | 47.1        | 1.00        | 41.2        | 290.6                   |
| 4        | 150                        | 1.17        | 47.1        | 1.00        | 40.2        | 244.5                   |

Results for both composites indicate increasing gravity recovery with finer primary grind size. At the target grind  $P_{80}$  of 75  $\mu\text{m}$ , recoveries to the Knelson concentrate for the Ouro Verde and Grota Seca ROM composites were 49.7% and 43.1%, respectively. The combined gravity concentrate at this grind size graded 247 g/t Au.

Cyanide leach tests were conducted on the gravity tailings at varying grind size (53  $\mu\text{m}$  and 75  $\mu\text{m}$ ), and with and without air/ $\text{O}_2$  sparging. The results indicated that gold extraction was relatively independent of the variables tested, at  $\approx 90\%$  for the Ouro Verde ROM composite, and  $\approx 84\%$  for the Grota Seca ROM composite. Cyanide consumption for these tests was lower than for the earlier testwork on whole ore averaging 0.13 kg/t NaCN.

### 13.3.4 Carbon Adsorption

Bench-scale carbon adsorption testwork was carried out on both ROM composites, consisting of equilibrium isotherms and a kinetics test. Results for both composites were similar with gold recovery to carbon after 24 hours of 97.8%.

### 13.3.5 Tailings Detoxification

Additional Inco  $\text{SO}_2$ -air batch tests were carried out on both ROM composites, this time in the presence of a copper catalyst. Final  $\text{CN}_{\text{WAD}}$  concentrations of less than 1 ppm were achieved after three hours of residence time in a batch reactor.



## **13.4 Recovery Estimate**

Based on the results of the testwork completed on Volta Grande project samples, a metallurgical projection has been made. The projection assumes a plant feed consisting of a 1:1 ratio of Ouro Verde:Grotá Seca feed, and that processing will follow a conventional route of crushing/grinding to a  $P_{80}$  product size of  $\approx 75 \mu\text{m}$ . The grinding circuit would include gravity concentration on a split from the cyclone underflow, in order to prevent the build-up of a circulating load of coarse gold in the milling circuit and ensure optimum gold recovery.

High-grade gravity-circuit concentrate would be treated in an intensive leach reactor, with the leach solution going directly to electrowinning. The cyclone overflow would report to a CIL circuit. Gold would be recovered from both streams as cathode sludge and fed to a common induction furnace.

The average leach gold extraction for the two deposits is calculated to be 95.1%. An allowance of 1.0% has been made to account for process gold losses, including to the CIL tailings solution, and to carbon attrition. Gold recovery is therefore estimated at 94.1%.

During life-of-mine (LOM), the plant feed grade is estimated at 1.14 g/t Au, with a projected gold recovery of 92.8%.



## **14 MINERAL RESOURCE ESTIMATE**

### **14.1 Introduction**

The Mineral Resource model supporting the present PEA was prepared by Belo Sun and was audited by SRK. It represents the eighth Mineral Resource evaluation prepared for the Project in accordance with the Canadian Securities Administrators' NI 43-101.

The Mineral Resource model considers 313 core boreholes (85,159 m) for the Ouro Verde deposit, 474 core boreholes and 59 RC boreholes (126,832 m) for the Grotta Seca deposit, and 95 core boreholes (21,318 m) for the South Block deposit. The drilling data were acquired by TVX Gold Inc. (1996 to 1998), Verena (2006–2008), and Belo Sun (since 2010).

The audited Mineral Resource Statement presented herein was prepared by Camila Passos (CREA 5061868179/D), Dr. Leuangthong, P.Eng. (PEO#90563867), and Dr. Couture, P.Geo. (APGO#0197), full time employees of SRK. Dr. Leuangthong and Dr. Couture are independent QPs as this term is defined in NI 43-101. The effective date of the audited Mineral Resource Statement is 1 October 2013.

This section describes the methodology and key assumptions considered by Belo Sun to prepare the Mineral Resource block model that was audited by SRK. In the opinion of SRK, the resource evaluation reported herein is a reasonable representation of the global gold Mineral Resources found in the Project at the current level of sampling. The Mineral Resources have been estimated in conformity with generally accepted CIM *Estimation of Mineral Resource and Mineral Reserves Best Practices Guidelines*, and are reported in accordance with the Canadian Securities Administrators' National Instrument 43-101. Mineral Resources are not Mineral Reserves, and have no demonstrated economic viability. There is no certainty that all or any part of the Mineral Resource will be converted into a Mineral Reserve.

GEMS software (version 6.5) was used by Belo Sun to construct the geological solids, prepare assay data for geostatistical analysis, construct the block model, estimate gold grades, and tabulate Mineral Resources. SRK used a combination of GEMS, Leapfrog™, GOCAD®, and GSLIB software for the audit.



## **14.1 Resource Estimation Procedures**

The construction of the Mineral Resource model involved the following methodology:

- database compilation and verification
- construction of wireframe models for the boundaries of the gold mineralization
- definition of resource domains
- data conditioning (compositing and capping) for geostatistical analysis and variography
- block modelling and grade interpolation
- block classification and validation
- assessment of “reasonable prospects for economic extraction,” and selection of appropriate reporting cutoff grade
- preparation of an audited Mineral Resource Statement.

SRK independently audited the methodology and key assumptions considered by Belo Sun to prepare the geology and Mineral Resource model. SRK performed the assessment of “reasonable prospects for economic extraction” to assist with the selection of appropriate reporting assumptions. Finally, SRK prepared the audited Mineral Resource Statement reported herein.

## **14.2 Resource Database**

The database used to evaluate the project’s Mineral Resources includes 313 core boreholes (85,159 m) for the Ouro Verde deposit, 474 core boreholes and 59 RC boreholes (126,832 m) for the Grota Seca deposit, and 95 core boreholes (21,318 m) for the South Block deposit (Table 14-1). SRK notes that an additional 13 core boreholes were drilled in the South Block deposit; however, these exploratory boreholes are located far from the three main zones of gold mineralization delineated within the South Block. These 13 core boreholes were excluded from the South Block resource database. The drilling data were collected by TVX (1996 to 1998), Verena (2006 to 2008), and Belo Sun (since 2010). TVX used BQ and NQ core drilling equipment for unweathered rock, and HQ core for weathered material. Verena and Belo Sun core drilling used HQ equipment for weathered material, and NQ for unweathered rock. The effective dates of the drilling database for the various deposits are:

- 25 April 2013 for Grota Seca
- 22 April 2013 for Ouro Verde
- 17 May 2013 for South Block.



All borehole collars were surveyed according to UTM coordinates (SAD69 datum, Zone 22S). TVX and Verena completed downhole surveys at intervals of approximately 50 m. Belo Sun's downhole surveys were completed at 3 m intervals using a Maxibore downhole survey tool. Core recovery was found to be good, exceeding 95% within the auriferous intervals.

Based on the three previous site visits completed by SRK between April 2011 and October 2012, SRK believes that drilling, logging, core handling, core storage, and assay quality assurance protocols used by Belo Sun exceed generally-accepted industry best practices. As a result, SRK considers that the exploration data collected by Belo Sun and previous project operators are of sufficient quality to support Mineral Resource evaluation.

**Table 14-1: Summary of the Ouro Verde, Grota Seca, and South Block Borehole Database**

| Deposit      | Core Boreholes |                |                 | RC Boreholes |               |                 |
|--------------|----------------|----------------|-----------------|--------------|---------------|-----------------|
|              | Count          | Length (m)     | Assay Intervals | Count        | Length (m)    | Assay Intervals |
| Ouro Verde   | 259            | 69,477         | 12,328          | -            | -             | -               |
| Grota Seca   | 408            | 98,659         | 16,360          | 59           | 11,225        | 553             |
| South Block  | 62             | 14,275         | 462             | -            | -             | -               |
| <b>Total</b> | <b>729</b>     | <b>182,411</b> | <b>29,150</b>   | <b>59</b>    | <b>11,225</b> | <b>553</b>      |

### 14.3 Geological Interpretation and Modelling

The gold mineralization at the Project occurs primarily in unweathered intrusive rock; subordinate mineralization occurs in the near surface saprolite. Gold occurs in a stack of mineralized zones up to 1 km in strike length, from the surface to approximately 400 m deep. The true thickness of the gold mineralization ranges from a few metres up to 50 m. These zones are associated with a regional shear zone and, in the case of the South Block, crosscutting faults. In general, the gold mineralization is associated with:

- intense silicification with fine-grained sulphide (predominantly arsenopyrite) within strongly sheared diorite, such as at the Grota Seca area
- weak to moderate silicification in diorite with minor sulphide (mainly pyrite), such as at the Ouro Verde area
- intense silicification overprinted by sulphide alteration (pyrite) and potassium alteration (sericitization), such as in the South Block area.



#### *14.1.1 Belo Sun Geological Modelling*

Belo Sun used a lithological assay-based approach to define the boundaries of the gold mineralization in the Ouro Verde, Grota Seca, and South Block deposits. Due to the relatively small number of boreholes in the South Block area, gold mineralization boundaries are more conceptual in nature compared to the well-defined boundaries at Ouro Verde and Grota Seca.

The gold mineralization was subdivided into three grade domains: LG, MG, and HG domains. Previous Mineral Resource evaluations considered gold mineralization in what is referred to as the MG domain. A LG domain was modelled around the MG domain to encompass lower grade gold mineralization found outside the main MG domain. The higher-grade gold mineralization inside two MG domains was also delineated to define HG domains. In the South Block, only one grade domain was defined in a similar manner to the MG domains of Ouro Verde and Grota Seca.

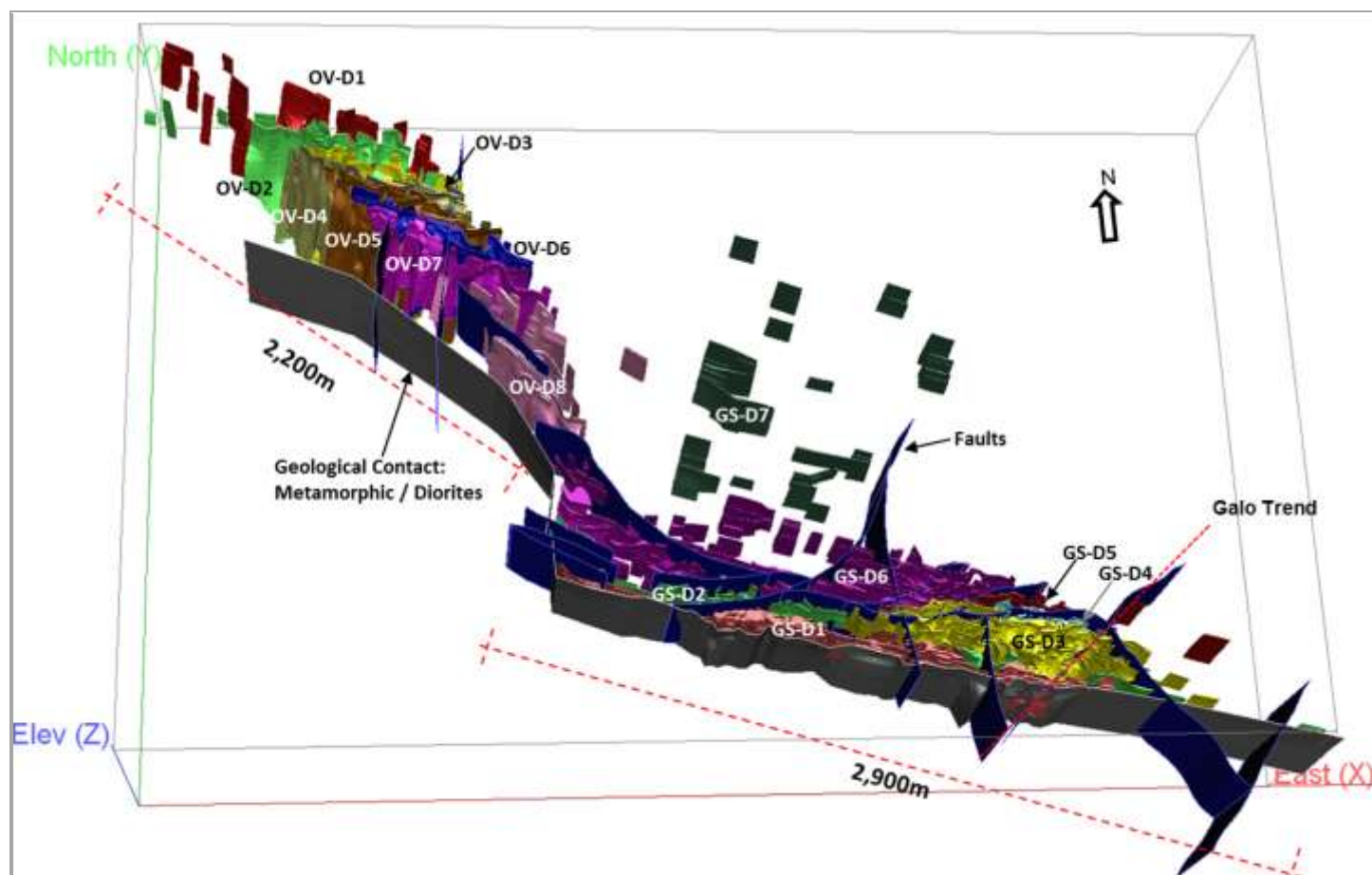
To define the MG domains, auriferous intervals associated with silicification, sulphide, or quartz veining were combined to define a mineralized zone using the following criteria:

- minimum average grade of composite interval (hanging wall to footwall contact) is 0.5 g/t Au for saprolite or unweathered rock
- maximum length of internal dilution within mineralized interval is 3.0 m
- generally, the minimum thickness of an interval is 2.0 m, and should comprise at least two assayed intervals
- the strike continuity of the gold mineralization is generally assumed to be sub-parallel to the regional foliation.

Using this approach and the recent database, Belo Sun modelled eight auriferous zones in fresh rock at Ouro Verde, seven at Grota Seca, and three at South Block (Figure 14-2 to Figure 14-3). Each deposit also considers a saprolite zone. In all, there are 21 auriferous zones across the three deposits; these are referred to as the MG zones in the current resource model, and correspond to the zones considered in previous resource models that were independently audited by SRK.

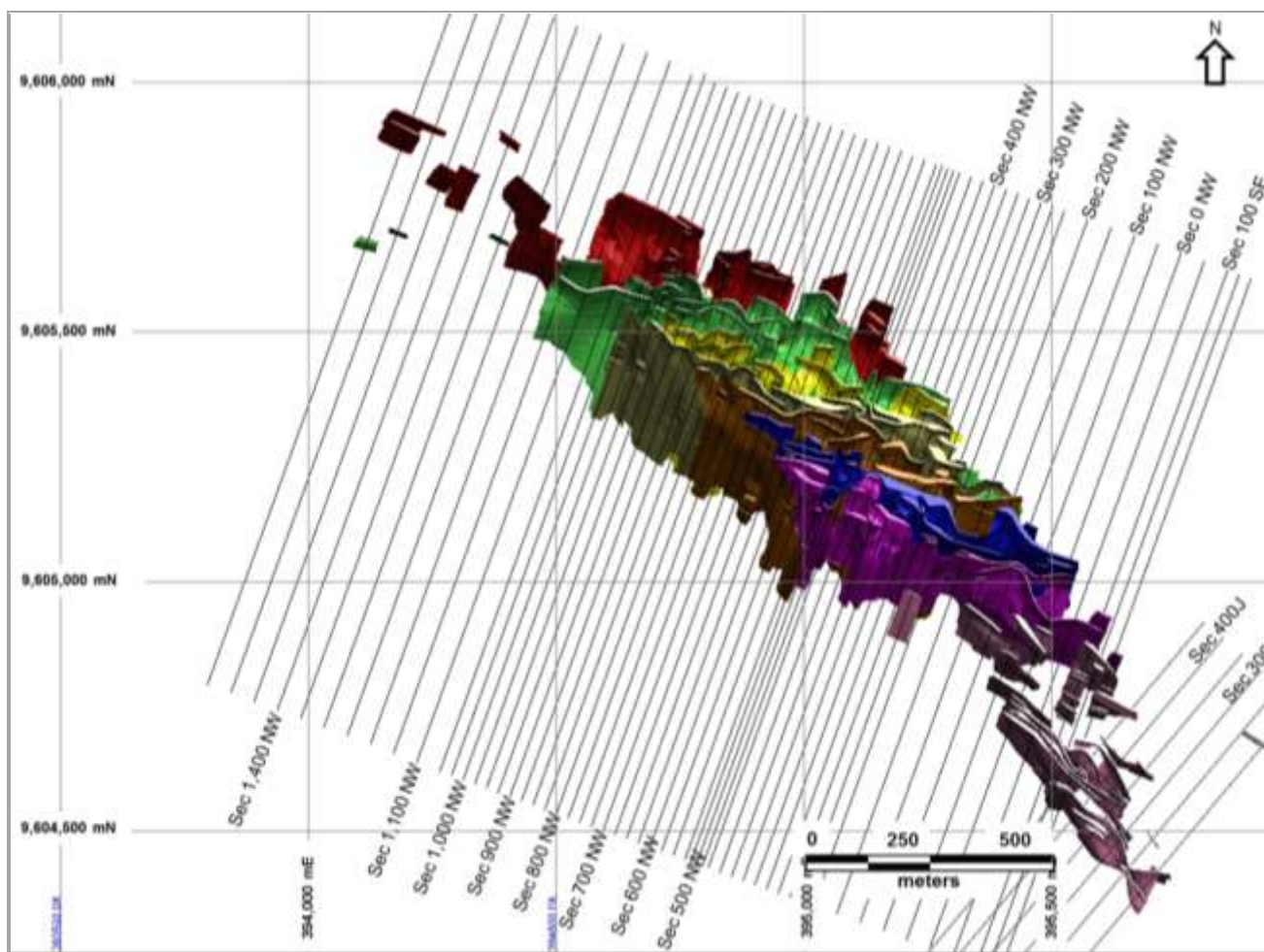
In April 2013, Belo Sun disclosed an updated, unaudited Mineral Resource Statement. This model introduced a new LG domain in the Grota Seca and Ouro Verde deposits to recognize that there is a broad halo of low-grade gold mineralization surrounding the MG domains. The LG domain was defined based on a threshold of 0.25 g/t Au, and on the interpretation and extrusion of the boundary of the gold mineralization on vertical sections spaced at 25 m.

Figure 14-1: Schematic Illustration of MG Resource Domains and Structural Controls of Ouro Verde and Grota Seca Deposits



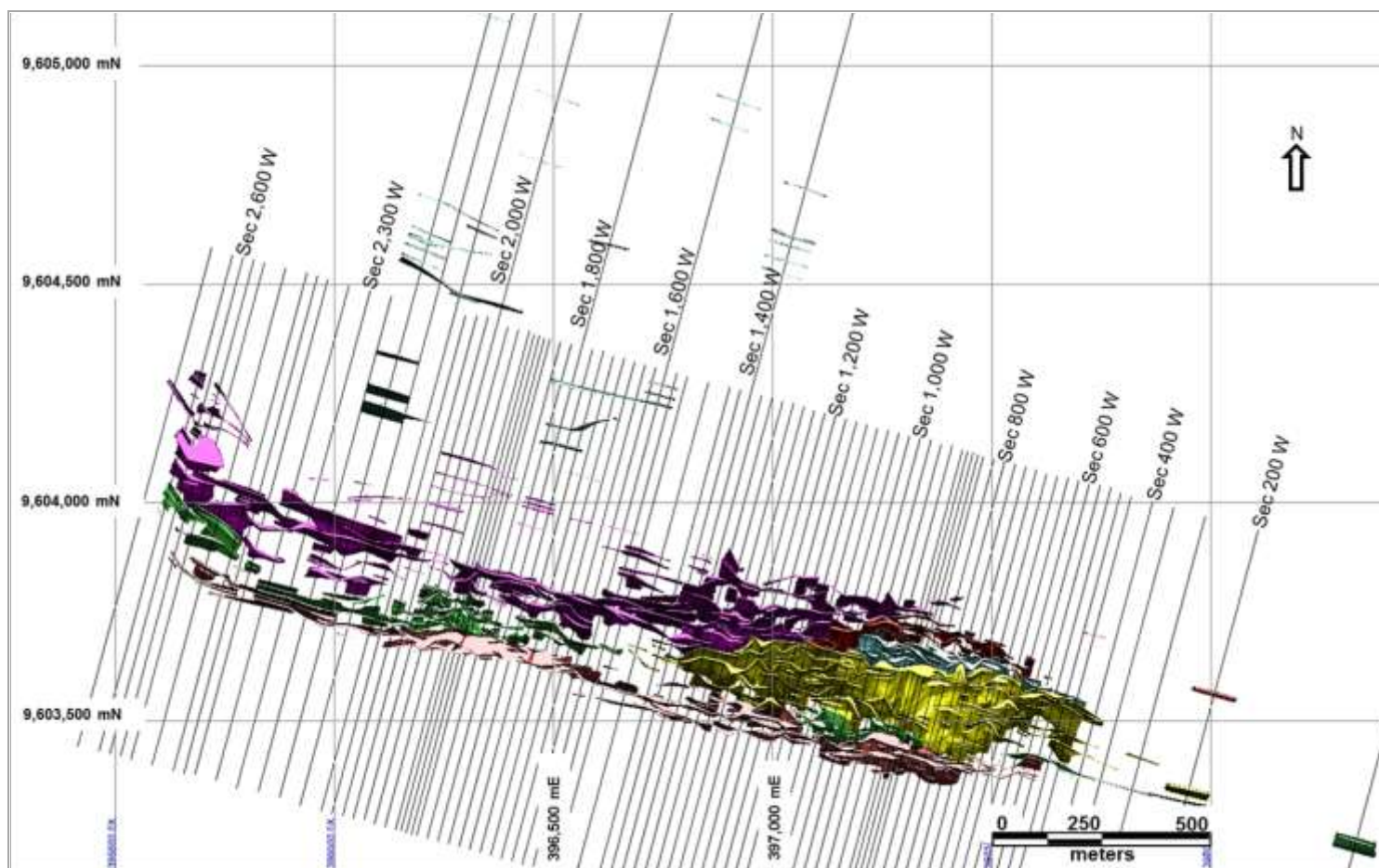
Source: Belo Sun

Figure 14-2: Volta Grande Project Ouro Verde Resource Domains



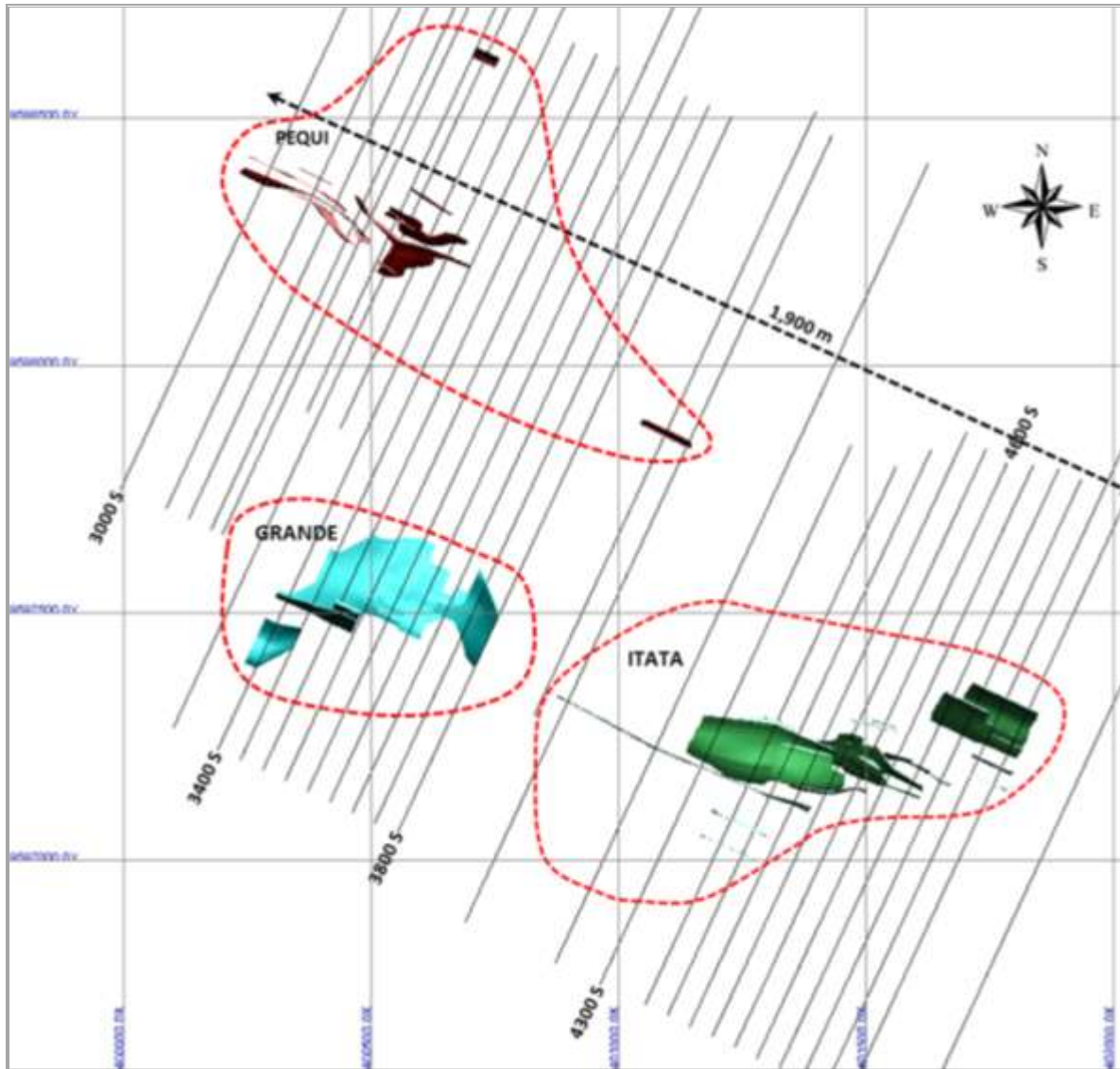
Source: Belo Sun

**Figure 14-3: Grotta Seca (top) and Resource Domains**



Source: Belo Sun

**Figure 14-4: South Block Resource Domains**



**Source:** Belo Sun

The April 2013 unaudited Mineral Resource statement was reported using a 0.5 g/t Au cutoff and did not include any tonnage in the LG domains.

Further, in the prefeasibility technical report (AMEC, 2013), AMEC included certain risk statements regarding the continuity of the higher-grade gold mineralization defined at the Ouro Verde and Grota Seca deposits. To address these risks, Belo Sun modelled HG domains inside the MG domains, based on a 1.0 g/t Au threshold. Two new HG domains were defined as one within Ouro Verde Domain, and two within Grota Seca Domain 1.



These two sub-domains were delineated using the dynamic shells module within GEMS, which implicitly models the continuity of gold above a specified threshold.

Table 14-2 provides a list of the resource domains used in the Volta Grande resource model, including rock codes found within the GEMS project.

**Table 14-2: Summary of Resource Domains for Ouro Verde, Grota Seca, and South Block**

| Ouro Verde   |           |           | Grota Seca   |           |           | South Block  |           |           |
|--------------|-----------|-----------|--------------|-----------|-----------|--------------|-----------|-----------|
| Grade Domain | Domain    | Rock Code | Grade Domain | Domain    | Rock Code | Grade Domain | Domain    | Rock Code |
| HG           | 2         | 1002      | HG           | 1         | 2001      |              |           |           |
| MG           | Saprolite | 200       | MG           | Saprolite | 300       | MG           | Saprolite | 600       |
|              | 1         | 201       |              | 1         | 301       |              | Itatá     | 601       |
|              | 2         | 202       |              | 2         | 302       |              | Pequi     | 602       |
|              | 3         | 203       |              | 3         | 303       |              | Grande    | 603       |
|              | 4         | 204       |              | 4         | 304       |              |           |           |
|              | 5         | 205       |              | 5         | 305       |              |           |           |
|              | 6         | 206       |              | 6         | 306       |              |           |           |
|              | 7         | 207       |              | 7         | 307       |              |           |           |
|              | 8         | 208       |              |           | -         |              |           |           |
| LG           | Saprolite | 70        | LG           | Saprolite | 80        |              |           |           |
|              | Fresh     | 71        |              | Fresh     | 81        |              |           |           |

#### 14.1.2 SRK Audit of the Geological Model

Upon receipt of the geological model, SRK verified the MG domain against borehole data. At the same time, SRK also verified that stated model parameters, such as maximum waste inclusion in the wireframes, were adhered to. SRK identified discrepancies between borehole and wireframe intersections of the same boreholes, as well as waste intersections greater than 3 m in some gold mineralization wireframes. However, in the latter cases, the average grade of the borehole intersections was greater than the cutoff grade used for the creation of the domains. The differences between borehole and wireframe intersections that are greater than 0.1 m amount to less than 2% of all intersections. SRK is of the opinion that this difference is not material, and that the wireframes generally are well-constructed and are an adequate representation of the boundaries of the gold mineralization.

SRK performed a similar verification of the LG domains. As the LG domains were constructed by extrusion from vertical sections without snapping to assay intersection, waste samples may be incorporated into a domain and, conversely, mineralized samples



may be excluded. SRK found examples of both situations. SRK supports the modelling of LG domains for estimating a grade in the material adjacent to the main auriferous domains (MG and HG), and that may contribute to mining dilution. However, SRK recommends that Belo Sun adopt a more rigorous modelling methodology. The LG domains should be defined and interpreted using a wireframe approach, similar to the construction of the MG domains. This would ensure continuity of the geological interpretation between sections, and improve confidence in the geological continuity of the LG domains.

To validate the HG domains, SRK independently compared the continuity of the HG domains at Ouro Verde and Grota Seca with similar domains constructed using a MultiGaussian kriging approach (Leuangthong and Srivastava, 2012). This was completed using SRK's in-house developed software and GOCAD®. The results of SRK's assessment confirm that it is reasonable to model HG domains within Grota Seca Domain 1 and Ouro Verde Domain 2. The extents of Belo Sun's modelled HG domains were also independently validated.

Belo Sun also asked SRK to investigate the potential for a HG domain near the Galo Trend structural feature in the southern portion of Grota Seca, along a strike of approximately 050° (see Figure 14-1). Site photographs indicate that the Galo Trend may host high-grade gold mineralization. However, SRK found that higher-grade gold mineralization in this region lacks any obvious geological continuity at the present sampling spacing. As such, infill drilling is required to demonstrate the continuity of the higher-grade gold mineralization within the Galo Trend.

#### **14.4 Specific Gravity**

Belo Sun measured SG using a standard weight in water/weight in air methodology on core from complete sample intervals. The SG database contains 826, 1,269, and 124 measurements for unweathered material for Ouro Verde, Grota Seca, and South Block, respectively. The average SG in each deposit is 2.75 for both Ouro Verde and Grota Seca, and 2.77 for South Block. Only 48 SG measurements were taken on saprolite material for all deposits combined. The data yield an average SG of 1.36. While the saprolite SG data are scarce, the bulk of the Mineral Resources occur in fresh rock. Therefore, the risk associated with saprolite SG is considered low.

SRK has reviewed the Belo Sun SG database and has confirmed that the average SG used is appropriate for converting volumes into tonnages.



## 14.5 Mineral Resource Model

Belo Sun prepared the Mineral Resource model. SRK performed audits of statistical and geostatistical data, block model checks, and a review of classification parameters.

### 14.1.3 Resource Database

The borehole database used for resource estimation consists of 882 core boreholes and 59 RC boreholes. Table 14-3 provides a summary of the available boreholes for Ouro Verde, Grota Seca, and South Block.

**Table 14-3: Summary of Available Data for Volta Grande**

| Deposit      | Core Boreholes |                |                 | RC Boreholes |               |                 |
|--------------|----------------|----------------|-----------------|--------------|---------------|-----------------|
|              | Count          | Length (m)     | Assay Intervals | Count        | Length (m)    | Assay Intervals |
| Ouro Verde   | 313            | 85,159         | 13,814          | -            | -             | -               |
| Grota Seca   | 474            | 115,607        | 18,477          | 59           | 11,225        | 553             |
| South Block  | 95             | 21,318         | 711             | -            | -             | -               |
| <b>Total</b> | <b>882</b>     | <b>222,084</b> | <b>33,002</b>   | <b>59</b>    | <b>11,225</b> | <b>553</b>      |

### 14.1.4 Compositing, Statistics, and Capping

All assay intervals within the resource domains were composited to a length of 1 m. Plots of sample length frequencies for all domains within Ouro Verde, Grota Seca, and South Block deposits are provided in Figure 14-5. Approximately 95% of all sample intervals in Ouro Verde and Grota Seca are 1 m or less in length. For South Block, approximately 85% of all sample intervals are 1 m or less in length.

To limit the influence of high gold grade outliers, Belo Sun capped the majority of the composites in the unweathered rock and saprolite domains. Only three sub-domains (the saprolite and Itatá Zones in South Block, and the LG saprolite) did not warrant capping. Selected capping values for the Ouro Verde, Grota Seca, and South Block deposits are outlined in Table 14-4.

Summary sample statistics for the three areas are provided in Table 14-5. Composite statistics are provided in Table 14-6.

**Figure 14-5: Sample Length Distribution for All Domains at Ouro Verde (top left), Grota Seca (top right), and South Block (bottom left)**

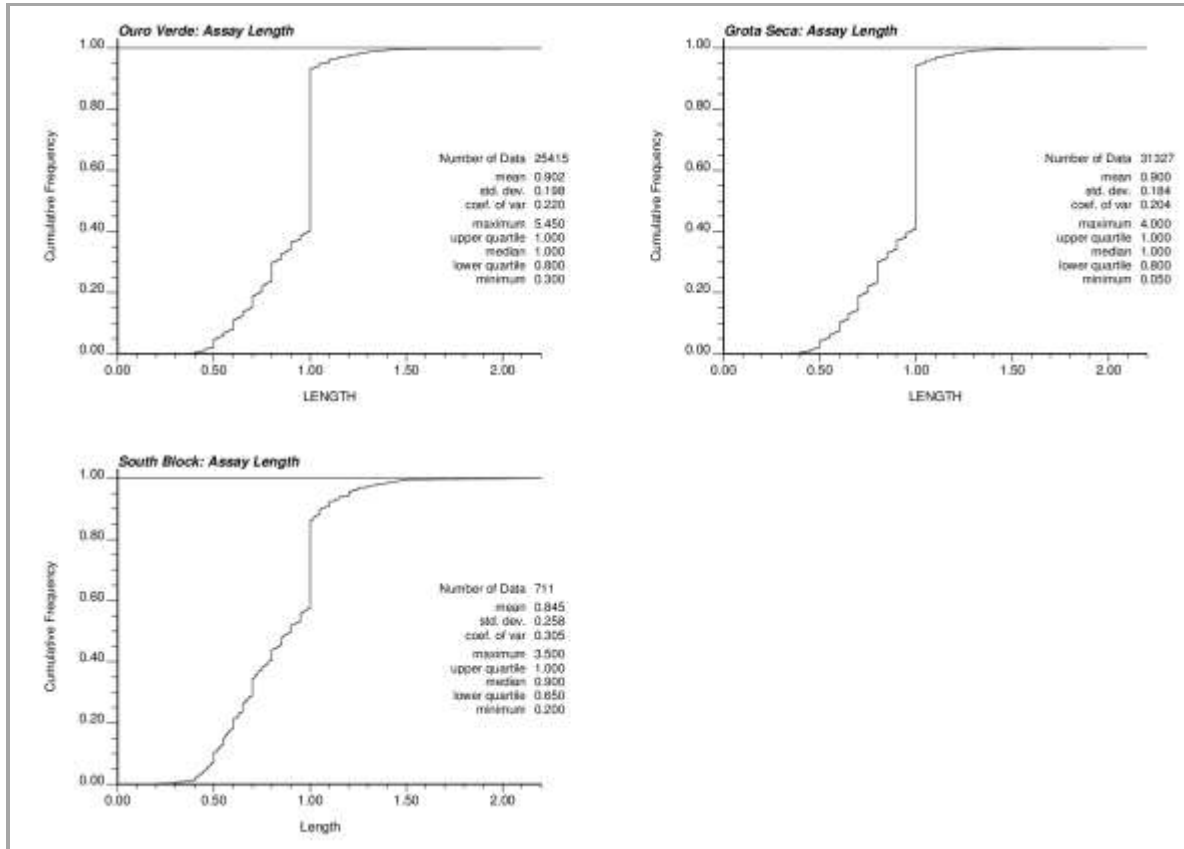


**Table 14-4: Volta Grande Composite Capping Values**

| Ouro Verde   |           |                     |               | Grota Seca   |           |                     |               | South Block |                     |               |
|--------------|-----------|---------------------|---------------|--------------|-----------|---------------------|---------------|-------------|---------------------|---------------|
| Grade Domain | Zone      | Capping Value (g/t) | Number Capped | Grade Domain | Zone      | Capping Value (g/t) | Number Capped | Target      | Capping Value (g/t) | Number Capped |
| HG           | 2         | 32                  | 7             | HG           | 1         | 40                  | 5             |             |                     |               |
| MG           | Saprolite | 9                   | 14            | MG           | Saprolite | 10                  | 3             | Saprolite   | No cap              | -             |
|              | 1         | 25                  | 15            |              | 1         | 10                  | 34            | Pequi       | 20                  | 2             |
|              | 2         | 25                  | 7             |              | 2         | 23                  | 14            | Grande      | 40                  | 6             |
|              | 3         | 20                  | 10            |              | 3         | 17                  | 49            | Itatá       | No Cap              | -             |
|              | 4         | 40                  | 9             |              | 4         | 16                  | 13            |             |                     |               |
|              | 5         | 30                  | 4             |              | 5         | 24                  | 7             |             |                     |               |
|              | 6         | 15                  | 13            |              | 6         | 20                  | 26            |             |                     |               |
|              | 7         | 10                  | 8             |              | 7         | 9                   | 3             |             |                     |               |
|              | 8         | 31                  | 8             |              |           |                     |               |             |                     |               |
| LG           | Saprolite | 6                   | 1             | LG           | Saprolite | No cap              | -             |             |                     |               |
|              | Fresh     | 7                   | 21            |              | Fresh     | 7                   | 11            |             |                     |               |



**Table 14-5: Summary Assay Statistics for Volta Grande Project (length-weighted)**

| Area        | Grade Domain | Sub-Domain | Assays |       |           |       |        |
|-------------|--------------|------------|--------|-------|-----------|-------|--------|
|             |              |            | Count  | Mean  | Std. Dev. | Min.  | Max.   |
| Ouro Verde  | HG           | 2          | 944    | 3.068 | 8.924     | 0.032 | 299.50 |
|             | MG           | Saprolite  | 1,054  | 1.400 | 3.548     | 0.041 | 67.30  |
|             |              | 1          | 2,113  | 1.653 | 5.519     | 0.006 | 155.00 |
|             |              | 2          | 2,283  | 1.247 | 4.555     | 0.003 | 142.30 |
|             |              | 3          | 1,133  | 1.956 | 6.657     | 0.005 | 147.10 |
|             |              | 4          | 2,749  | 1.958 | 6.488     | 0.003 | 270.00 |
|             |              | 5          | 1,358  | 1.789 | 4.816     | 0.010 | 85.70  |
|             |              | 6          | 802    | 1.901 | 5.326     | 0.015 | 78.80  |
|             |              | 7          | 550    | 1.422 | 3.319     | 0.010 | 51.60  |
|             |              | 8          | 828    | 1.942 | 11.274    | 0.003 | 277.50 |
|             | LG           | Saprolite  | 797    | 0.335 | 0.561     | 0.003 | 15.70  |
|             |              | Fresh      | 10,804 | 0.329 | 0.618     | 0.000 | 26.90  |
| Grotta Seca | HG           | 1          | 875    | 3.032 | 8.274     | 0.005 | 227.00 |
|             | MG           | Saprolite  | 1,057  | 1.054 | 1.545     | 0.034 | 29.64  |
|             |              | 1          | 5,301  | 1.024 | 1.949     | 0.003 | 53.00  |
|             |              | 2          | 1,682  | 1.908 | 9.109     | 0.003 | 415.80 |
|             |              | 3          | 4,172  | 1.816 | 6.236     | 0.001 | 215.50 |
|             |              | 4          | 1,771  | 1.618 | 5.564     | 0.005 | 153.30 |
|             |              | 5          | 868    | 1.886 | 6.267     | 0.005 | 140.70 |
|             |              | 6          | 2,628  | 1.949 | 6.074     | 0.003 | 126.80 |
|             |              | 7          | 123    | 1.466 | 2.118     | 0.012 | 14.50  |
|             | LG           | Saprolite  | 219    | 0.340 | 0.253     | 0.001 | 2.33   |
|             |              | Fresh      | 12,631 | 0.307 | 0.413     | 0.001 | 14.90  |
| South Block |              | All        | 711    | 3.422 | 10.64     | 0     | 168.80 |
|             |              | Saprolite  | 54     | 1.186 | 2.072     | 0     | 10.60  |
|             |              | Pequi      | 215    | 2.586 | 7.278     | 0.003 | 88.30  |
|             |              | Grande     | 165    | 6.474 | 18.786    | 0.010 | 168.80 |
|             |              | Itatá      | 277    | 3.004 | 7.000     | 0     | 73.60  |



**Table 14-6: Summary Statistics for Uncapped and Capped Composites (length-weighted)**

| Area        | Grade Domain | Sub-Domain | Composites  |       |           |       |        | Capped Composites |       |           |       |       |
|-------------|--------------|------------|-------------|-------|-----------|-------|--------|-------------------|-------|-----------|-------|-------|
|             |              |            | No. of Data | Mean  | Std. Dev. | Min.  | Max.   | No. Data          | Mean  | Std. Dev. | Min.  | Max.  |
| Ouro Verde  | HG           | 2          | 821         | 3.066 | 6.220     | 0.055 | 127.53 | 821               | 2.896 | 4.084     | 0.055 | 32.00 |
|             | MG           | Saprolite  | 1,099       | 1.384 | 3.416     | 0.041 | 67.30  | 1,099             | 1.173 | 1.446     | 0.041 | 9.00  |
|             |              | 1          | 1,928       | 1.653 | 4.081     | 0.006 | 77.68  | 1,928             | 1.554 | 3.052     | 0.006 | 25.00 |
|             |              | 2          | 2,082       | 1.272 | 3.653     | 0.005 | 97.28  | 2,082             | 1.197 | 2.328     | 0.005 | 25.00 |
|             |              | 3          | 1,046       | 1.956 | 6.095     | 0.005 | 147.10 | 1,046             | 1.692 | 2.744     | 0.005 | 20.00 |
|             |              | 4          | 2,543       | 1.958 | 5.295     | 0.008 | 103.61 | 2,543             | 1.867 | 4.131     | 0.008 | 40.00 |
|             |              | 5          | 1,264       | 1.790 | 3.938     | 0.010 | 57.56  | 1,264             | 1.737 | 3.379     | 0.010 | 30.00 |
|             |              | 6          | 757         | 1.898 | 4.757     | 0.015 | 69.93  | 757               | 1.661 | 2.696     | 0.015 | 15.00 |
|             |              | 7          | 500         | 1.422 | 2.647     | 0.016 | 51.60  | 500               | 1.309 | 1.756     | 0.016 | 10.00 |
|             |              | 8          | 738         | 1.969 | 8.227     | 0.017 | 144.66 | 738               | 1.623 | 3.563     | 0.017 | 31.00 |
|             | LG           | Saprolite  | 835         | 0.343 | 0.520     | 0.003 | 10.23  | 835               | 0.338 | 0.436     | 0.003 | 6.00  |
|             |              | Fresh      | 10,218      | 0.372 | 0.695     | 0.001 | 26.30  | 10,218            | 0.364 | 0.541     | 0.001 | 7.00  |
| Grota Seca  | HG           | 1          | 811         | 3.029 | 6.100     | 0.005 | 91.74  | 811               | 2.901 | 4.832     | 0.005 | 40.00 |
|             | MG           | Saprolite  | 1,095       | 1.056 | 1.533     | 0.034 | 29.64  | 1,095             | 1.016 | 0.947     | 0.034 | 10.00 |
|             |              | 1          | 4,932       | 1.026 | 1.641     | 0.003 | 34.29  | 4,932             | 0.989 | 1.227     | 0.003 | 10.00 |
|             |              | 2          | 1,577       | 1.908 | 6.810     | 0.005 | 211.78 | 1,577             | 1.663 | 2.894     | 0.005 | 23.00 |
|             |              | 3          | 3,783       | 1.816 | 4.837     | 0.001 | 143.91 | 3,783             | 1.622 | 2.649     | 0.001 | 17.00 |
|             |              | 4          | 1,588       | 1.618 | 5.012     | 0.005 | 153.30 | 1,588             | 1.439 | 2.369     | 0.005 | 16.00 |
|             |              | 5          | 787         | 1.886 | 4.740     | 0.005 | 54.90  | 787               | 1.752 | 3.644     | 0.005 | 24.00 |
|             |              | 6          | 2,416       | 1.948 | 5.024     | 0.003 | 117.47 | 2,416             | 1.761 | 3.071     | 0.003 | 20.00 |
|             |              | 7          | 122         | 1.466 | 2.027     | 0.030 | 11.05  | 122               | 1.429 | 1.865     | 0.030 | 9.00  |
|             | LG           | Saprolite  | 232         | 0.345 | 0.261     | 0.001 | 2.33   | 232               | 0.345 | 0.261     | 0.001 | 2.33  |
|             |              | Fresh      | 11,904      | 0.344 | 0.612     | 0.001 | 31.89  | 11,904            | 0.338 | 0.428     | 0.001 | 7.00  |
| South Block |              | All        | 639         | 3.424 | 8.076     | 0.001 | 134.50 | 639               | 3.141 | 5.933     | 0.001 | 43.20 |
|             |              | Saprolite  | 62          | 1.186 | 1.856     | 0.001 | 10.60  | 62                | 1.186 | 1.856     | 0.001 | 10.60 |
|             |              | Pequi      | 204         | 2.588 | 6.851     | 0.003 | 88.30  | 204               | 2.228 | 3.220     | 0.003 | 20.00 |
|             |              | Grande     | 139         | 6.474 | 12.978    | 0.018 | 134.50 | 139               | 5.696 | 9.314     | 0.018 | 40.00 |
|             |              | Itatá      | 234         | 3.005 | 5.513     | 0.001 | 43.20  | 234               | 3.005 | 5.513     | 0.001 | 43.20 |

SRK compared assays and composite statistics for data generated independently by Belo Sun and SRK. No differences were found between the two data sets. SRK checked the selected capping values by comparing probability plots of gold composites for each zone, plotting the mean grade and the number of affected data by the chosen cap value, and decile analysis for the various sub-domains. SRK's checks confirmed the capping values used for the saprolite and unweathered domains within Ouro Verde, Grota Seca, and South Block. SRK considered capping values for Ouro Verde MG Zones 1, 3, 5, and 7 as slightly optimistic; SRK recommends reducing the cap value by approximately 5 g/t Au in



all four cases. Capped composite statistics for the two areas are summarized in Table 14-6. Based on the assay and composite database checks, as well as a review of capping values, SRK concludes that the data are reasonable and appropriate, and can be used for the estimation of Mineral Resources.

#### 14.1.5 Variography

Belo Sun used GEMS mining software to model the spatial continuity of gold for the Project. For the MG sub-domains within Ouro Verde and Grota Seca, four zones exhibiting the most stable variograms were considered: Ouro Verde MG sub-domains 1, 2, and 4, and Grota Seca MG sub-domain 1. In all cases, Belo Sun modelled the variogram using two spherical structures (Table 14-7). Belo Sun also modelled variograms for the HG sub-domains within Ouro Verde and Grota Seca. The main differences between the modelled HG sub-domain variograms and their MG counterparts are a reduced nugget effect and a slight refinement of the variogram range. Variograms for the LG domains within these two deposits were also modelled.

**Table 14-7: Summary of Belo Sun Variogram Model Parameters**

| Area        | Domain | Sub-Domain | GEMS Rotation (ADA) |     |        | Variogram Model |          |           |      |         |         |         |
|-------------|--------|------------|---------------------|-----|--------|-----------------|----------|-----------|------|---------|---------|---------|
|             |        |            | Azimuth             | Dip | Plunge | Nugget*         | Str. No. | Type      | CC*  | Y Range | X Range | Z Range |
| Ouro Verde  | HG     | 2          | 198                 | -50 | 288    | 0.02            | 1        | Spherical | 0.48 | 35      | 83      | 1.9     |
|             |        |            | 198                 | -50 | 288    |                 | 2        | Spherical | 0.50 | 35      | 120     | 3.2     |
|             | MG     | 1          | 198                 | -50 | 288    | 0.10            | 1        | Spherical | 0.56 | 78      | 98      | 2       |
|             |        |            | 198                 | -50 | 288    |                 | 2        | Spherical | 0.34 | 108     | 115     | 4.1     |
|             |        | 2          | 198                 | -50 | 288    | 0.18            | 1        | Spherical | 0.41 | 27      | 75      | 2.5     |
|             |        |            | 198                 | -50 | 288    |                 | 2        | Spherical | 0.41 | 50      | 128     | 5       |
|             |        | 4          | 198                 | -50 | 288    | 0.20            | 1        | Spherical | 0.50 | 36      | 42      | 1.7     |
|             |        |            | 198                 | -50 | 288    |                 | 2        | Spherical | 0.30 | 59      | 62      | 3.8     |
|             | LG     |            | 198                 | -50 | 288    | 0.30            | 1        | Spherical | 0.30 | 35      | 42      | 1.7     |
|             |        |            | 198                 | -50 | 288    |                 | 2        | Spherical | 0.40 | 95      | 95      | 8.0     |
| Grota Seca  | HG     | 1          | 285                 | 0   | 15     | 0.05            | 1        | Spherical | 0.65 | 24      | 40      | 55      |
|             |        |            | 285                 | 0   | 15     |                 | 2        | Spherical | 0.30 | 85      | 95      | 55      |
|             | MG     | 1          | 285                 | 0   | 15     | 0.10            | 1        | Spherical | 0.55 | 20      | 45      | 25      |
|             |        |            | 285                 | 0   | 15     |                 | 2        | Spherical | 0.35 | 20      | 90      | 40      |
|             | LG     |            | 285                 | 0   | 15     | 0.10            | 1        | Spherical | 0.28 | 5       | 45      | 50      |
|             |        |            | 285                 | 0   | 15     |                 | 2        | Spherical | 0.62 | 275     | 63      | 215     |
| South Block | Pequi  | 1          | 115                 | 0   | 25     | 0.10            | 1        | Spherical | 0.90 | 8       | 150     | 125     |

**Note:** \* Normalized to sill of 1.0

In SRK's December 2012 audit of the Project, lack of data in South Block led to poor inference of the variogram model. While South Block data remains small relative to Ouro Verde and Grota Seca, Belo Sun was able to infer and model a variogram for Pequi Zone.



Unfortunately, there is still insufficient sample data for the Itatá and Grande Zones, preventing variogram inference.

SRK audited the Belo Sun variogram models for Ouro Verde, Grota Seca, and South Block by reviewing the detailed GEMS parameters used to generate the variograms, and independently calculated gold variograms for all sub-domains tabulated in Table 14-7 using the Geostatistical Software Library (GSLIB; Deutsch and Journel, 1998).

For each zone, SRK assessed four different spatial metrics:

- 1) Traditional semivariogram of original gold
- 2) Correlogram of original gold
- 3) Traditional semivariogram of normal scores of gold
- 4) Correlogram of normal scores of gold.

Belo Sun's fitted model appears to fit reasonably the experimental values based on these four spatial metrics. In general, SRK considers that Belo Sun's calculation parameters, orientation, and fitted variogram models are appropriate for the available data and geological interpretation. SRK notes that the two HG sub-domains are fitted with an exceptionally low nugget effect, considering the auriferous nature of this deposit. The sensitivity of the grade estimates to this parameter was assessed as part of SRK's audit work (refer to Section 14.6).

#### **14.1.6 Block Model Parameters**

Two rotated, full-block models were generated for the Project using GEMS. The block model coordinates are based on the local UTM grid (SAD 69 datum, Zone 22S). The model is rotated using GEMS convention at -17° for Ouro Verde and Grota Seca block model, and -25° for the South Block model. Table 14-8 summarizes the block model definition for the three deposits.

SRK notes that, unlike previous resource models, the block size was reduced from 12.5 m x 5 m x 10 m to 6 m x 6 m x 10 m. This change to a smaller block size was motivated by a desire to refine mine engineering plans and schedules. To assess the impact of this change, Belo Sun generated block models for both block sizes and compared the resultant global quantities and grade estimates to ensure that no bias was introduced.



**Table 14-8: Volta Grande GEMS Block Model Definition**

|                                         | <b>Block Size<br/>(m)</b> | <b>Origin*<br/>(m)</b> | <b>No.<br/>Blocks</b> |
|-----------------------------------------|---------------------------|------------------------|-----------------------|
| <b><i>Ouro Verde and Grota Seca</i></b> |                           |                        |                       |
| X                                       | 6                         | 393,206.42             | 927                   |
| Y                                       | 6                         | 9,604,126.42           | 381                   |
| Z                                       | 10                        | 260.00                 | 88                    |
| <b><i>South Block</i></b>               |                           |                        |                       |
| X                                       | 6                         | 399,504.26             | 440                   |
| Y                                       | 6                         | 9,597,547.69           | 270                   |
| Z                                       | 10                        | 250.00                 | 47                    |

**Note:** \* SAD 69 datum, Zone 22S

Belo Sun provided to SRK the block model for the MG domains, at different block sizes, for review. A reduced block size should result in little to no change to the global average grade and an increase in the global variance. Given that the block dimension is actually halved in one of the three principal directions, SRK did not expect a significant increase in the variance of the block model. This was confirmed when SRK compared the grade distribution, on a by-sub-domain basis, at both zero (Table 14-9) and 0.5 g/t Au cutoff grades (Table 14-10). This comparison showed that there was no material change in global average grade, and less than a 1% reduction in the global variance. Consequently, SRK believes that a reduced block size should have little impact on the Mineral Resource quantity and quality for Volta Grande.



**Table 14-9: Comparison of Estimated Blocks at Different Block Sizes at Zero Cutoff Grade**

| Deposit                 | Zone      | 6 m x 6 m x 10 m Blocks |       |           | 12.5 m x 5 m x 10 m Blocks |       |           | % Difference |               |
|-------------------------|-----------|-------------------------|-------|-----------|----------------------------|-------|-----------|--------------|---------------|
|                         |           | No. Blocks              | Mean  | Std. Dev. | No. Blocks                 | Mean  | Std. Dev. | Mean (%)     | Std. Dev. (%) |
| Ouro Verde + Grota Seca | All MG    | 356,904                 | 1.623 | 1.177     | 245,207                    | 1.620 | 1.176     | 0.2          | 0.1           |
| Ouro Verde              | Saprolite | 8,024                   | 1.141 | 0.736     | 5,371                      | 1.140 | 0.743     | 0.1          | -0.9          |
|                         | 1         | 43,909                  | 1.536 | 0.996     | 27,791                     | 1.539 | 0.996     | -0.2         | 0.0           |
|                         | 2         | 37,442                  | 1.702 | 1.104     | 23,114                     | 1.699 | 1.101     | 0.2          | 0.3           |
|                         | 3         | 14,353                  | 1.716 | 1.130     | 8,919                      | 1.707 | 1.129     | 0.5          | 0.1           |
|                         | 4         | 25,859                  | 1.810 | 1.515     | 15,981                     | 1.810 | 1.524     | 0.0          | -0.6          |
|                         | 5         | 13,567                  | 1.690 | 1.357     | 8,534                      | 1.679 | 1.333     | 0.7          | 1.8           |
|                         | 6         | 10,690                  | 1.603 | 1.060     | 6,690                      | 1.607 | 1.059     | -0.2         | 0.1           |
|                         | 7         | 9,613                   | 1.433 | 0.829     | 6,283                      | 1.436 | 0.839     | -0.2         | -1.2          |
|                         | 8         | 13,185                  | 1.682 | 1.610     | 10,260                     | 1.689 | 1.622     | -0.4         | -0.7          |
| Grota Seca              | Saprolite | 20,035                  | 1.023 | 0.426     | 15,441                     | 1.024 | 0.427     | -0.1         | -0.2          |
|                         | 1         | 33,978                  | 1.220 | 0.891     | 24,015                     | 1.222 | 0.900     | -0.2         | -1.0          |
|                         | 2         | 16,030                  | 1.705 | 1.234     | 12,228                     | 1.701 | 1.238     | 0.2          | -0.3          |
|                         | 3         | 38,986                  | 1.836 | 1.159     | 27,215                     | 1.831 | 1.164     | 0.3          | -0.4          |
|                         | 4         | 19,138                  | 1.604 | 1.069     | 13,217                     | 1.592 | 1.046     | 0.8          | 2.2           |
|                         | 5         | 9,126                   | 1.789 | 1.321     | 7,077                      | 1.789 | 1.335     | 0.0          | -1.0          |
|                         | 6         | 40,400                  | 1.908 | 1.335     | 30,969                     | 1.893 | 1.315     | 0.8          | 1.5           |
|                         | 7         | 2,569                   | 1.295 | 0.704     | 2,102                      | 1.268 | 0.662     | 2.1          | 6.3           |



**Table 14-10: Comparison of Estimated Blocks at Different Block Sizes at 0.5 g/t Au Cutoff Grade**

| Deposit                 | Zone      | 6 x 6 x 10 m Blocks |       |           | 12.5 x 5 x 10 m Blocks |       |           | % Difference |               |
|-------------------------|-----------|---------------------|-------|-----------|------------------------|-------|-----------|--------------|---------------|
|                         |           | No. Blocks          | Mean  | Std. Dev. | No. Blocks             | Mean  | Std. Dev. | Mean (%)     | Std. Dev. (%) |
| Ouro Verde + Grota Seca | All       | 356,904             | 1.652 | 1.177     | 239,906                | 1.648 | 1.175     | 0.2          | 0.2           |
| Ouro Verde              | Saprolite | 7,740               | 1.169 | 0.737     | 5,184                  | 1.165 | 0.744     | 0.3          | -0.9          |
|                         | 1         | 42,899              | 1.565 | 0.992     | 27,156                 | 1.568 | 0.992     | -0.2         | 0.0           |
|                         | 2         | 36,384              | 1.734 | 1.099     | 22,419                 | 1.734 | 1.096     | 0.0          | 0.3           |
|                         | 3         | 13,882              | 1.762 | 1.122     | 8,639                  | 1.748 | 1.123     | 0.8          | -0.1          |
|                         | 4         | 25,132              | 1.850 | 1.519     | 15,508                 | 1.848 | 1.527     | 0.1          | -0.5          |
|                         | 5         | 12,941              | 1.759 | 1.359     | 8,152                  | 1.746 | 1.335     | 0.7          | 1.8           |
|                         | 6         | 10,202              | 1.660 | 1.052     | 6,393                  | 1.660 | 1.051     | 0.0          | 0.1           |
|                         | 7         | 9,279               | 1.471 | 0.820     | 6,087                  | 1.467 | 0.832     | 0.3          | -1.4          |
|                         | 8         | 12,737              | 1.735 | 1.622     | 9,911                  | 1.741 | 1.634     | -0.3         | -0.7          |
| Grota Seca              | Saprolite | 19,772              | 1.031 | 0.424     | 15,220                 | 1.033 | 0.424     | -0.2         | 0.0           |
|                         | 1         | 33,130              | 1.242 | 0.894     | 23,442                 | 1.243 | 0.903     | -0.1         | -1.0          |
|                         | 2         | 15,892              | 1.718 | 1.233     | 12,120                 | 1.714 | 1.238     | 0.2          | -0.4          |
|                         | 3         | 38,600              | 1.852 | 1.156     | 26,936                 | 1.849 | 1.161     | 0.2          | -0.4          |
|                         | 4         | 18,742              | 1.632 | 1.065     | 12,931                 | 1.623 | 1.040     | 0.6          | 2.4           |
|                         | 5         | 9,031               | 1.812 | 1.321     | 7,018                  | 1.807 | 1.335     | 0.3          | -1.0          |
|                         | 6         | 40,061              | 1.922 | 1.333     | 30,705                 | 1.907 | 1.314     | 0.8          | 1.4           |
|                         | 7         | 2,555               | 1.300 | 0.703     | 2,085                  | 1.276 | 0.660     | 1.9          | 6.5           |

#### 14.1.7 Estimation

Belo Sun estimated gold grades using ordinary kriging and three estimations runs with progressively relaxed search ellipsoids and data requirements. Table 14-11 summarizes the initial Belo Sun data requirements per estimation pass, on a by-deposit basis, and Table 14-12 provides the search ellipsoid ranges and orientation, by estimation pass and by sub-domain, within the three deposits. For both Ouro Verde and Grota Seca, the first estimation pass was based on an octant search, while the second and third passes used an ellipsoidal search. For South Block, an ellipsoidal search was used for all estimation passes.



**Table 14-11: Initial\* Data and Search Parameters for Estimation, by Deposit**

| Area        | Estimation Pass | Number of Composites |      |                         | Search Type & Parameters |                   |                      |
|-------------|-----------------|----------------------|------|-------------------------|--------------------------|-------------------|----------------------|
|             |                 | Min.                 | Max. | Max. Comps/<br>Borehole | Octant Search            | Min. Num. Octants | Max. Data/<br>Octant |
| Ouro Verde  |                 | 4                    | 12   | 5                       | Yes                      | 3                 | 5                    |
|             | 2               | 4                    | 16   | 6                       | No                       | -                 | -                    |
|             | 3               | 4                    | 16   | 3                       | No                       | -                 | -                    |
| Grota Seca  | 1               | 4                    | 12   | 5                       | Yes                      | 3                 | 5                    |
|             | 2               | 4                    | 16   | 6                       | No                       | -                 | -                    |
|             | 3               | 4                    | 16   | 3                       | No                       | -                 | -                    |
| South Block | 1               | 3                    | 16   | 3                       | No                       | -                 | -                    |
|             | 2               | 4                    | 16   | 16                      | No                       | -                 | -                    |
|             | 3               | 4                    | 16   | 16                      | No                       | -                 | -                    |

**Note:** \* Refer to Table 14-14 for final data and search parameters used for the construction of the block model.

**Table 14-12: Summary of Estimation Search Parameters**

| Area        | Grade Domain | Sub-Domain  | Estimation Pass | SVx* (m) | Svy* (m) | SVz* (m) | GEMS Rotation (ADA) |     |      |
|-------------|--------------|-------------|-----------------|----------|----------|----------|---------------------|-----|------|
|             |              |             |                 |          |          |          | Azm.                | Dip | Azm. |
| Ouro Verde  | HG           | 2           | 1, 2            | 120      | 35       | 3.2      | 198                 | -50 | 288  |
|             |              | 2           | 3               | 240      | 70       | 6.4      | 198                 | -50 | 288  |
|             | MG           | 1           | 1, 2            | 127      | 155      | 4        | 198                 | -50 | 288  |
|             |              | 1           | 3               | 254      | 310      | 8        | 198                 | -50 | 288  |
|             |              | 2 and 3     | 1, 2            | 120      | 50       | 3.6      | 198                 | -50 | 288  |
|             |              | 2 and 3     | 3               | 240      | 100      | 7.2      | 198                 | -50 | 288  |
|             |              | 4 to 6      | 1, 2            | 105      | 55       | 3.5      | 198                 | -50 | 288  |
|             |              | 4 to 6      | 3               | 210      | 110      | 7        | 198                 | -50 | 288  |
|             |              | 7           | 1, 2            | 105      | 55       | 3.5      | 198                 | -65 | 288  |
|             |              | 7           | 3               | 210      | 110      | 7        | 198                 | -65 | 288  |
|             |              | 8           | 1,2             | 105      | 55       | 3.5      | 230                 | -85 | 320  |
|             |              | 8           | 3               | 210      | 110      | 7        | 230                 | -85 | 320  |
|             | LG           |             | 1**, 2          | 95       | 95       | 8        | 198                 | -50 | 288  |
|             |              |             | 3               | 190      | 190      | 16       | 198                 | -50 | 288  |
| Grota Seca  | HG           | 1           | 1, 2            | 95       | 24       | 55       | 285                 | 0   | 15   |
|             |              | 1           | 3               | 190      | 48       | 110      | 285                 | 0   | 15   |
|             | MG           | 1 to 7      | 1, 2            | 90       | 20       | 40       | 285                 | 0   | 15   |
|             |              | 1 to 7      | 3               | 180      | 40       | 80       | 285                 | 0   | 15   |
|             | LG           |             | 1**, 2          | 45       | 5        | 50       | 285                 | 0   | 15   |
|             |              |             | 3               | 90       | 10       | 100      | 285                 | 0   | 15   |
| South Block |              | All targets | 1, 2            | 150      | 8        | 125      | 115                 | 0   | 25   |
|             |              | All targets | 3               | 300      | 16       | 250      | 115                 | 0   | 25   |

**Notes:** \* GEMS rotations.

\*\* Final parameters for Pass 1 included limiting the influence of composites grading greater than 2.0 g/t Au to within radii of 10/10/8 and 10/5/10 for Ouro Verde and Grota Seca, respectively.



The estimation ellipse ranges and orientations are based on the variogram models developed for the various sub-domains within each deposit. Ouro Verde Zone 3 used the variogram model for Ouro Verde Zone 2, while Ouro Verde's Zones 4 to 8 used the variogram model for Ouro Verde Zone 4. The ellipse orientations for Ouro Verde Zones 7 and 8 were adjusted to match better the orientation of the gold mineralization in these zones. All seven zones in Grota Seca used the variogram model for Grota Seca MG Zone 1.

First and second estimation runs considered search neighbourhood sizes based on the variogram ranges of the second structure. The third estimation run considered search ellipses sized at twice the variogram ranges. The estimation of the saprolite domains followed the same estimation parameters as Zone 1 and Zone 4 for Grota Seca and Ouro Verde, respectively. All estimates used hard boundaries, relying only on data within each zone or saprolite domain.

An average SG of 1.36 was assigned to saprolite blocks for all three deposits. An average SG of 2.75 was assigned to all unweathered blocks within Ouro Verde and Grota Seca, while an average SG of 2.77 was assigned to all unweathered blocks within South Block.

The block model estimates were validated by Belo Sun using: a visual comparison of block grades and composites; statistical comparisons between composites and block model distributions; statistical comparisons between ordinary kriging and nearest neighbourhood estimates at no cutoff grade; and change-of-support checks for Grota Seca MG sub-domains 1 and 3, and Ouro Verde MG Zones 1 and 4.

## **14.6 SRK Audit Work**

The SRK audit was conducted in three parts, with close collaboration with Belo Sun. Throughout this process, findings and recommendations were communicated to Belo Sun. Revisions arising from these discussions triggered revisions to the final parameters considered for the preparation of the block estimates. The following sections document the analysis and findings of SRK, as well as any revisions adopted by Belo Sun.

### **14.1.8 Reproducibility of Belo Sun Estimates**

SRK estimated eight individual zones independently, using the same estimation parameters as Belo Sun. These were Ouro Verde Zones 1, 2, and 4; Grota Seca Zones 1 and 3; and South Block Zones Grande, Itatá, and Pequi. In all cases, a comparison of the in situ total tonnes and average grade at zero cutoff grade, showed no difference between the SRK and Belo Sun estimates. SRK was able to reproduce the Belo Sun estimates.



#### 14.1.9 Sensitivity of Grade Estimates

SRK assessed the sensitivity of the estimates to the estimation strategy by varying some parameters. The parameters assessed were:

- maximum number of boreholes used for a block estimate
- minimum and maximum number of composites used for a block estimate
- type of search
- effect of grade capping, by using uncapped gold composites.

This independent analysis was undertaken by SRK for the different deposits and grade domains.

##### ***Ouro Verde and Grota Seca***

For the LG and MG domains within Grota Seca and Ouro Verde, SRK used the parameters outlined in Table 14-13 for seven zones: Ouro Verde LG Zone, MG Zones 1, 2, and 4; Grota Seca LG Zone, and MG Zones 1 and 3. In addition, SRK developed a completely independent model (case SRK5) using an SRK-fitted variogram model and SRK-chosen capping values for all zones except Ouro Verde MG Zone 4. For these zones, SRK considers that the SRK-selected inputs were sufficiently different from Belo Sun's to warrant further investigations.

**Table 14-13: SRK Sensitivity Analysis Parameters**

| Case      | Data       | Max.         | Estimation Pass 1 |      |             | Estimation Pass 2 |      |             | Estimation Pass 3 |      |             |
|-----------|------------|--------------|-------------------|------|-------------|-------------------|------|-------------|-------------------|------|-------------|
|           |            | Per Borehole | Min.              | Max. | Search Type | Min.              | Max. | Search Type | Min.              | Max. | Search Type |
| Base Case | Capped     | 5; 6; 3      | 4                 | 12   | Octant      | 4                 | 16   | Elliptical  | 4                 | 16   | Elliptical  |
| SRK1*     | Capped     | 5; 6; 3      | 4                 | 12   | Octant      | 4                 | 16   | Elliptical  | 4                 | 16   | Elliptical  |
| SRK2      | Capped     | 6; 6; 6      | 7                 | 12   | Octant      | 4                 | 12   | Octant      | 3                 | 20   | Elliptical  |
| SRK3**    | Capped     | 5; 6; 3      | 4                 | 12   | Octant      | 4                 | 16   | Elliptical  | 4                 | 16   | Elliptical  |
| SRK4      | Uncapped   | 5; 6; 3      | 4                 | 12   | Octant      | 4                 | 16   | Elliptical  | 4                 | 16   | Elliptical  |
| SRK5***   | SRK Capped | 6; 6; 6      | 7                 | 12   | Octant      | 5                 | 16   | Elliptical  | 4                 | 16   | Elliptical  |

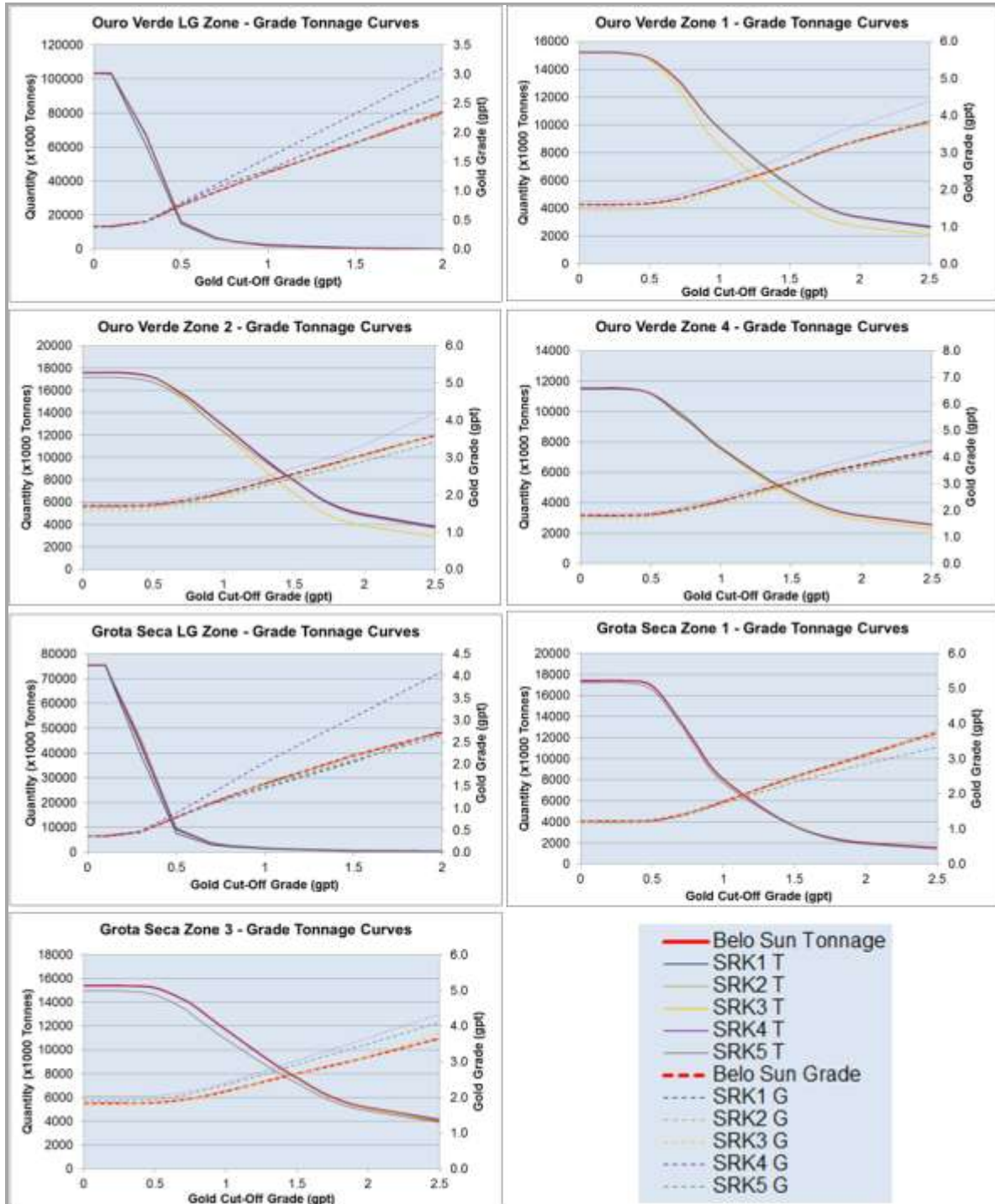
**Notes:** \* Same parameters as Base Case, but inverse distance power of 2 as estimation method; run only for South Block domains.

\*\* Influence of composites with high-grade is limited using different searches for each zone.

\*\*\* SRK-modelled variogram and SRK-chosen capping values used, with search ellipse ranges reflecting the SRK variogram model.

A summary of this analysis is provided as global grade and tonnage plots (Figure 14-6).

**Figure 14-6: Estimation Sensitivity Analysis for the Ouro Verde LG and MG Zones (top two rows), and Grota Seca LG and MG Zones (bottom two rows)**





For the LG zones in both Ouro Verde and Grota Seca, Case 1 shows the sensitivity to the estimation method, and reveals that using an inverse distance (power of 2) estimator has no material impact on the Grota Seca LG domain. This is contrasted with the Ouro Verde LG domain, where grade differences increase with the increase of the cutoff grade. SRK is comfortable that ordinary kriging yields more conservative estimates for the LG domains than an inverse distance model.

For Ouro Verde MG Zones 1 and 2, the restriction of estimation ranges for high-grade composites above a specified gold grade threshold (Case 3) results in a significant decrease in tonnage at cutoff grades higher than 0.5 g/t Au and 1.0 g/t Au for Zones 1 and 2, respectively. All other zones do not show an appreciable difference in quantity or quality of the estimates.

In general, the results of the estimates using uncapped composites (Case 4) show an expected trend of increased grade with little to marginal changes in tonnage. The impact of capping is most pronounced in both the Ouro Verde and Grota Seca LG Zones. Given that the LG geology model includes some high-grade intervals (that were previously excluded from the MG geology model), SRK is not surprised that capping in these two LG domains shows a significant impact. SRK is comfortable with the capping values chosen by Belo Sun in these two domains.

Case 5 considers not only a slight difference in the variogram model for each zone as fitted by SRK, but also more conservative capping values of 10 g/t, 15 g/t, 15 g/t, and 25 g/t Au for the Ouro Verde MG Zones 1 and 2, and Grota Seca MG Zones 1 and 3, respectively. With the exception of Grota Seca MG Zone 3, this case considered lower capping values than proposed by Belo Sun. Average grade differences are only noticeable at cutoff grades exceeding 1 g/t Au to 1.5 g/t Au. For Grota Seca MG Zone 3, SRK considers that Belo Sun's model is conservative. Overall, the grade-tonnage comparisons show that the estimates conform to expectations, and are generally insensitive to slight changes in estimation parameters and the variogram model.

For the HG domains within Ouro Verde and Grota Seca, SRK considered only Case 5 parameters, using an SRK-modelled variogram, and reduced the cap value to 30 g/t Au and 25 g/t Au for Ouro Verde HG Zone 2 and Grota Seca HG Zone 1, respectively. SRK increased the nugget effect to 20% of the sill and slightly modified the variogram ranges from those modelled by Belo Sun. These changes in capping, estimation parameters, and variogram models resulted in a reduction in the average grade of less than 1% and 2% for Ouro Verde and Grota Seca, respectively, for cutoff grades less than 2.0 g/t Au.

For the LG domains, SRK also checked the potential for high-grade smearing. Based on the estimation search ellipses used to estimate the LG domains, these higher-grade composites may affect blocks that are as far as 50 m and 100 m away for Ouro Verde and



Grota Seca, respectively. SRK assessed the relative location of composites higher than 0.5 g/t Au, and those estimated blocks with grade higher than 0.5 g/t Au. Visual inspection of this distribution of blocks suggests that these higher-grade composites have a strong influence on the estimation of the surrounding blocks.

While the probability plots suggest that the cap value of 7 g/t Au in the unweathered material may be reasonable, the secondary decile analysis performed by SRK for the LG domains shows that there may be a more conservative cap choice at 2 g/t Au. SRK re-estimated the LG domains within Ouro Verde and Grota Seca using an option in GEMS to control the spatial influence of composites greater than 2 g/t Au to within a radii of 10 m or less. All other parameters remained unchanged. This effectively restricted the influence of these higher-grade composites to up to two blocks, which appears to be consistent with the spatial distribution of the composites within this domain. This resulted in a 58% reduction in tonnes above 0.5 g/t Au for the combined Ouro Verde and Grota Seca LG domains. SRK believes this is more representative of the grade distribution in the LG domains.

These findings were shared with Belo Sun, and the recommendation of limiting the influence of composites greater than 2 g/t Au to within 10 m was adopted for the first pass, as indicated in Table 14-12.

Based on the overall results of the sensitivity analysis and the revised parameters used for LG domains within Ouro Verde and Grota Seca, SRK concludes that there is minimal sensitivity to changes in estimation parameters. All zones performed within expectations for the various cases considered. SRK considers that estimation parameters for these two deposits are reasonable.

### ***South Block***

In contrast, a review of the South Block deposit has shown that the block model appears to be sensitive to the data parameters chosen by Belo Sun. Relative to the average grade obtained using the Belo Sun-selected estimation parameters at zero cutoff, the sensitivity cases show differences by as much as -10%, 13%, and -1% for Pequi, Grande, and Itatá, respectively. SRK has no concerns related to Itatá; however, absolute differences of 10% and 13% are considered material. In both Pequi and Grande, SRK found the grade estimates are highly sensitive to the parameters, thereby resulting in highly unpredictable average grades.

For the South Block, SRK chose to focus on the Pequi Zone for an in-depth investigation into the cause of the grade estimation sensitivity. Within the Pequi Zone, SRK chose four specific blocks where a borehole intersects the block. For each of these four blocks, SRK varied the data requirements for Pass 1 of the estimation, kept all other parameters



identical to Belo Sun's parameters, and then compared the grade estimates. In general, the result of this local investigation suggests that the maximum number of composites per borehole should be at least six, and that a minimum of seven composites in the first estimation pass should be required. SRK then examined the global impact of these parameters by estimating the entire Pequi, Grande, and Itatá Zones. Results show that the model sensitivity is greatly reduced with this proposed change in estimation parameters.

SRK shared these results with Belo Sun, and recommended that the maximum number of composites per borehole should be at least six, and that a minimum of seven composites in the first estimation pass should be required. Belo Sun adopted these recommendations and revised the South Block block model accordingly. SRK verified that the revised model yields the expected quantity and quality of estimates as per the recommended parameters. SRK is comfortable with the revised South Block resource model.

Table 14-14 shows the revised and final data and search parameters used in the grade estimation of Volta Grande. The parameters in this table supersede those originally presented in Table 14-11. The restriction of high-grade composites in the Ouro Verde and Grota Seca LG domains was already noted in Table 14-12.

**Table 14-14: Final Data and Search Parameters for Estimation, by Deposit**

| Area        | Estimation Pass | Number of Composites |      |                         | Search Type and Parameters |                      |                      |
|-------------|-----------------|----------------------|------|-------------------------|----------------------------|----------------------|----------------------|
|             |                 | Min.                 | Max. | Max. Comps/<br>Borehole | Octant Search              | Min. Num.<br>Octants | Max. Data/<br>Octant |
| Ouro Verde  | 1               | 4                    | 12   | 5                       | Yes                        | 3                    | 5                    |
|             | 2               | 4                    | 16   | 6                       | No                         | -                    | -                    |
|             | 3               | 4                    | 16   | 3                       | No                         | -                    | -                    |
| Grota Seca  | 1               | 4                    | 12   | 5                       | Yes                        | 3                    | 5                    |
|             | 2               | 4                    | 16   | 6                       | No                         | -                    | -                    |
|             | 3               | 4                    | 16   | 3                       | No                         | -                    | -                    |
| South Block | 1               | 7                    | 16   | 6                       | No                         | -                    | -                    |
|             | 2               | 4                    | 16   | 16                      | No                         | -                    | -                    |
|             | 3               | 4                    | 16   | 16                      | No                         | -                    | -                    |

#### 14.1.10 Change of Support Validation

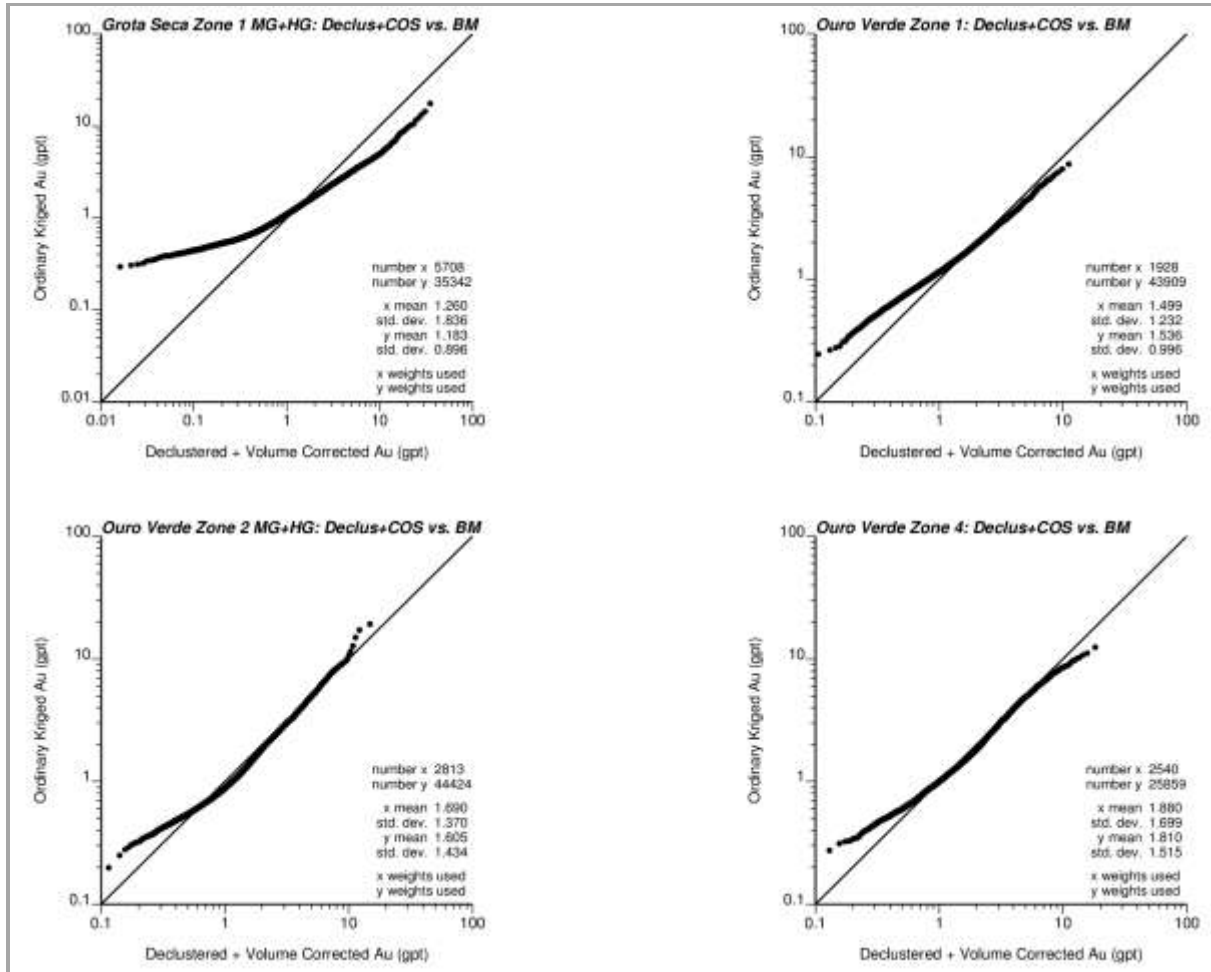
The third part of the audit comprised checking the Belo Sun estimate by comparing the block model distribution with the declustered, change-of-support-corrected distribution of the informing composites. Declustering mitigates the influence of preferential



sampling of borehole data; this often results in a distribution of composites whose mean statistic is often comparable to that of the estimated model. Furthermore, a change-of-support correction is applied to account for the volume difference between the composite scale and the final block volume scale. SRK applied a discrete Gaussian model (DGM) change-of-support, as this model is the most robust and practical for volume correction. This approach was applied for Grota Seca Zone 1, and Ouro Verde Zones 1, 2, and 4, as the variograms used for modelling are based on these four zones for their respective deposits. For both Grota Seca Zone 1 and Ouro Verde Zone 2, this change-of-support assessment was performed for the combined MG and HG domains. South Block quantities minimally contribute to the overall Project; hence, this analysis was not performed for South Block.

Figure 14-7 shows the comparison of the gold distribution from the block model and the expected grade distribution following declustering and change-of-support corrections for these four zones. Overall, the mean grades from the block model are consistent with those predicted from declustering. The quantile-quantile plot comparing block grade estimates with declustered change-of-support composites for Grota Seca Zone 1 (Figure 14-7) suggests that the block model is smoother than that predicted by the DGM change-of-support model, while for Ouro Verde Zones 1, 2, and 4, the standard deviations of the two distributions are comparable, suggesting a smoothness of the estimates that conforms to expectations. Based on these checks, SRK confirms that the Belo Sun block estimates for the Ouro Verde and Grota Seca deposits are appropriate, and reasonably reflect the underlying borehole sampling data.

**Figure 14-7: Quantile-Quantile Comparison of Block Model Grades to Declustered Change-of-Support Corrected Gold Distributions**



## 14.7 Classification

The classification parameters used by Belo Sun for Ouro Verde and Grotta Seca are as follows:

- Measured: blocks estimated in the first estimation run (within the variogram range), whose estimation required a minimum of three boreholes, and composites in a minimum of three octants
- Indicated: blocks estimated in the first or second estimation runs (within the variogram range), whose estimation required a minimum of two boreholes



- Inferred: all blocks not classified as Measured or Indicated in the first and second estimation runs, and all blocks estimated in the third estimation run (twice the variogram range).

SRK has reviewed the classification parameters used by Belo Sun, and has examined the classification visually by inspecting sections and plans through the block models. SRK concludes that the parameters used to define Measured blocks reasonably reflect estimates that can be considered to be at a high confidence level, material classified as Indicated reflects estimates made with a moderate level of confidence, and all other material is estimated at a lower confidence level. In addition to Belo Sun's proposed classification scheme, SRK applied a post-smoothing filter on the classified material to ensure continuity within the classification categories.

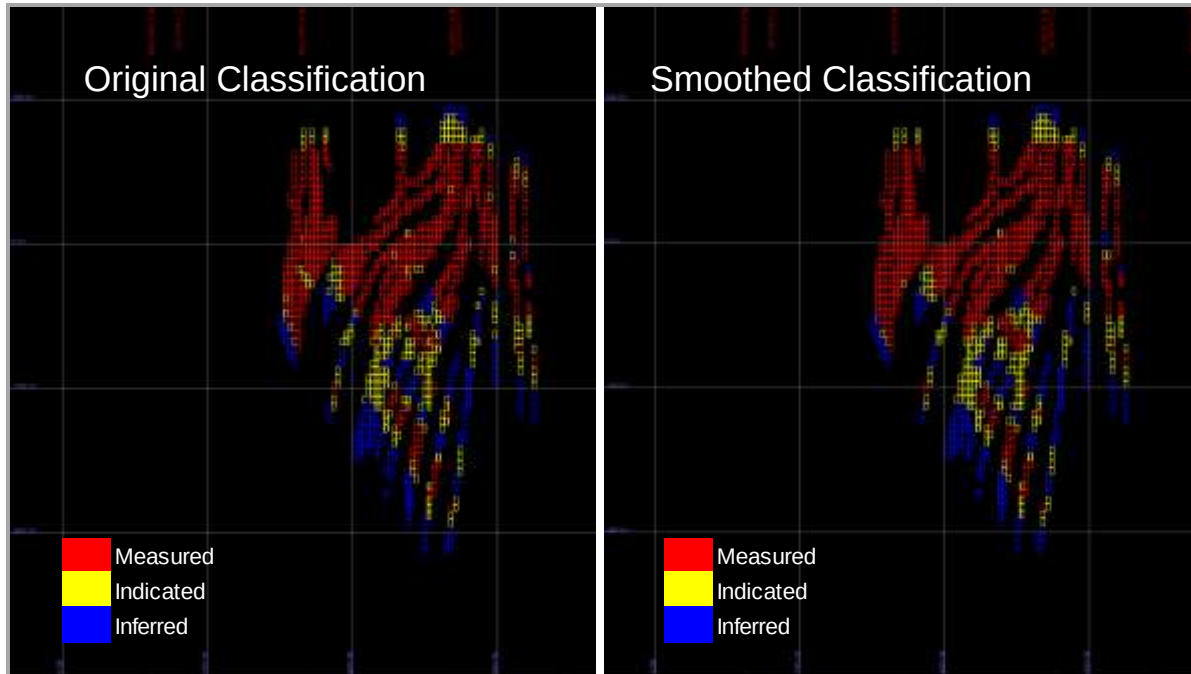
SRK reclassified any blocks initially classified as Measured to Indicated in the saprolite zones. In Ouro Verde and Grotá Seca, a few blocks outside the conceptual pit shell considered to prepare the Mineral Resource Statement were initially classified as Measured for potential underground extraction; however, SRK reclassified these as Indicated due to their insignificant quantity.

In addition, SRK reclassified the LG domain by reassigning all Measured blocks to Indicated, and all Indicated blocks were reclassified to Inferred. This LG reclassification reflects the lack of confidence in the geological continuity of the LG domain model, which is based on extruded vertical sections. SRK anticipates that more rigorous geological modelling of the LG zone should permit upgrading of classification within this domain.

For the South Block, Belo Sun used the same classification criteria for Indicated and Inferred resources as for Ouro Verde and Grotá Seca. There are no Measured blocks in the South Block. Only the Pequi and Itatá deposits have Indicated blocks. An isolated and small group of blocks initially assigned in the Indicated category located between Pequi and Itatá was also reclassified as Inferred. SRK also reclassified any Indicated block in Grande to Inferred due to the potential secondary orientation within the Grande domain. The current database does not support reliable estimation of Mineral Resources within this potential structural domain.

Additional infill drilling and sampling data are required to support a higher classification. It cannot be assumed that all or any part of an Inferred Mineral Resource will be upgraded to an Indicated or Measured Mineral Resource as a result of continued exploration.

Figure 14-8: Comparison of Pre- and Post-Smoothing Classified Resources, Section 800W in Grota Seca Deposit



## 14.8 Mineral Resource Statement

CIM *Definition Standards for Mineral Resources and Mineral Reserves* (November 2010) defines a Mineral Resource as:

*“[A] concentration or occurrence of diamonds, natural solid inorganic material, or natural solid fossilized minerals in or on the Earth’s crust in such form and quantity and of such a grade or quality that it has reasonable prospects for economic extraction. The location, quantity, grade, geological characteristics, and continuity of a Mineral Resource are known, estimated, or interpreted from specific geological evidence and knowledge.”*

The “reasonable prospects for economic extraction” requirement generally implies that quantity and grade estimates meet certain economic thresholds, and that Mineral Resources are reported at an appropriate cutoff grade that takes into account extraction scenarios and processing recovery.

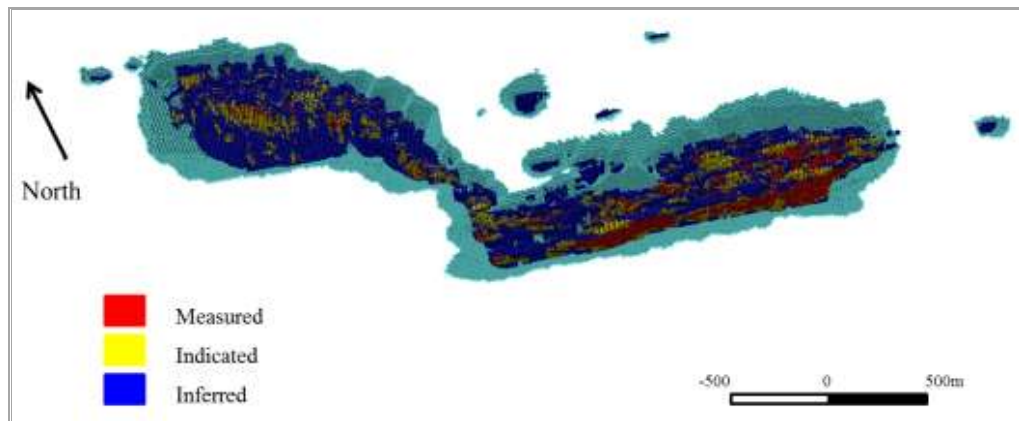
SRK considers that the Ouro Verde and Grota Seca deposits are amenable to both open pit and underground extraction, while South Block is amenable to open pit extraction only. To assist with determining which portions of the gold deposits show “reasonable prospect for economic extraction,” and to assist with selecting a reasonable reporting

cutoff grade, SRK has developed conceptual open pit shells using the following assumptions:

- pit berm height of 20 m, consisting of two 10-m benches
- overall slope angle of 31° for saprolite, and 53° for unweathered rock
- processing and G&A costs of \$14.87/t mined
- metallurgical gold recovery of 94% for saprolite and unweathered rock
- gold price of \$1,400/troy oz.

After review of optimization results, SRK considers that it is reasonable to report as open pit Mineral Resource those classified blocks located within the conceptual pit shells above a cutoff grade of 0.5 g/t Au (Figure 14-9), and that those blocks of the Ouro Verde and Grota Seca deposits located outside the conceptual pit shells above a cutoff grade of 2.0 g/t Au be reported as underground Mineral Resources.

**Figure 14-9: Plan Showing Block Estimates within the Ouro Verde and Grota Seca Deposits Relative to the Conceptual Pit**



SRK is satisfied that the Mineral Resources were estimated by Belo Sun in conformity with the generally accepted CIM *Estimation of Mineral Resource and Mineral Reserve Best Practices Guidelines*. The Mineral Resources may be affected by further infill and exploration drilling that may result in increases or decreases in subsequent resource estimates. The Mineral Resources may also be affected by subsequent assessments of mining, environmental, processing, permitting, taxation, socioeconomic, and other factors.

The audited Mineral Resource Statement presented in Table 14-15 was prepared by Camila Passos (CREA 5061868179/D), Dr. Oy Leuangthong, P.Eng. (PEO#90563867), and Dr. Jean-Francois Couture, P.Geo. (APGO#0196). Drs. Leuangthong and Couture are independent QPs as this term is defined in NI 43-101. The effective date of the Mineral Resource Statement is 1 October 2013.



**Table 14-15: Audited Mineral Resource Statement<sup>\*(1)</sup>**

| Domain                         | Category             | Quantity<br>('000s tonnes) | Gold Grade<br>(g/t) | Contained Gold<br>('000s oz) |
|--------------------------------|----------------------|----------------------------|---------------------|------------------------------|
| <b>Ouro Verde Open Pit</b>     |                      |                            |                     |                              |
| Saprolite                      | Indicated            | 405                        | 1.21                | 16                           |
|                                | Inferred             | 629                        | 0.99                | 20                           |
| Unweathered                    | Measured             | 24,036                     | 1.78                | 1,379                        |
|                                | Indicated            | 19,682                     | 1.61                | 1,022                        |
|                                | Inferred             | 21,973                     | 1.50                | 1,059                        |
| <b>Ouro Verde Underground</b>  |                      |                            |                     |                              |
| Unweathered                    | Indicated            | 64                         | 2.66                | 5                            |
|                                | Inferred             | 831                        | 3.13                | 84                           |
| <b>Grota Seca Open Pit</b>     |                      |                            |                     |                              |
| Saprolite                      | Indicated            | 721                        | 1.11                | 26                           |
|                                | Inferred             | 851                        | 0.97                | 27                           |
| Unweathered                    | Measured             | 31,384                     | 1.61                | 1,620                        |
|                                | Indicated            | 14,950                     | 1.59                | 763                          |
|                                | Inferred             | 17,413                     | 1.62                | 905                          |
| <b>Grota Seca Underground</b>  |                      |                            |                     |                              |
| Unweathered                    | Indicated            | 53                         | 2.88                | 5                            |
|                                | Inferred             | 695                        | 3.38                | 75                           |
| <b>South Block Open Pit</b>    |                      |                            |                     |                              |
| Saprolite                      | Inferred             | 169                        | 1.68                | 9                            |
| Unweathered                    | Indicated            | 2,503                      | 3.06                | 246                          |
|                                | Inferred             | 2,752                      | 4.08                | 361                          |
| <b>South Block Underground</b> |                      |                            |                     |                              |
| Unweathered                    | Indicated            | 24                         | 4.24                | 3                            |
|                                | Inferred             | 193                        | 4.05                | 25                           |
| <b>Total Open Pit</b>          |                      |                            |                     |                              |
|                                | Measured             | 55,420                     | 1.68                | 2,999                        |
|                                | Indicated            | 38,261                     | 1.68                | 2,072                        |
|                                | Measured + Indicated | 93,682                     | 1.68                | 5,070                        |
|                                | Inferred             | 43,788                     | 1.69                | 2,381                        |
| <b>Total Underground</b>       |                      |                            |                     |                              |
|                                | Indicated            | 140                        | 3.01                | 14                           |
|                                | Inferred             | 1,719                      | 3.33                | 184                          |
| <b>Total</b>                   |                      |                            |                     |                              |
|                                | Measured             | 55,420                     | 1.68                | 2,999                        |
|                                | Indicated            | 38,402                     | 1.69                | 2,085                        |
|                                | Measured + Indicated | 93,822                     | 1.69                | 5,084                        |
|                                | Inferred             | 45,507                     | 1.75                | 2,565                        |

**Notes:** \* Mineral Resources are not Mineral Reserves, and have no demonstrated economic viability. All figures have been rounded to reflect the relative accuracy of the estimates. Open pit Mineral Resources are reported at a cutoff grade of 0.5 g/t Au, and underground Mineral Resources are reported at a cutoff grade of 2.0 g/t Au. The cutoff grades are based on a gold price of \$1,400/troy oz, and metallurgical recoveries of 94% for saprolite and unweathered material. Mineral Resources are constrained within low, medium, and high-grade domains delineated from drilling data within Ouro Verde and Grota Seca.

<sup>(1)</sup> Volta Grande Project, Pará State, Brazil, SRK Consulting (Canada) Inc., 1 October 2013

## 14.9 Grade Sensitivity Analysis

The Mineral Resources of Volta Grande are highly sensitive to the selection of the reporting cutoff grade. To illustrate this sensitivity, grade tonnage curves are presented in Figure 14-10, and block model quantities and grade estimates at various cutoff grades are presented in Table 14-16. The reader is cautioned that the figures in Table 14-16 should not be misconstrued as a Mineral Resource statement. The figures only show the sensitivity of the block model estimates to the selection of cutoff grade, and do not consider the impact of an optimized pit.

**Figure 14-10: Grade Tonnage Sensitivity to Cutoff Grade by Classified Resource Categories**

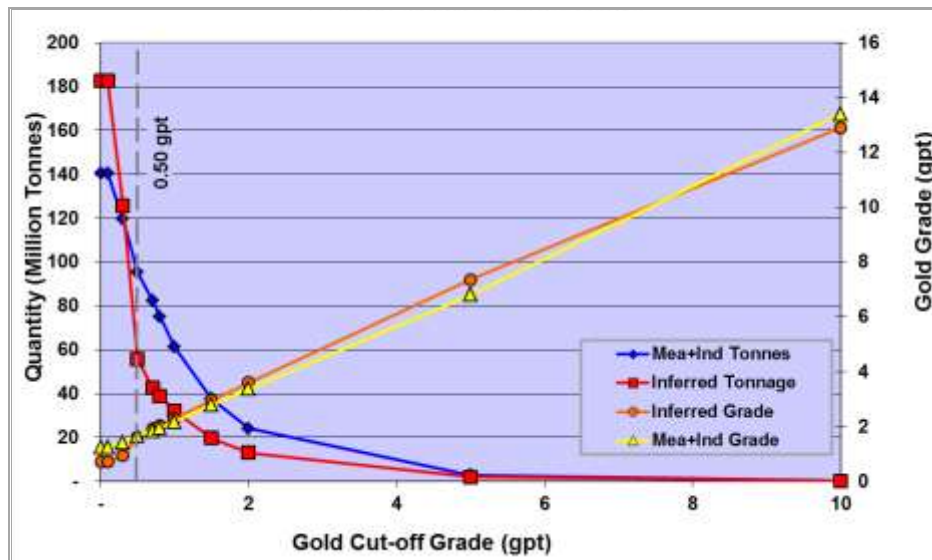


**Table 14-16: Global Block Model Quantities and Grade Estimates\* at Various Cutoff Grades**

| Cutoff Au<br>(g/t) | Measured              |                   |                        | Indicated             |                   |                        | Inferred              |                   |                        |
|--------------------|-----------------------|-------------------|------------------------|-----------------------|-------------------|------------------------|-----------------------|-------------------|------------------------|
|                    | Quantity<br>(t '000s) | Grade Au<br>(g/t) | Au Metal<br>(oz '000s) | Quantity<br>(t '000s) | Grade Au<br>(g/t) | Au Metal<br>(oz '000s) | Quantity<br>(t '000s) | Grade Au<br>(g/t) | Au Metal<br>(oz '000s) |
| 0.1                | 56,574                | 1.658             | 3,016                  | 84,048                | 0.952             | 2,573                  | 182,529               | 0.71              | 4,178                  |
| 0.3                | 56,562                | 1.658             | 3,016                  | 83,977                | 0.953             | 2,573                  | 125,815               | 0.92              | 3,733                  |
| 0.5                | 55,437                | 1.683             | 2,999                  | 63,048                | 1.188             | 2,407                  | 55,505                | 1.62              | 2,893                  |
| 0.7                | 49,011                | 1.823             | 2,872                  | 39,966                | 1.661             | 2,134                  | 42,727                | 1.93              | 2,655                  |
| 0.8                | 44,697                | 1.926             | 2,768                  | 33,485                | 1.867             | 2,010                  | 38,957                | 2.05              | 2,564                  |
| 1.0                | 36,431                | 2.160             | 2,530                  | 30,383                | 1.981             | 1,935                  | 32,095                | 2.29              | 2,366                  |
| 1.5                | 22,181                | 2.759             | 1,967                  | 24,792                | 2.226             | 1,774                  | 19,734                | 2.96              | 1,878                  |
| 2.0                | 14,212                | 3.337             | 1,525                  | 15,390                | 2.836             | 1,403                  | 13,023                | 3.60              | 1,506                  |
| 5.0                | 1,573                 | 6.703             | 339                    | 9,953                 | 3.442             | 1,101                  | 2,008                 | 7.36              | 475                    |
| 10.0               | 77                    | 13.077            | 32                     | 1,245                 | 6.932             | 278                    | 225                   | 12.91             | 93                     |

**Notes:** \* The reader is cautioned that the figures in this table should not be misconstrued as a Mineral Resource Statement. The figures are only presented to show the sensitivity of the block model estimates to the selection of a cutoff grade.



## 14.10 Comparison with Previous Mineral Resource Estimates

A comparison between the 15 April 2013 unaudited Mineral Resource Statement and the September 2013 audited Mineral Resource Statement is shown in Table 14-17. The additional 166 boreholes drilled from late 2012 to early 2013 have resulted in an overall increase in reported contained gold metal.

**Table 14-17: Comparison between December 2012, April 2013, and September 2013 Mineral Resource Statements**

| Class     | December 2012 |                |                    | April 2013    |                |                    | October 2013  |                |                    | Percentage Difference |                |                    |
|-----------|---------------|----------------|--------------------|---------------|----------------|--------------------|---------------|----------------|--------------------|-----------------------|----------------|--------------------|
|           | (audited)     |                |                    | (unaudited)   |                |                    | (audited)     |                |                    | April to October 2013 |                |                    |
|           | Quantity (Kt) | Au Grade (g/t) | Contained Au (Koz) | Quantity (Kt) | Au Grade (g/t) | Contained Au (Koz) | Quantity (Kt) | Au Grade (g/t) | Contained Au (Koz) | Quantity (Kt)         | Au Grade (g/t) | Contained Au (Koz) |
| Measured  | 42,422        | 1.73           | 2,356              | 55,825        | 1.68           | 3,021              | 55,420        | 1.68           | 2,999              | -1%                   | 0%             | -1%                |
| Indicated | 31,360        | 1.73           | 1,746              | 32,307        | 1.67           | 1,736              | 38,402        | 1.69           | 2,085              | 19%                   | 1%             | 20%                |
| M+I       | 73,782        | 1.73           | 4,103              | 88,132        | 1.68           | 4,757              | 93,822        | 1.69           | 5,084              | 6%                    | 0%             | 7%                 |
| Inferred  | 44,246        | 1.96           | 2,788              | 39,633        | 1.93           | 2,464              | 45,507        | 1.75           | 2,565              | 15%                   | -9%            | 4%                 |

The infill boreholes drilled during the period from late 2012 to early 2013 also have increased the confidence in the geological interpretation and the continuity of grade and thus have had a positive impact on the classification of the Mineral Resources. The primary gain lies in the upgrading of Inferred Mineral Resources to the Indicated category.



## **15 MINERAL RESERVES ESTIMATE**

This is at a PEA level of study and therefore no mineral reserves have been estimated.



## **16 MINING METHODS**

### **16.1 Geotechnical**

Belo Sun retained VOGBR Recursos Hidricos & Geotecnia SA (VOGBR) for work on the open pit slopes of the Project. From September 2011 until August 2012, VOGBR completed a series of tasks including site investigation and supervision of geotechnical and hydrogeological drilling. The objective of the work was to:

- analyze the data base collected by Belo Sun
- complete geological-geotechnical logging of the drill core from the campaign
- complete field point load tests in selected samples of the core
- geotechnical sampling of the drill core for laboratory geotechnical tests
- execute laboratory geotechnical testwork as follows: uniaxial compressive tests, triaxial compressive tests, shear strength and indirect tensile strength (Brazilian test)
- complete kinematic analysis of the pit slopes for identifying sectors with potential for occurrence of structurally controlled failures of the following types: planar, wedge and toppling
- definition of the parameters to be used in the pit slope design of the final pits based on the laboratory tests executed and the experience of VOGBR in similar projects
- pit slope design of the recommended final pit slopes (definition of the bench face and inter-ramp angles).

#### **16.1.1 Data Compilation and Review**

In the Ouro Verde and Grota Seca areas, 50 diamond drill core holes were completed amassing over 7,000 m of core samples. The holes were of either NQ or HQ2 diameter. The distribution of holes included:

- 24 geotechnical drill holes
- 16 hydrogeology drill holes
- 10 packer testing drill holes for permeability measurements.

The core was geomechanically logged. Most of the geotechnical and hydrogeological holes in the Ouro Verde Pit are in the center of the pit area with seven intersecting the



northeast wall and one hole intersecting the southwest wall. All holes are oriented to the northeast. In Grota Seca, numerous holes were collared in the center of the proposed pit area with 12 holes drilled into the southwest wall. Several of the holes were oriented to the southwest. Eight were drilled towards the northeast.

Table 16-1 shows a summary of work conducted and the number of field and laboratory tests carried out.

**Table 16-1: Summary of Geotechnical Logging and Testing**

| Work Executed                                            | Quantity |
|----------------------------------------------------------|----------|
| Geotechnical Core Description (m)                        | 7,072    |
| Fracturing Attitude Measurements                         | 2,236    |
| Point Load Tests                                         | 238      |
| Tilt Test                                                | 64       |
| Seepage Tests (permeability of different types of soils) | 17       |
| Packer Test                                              | 30       |
| Uniaxial Compression Test                                | 26       |
| Triaxial Compression Test                                | 34       |
| Shear Strength Tests                                     | 20       |
| Indirect Tensile Strength (Brazilian Test)               | 46       |

### 16.1.2 District Geology – Geotechnical Perspective

The Project is located in the Southern Amazonian Craton, which is composed of Archean and Paleoproterozoic era rocks exposed near the border of the Amazon Sedimentary Basin. The Amazonian Craton represents one of the largest and least known Pre-Cambrian areas of the world, and its basement includes high-grade igneous and metamorphic rocks (granite, gneisses and granulite) attributed to the Xingu Complex.

The Amazonian Craton is divided into seven tectonic/geochronological provinces:

- Carajás (3000 – 2500 Ma)
- Transamazonas (2260 – 1990 Ma)
- Tapajós – Parima (2030 – 1860 Ma)
- Amazônia – Central (1900 – 1860 Ma)
- Rondônia –Juruena (1850 – 1540 Ma)
- Rio Negro (1820 – 1520 Ma)
- Sunsás (1450 – 1000 Ma).



The latter two provinces are not located in the State of Pará.

From a tectonic standpoint, the region of Volta Grande do Xingú belongs to the Transamazonian Province, divided into five domains: Carecuru, Paru, Amapá, Bacajá and Santana do Araguaia. The Transamazonian Province represents an expressive orogenic-Paleoproterozoic that evolved with the Transamazonian Cycle (2260–1950 M.a.), corresponding to the Maroni-Itacaiunas Province of Tassinari & Macambira.

The Amazon Basin rocks that occur in the study area correspond to the Manacapuru Basin Formation (sandstone interspersed with siltstone), Maecuru (fine sandstone and conglomerates, embankments and subordinated shale), and Ererê (siltstone interspersed with sandstone and shale) belonging to the Trombeta Group. Diabase dikes and weirs from the Mesozoic period and sandstone, siltstone and claystone from the Alter do Chão Formation have also been recognized. Superimposed to these units are lateritic cover and gravel, sand, silt and alluvial clay.

Specifically, however, the region of study is located in the Bacajá Domain, and is represented by the following lithostratigraphic units: Archean, Greenstone Belt Três Palmeiras and Xingu Metamorphic Suite (orogenic and anorogenic).

#### ***Archean Basement***

The basement rocks are located to the south of the project and are constituted by gneisses (tonalitic, granodioritic) and undifferentiated granitoids.

#### ***Greenstone Belt Três Palmeiras***

Greenstone Belt Três Palmeiras belt rocks are characterized by a metavolcanic-sedimentary sequence, metamorphosed in a low- and medium-grade manner. It is composed of the base units for the top: Itatá Amphibolite (schist and amphibolite) and Bacajá Mica Schist (acid felsic metavolcanic).

#### ***Xingu Metamorphic Suites***

The granitic suites are comprised of monzogranite João Jorge (orogenic suite) and Oca granodiorite, Bacajá granitoid and Maloquinha intrusive suite (anorogenic suites).

#### ***Regional Structure***

The main geological structural features are lineaments in the principal direction northwest-southeast, with variations to west-northwest-east-southeast. These are related to extensive faults derived from regional characteristics that limit and internally interfere with the lithostratigraphic units.



Greenstone Belt Três Palmeiras occupies a narrow synform, laid out in the NW-SE direction, marked by narrow folding and intensive shearing. They include granitoid intrusions, along with quartz veins, generally gold bearing.

Associated to the main orientation are ruptures in the NE-SW direction that result in mafic dikes. These dikes are comprised of diabase related to the development of the Amazon Basin in the Jurassic era

### ***Local Geology***

The Volta Grande Deposit, where the mining project is proposed, is constituted of two areas in proximity to one another; Ouro Verde and Grota Seca. The gold bearing mineralization is associated with the shear zones that cut the granitic intrusions.

According to the descriptions of the boring core samples, the main lithotypes found in the Volta Grande do Xingu region are diorite, porphyritic diorite, metabasic, metasediments, sheared diorite, metavolcanic, diabase.

The rocks belonging to the Greenstone Belt Três Palmeiras are represented locally in the region of Volta Grande do Xingu as predominantly metavolcanic. The other lithotypes present are metasediments. The intrusive forms are constituted by granodiorites and diorites, which in the study area were informally designated as Grota Seca.

The contact between the diorite and the Três Palmeiras sequence is characterized by the positioning of the parallel intrusion to the regional trend of the greenstone belt, and is marked as a concentration zone for the deformation, resulting in mylonitic rock with heterogeneously developed foliation, as for example sheared diorite lithotype. Near the contact porphyritic diorite, they form continuous bands, and the rocks possess the same mineralogic assembly and chemical composition of the diorites, distinguished only in textured, formed by a fine matrix that involves porphyritic plagioclase.

The dioritic composition intrusions are the predominant lithotypes of the Project.

An intrusive association comprising diorite dominates the Ouro Verde region. Generally, diorites have a solid phaneritic texture structure, in equigranular with medium and coarse particle size. This intrusion is cut by metabase and diabase dikes.

The predominant rock in the Grota Seca region is also the intrusion of diorite found in the northern area of the pit. In the southern part of the Grota Seca Pit metavolcanic and metasediments occur. The metavolcanic unit is characterized by alternating phlogopite levels rich in plagioclase and exhibiting a marked banded composition. Sericite-schist, quartz sericite schist, graphite schist, and quartzite (metachert) represent the metasedimentary rocks, which display a banded structure.



The gold deposits that occur in Volta Grande of the Xingu River are prospecting areas in alluvial and saprolitic soils and primary mineralization. This gold bearing mineralization developed preferentially in shearing areas that cut the granitoids associated to the Oca Granodiorite (Ouro Verde), and near the contact of these granitoids and the supracrustal rocks of the Três Palmeiras sequence (Grota Seca).

### **16.1.3 Structural Evaluation**

The attitude measurements determined in the field were obtained from drill core samples oriented through the ACE Core Tool (ACT) method, taking into consideration only the open discontinuities. The orientation of the drill cores in two boreholes (VOG-03, VOG-06) were discarded due to the inconsistencies observed during the logging of the boreholes. The main types of discontinuities collected were fractures, foliations, and less frequently faults with centimetre to millimetre displacement.

These structures were collected for evaluating the structural behavior of the design and to verify its influence on the stability of the final pits.

Stereographic projection of the foliation of the Ouro Verde Pit data shows an average dip of 60° to southwest. The dispersion present in the stereogram reflects the anastomotic pattern of the mylonitic foliation. The Grota Seca area foliation has a separate orientation from that observed in the Ouro Verde deposit area. In the Grota Seca area, it is sub-vertical to vertical dipping to southwest and northeast. The structural data derived from the geological mapping provided by Belo Sun were not considered in this analysis because it is not statistically representative.

The faults generally observed have a northeast-southwest direction with a 55° dip to northwest. From the cut relation they are more recent than the regional mylonitic foliation. Due to the low statistical representativeness of the fault data, it was not possible to execute the analysis of the stereographic projections; however, the information obtained is consistent with the direction of one of the photo-interpreted lineations.

The stereographic projections of the fractures of each borehole exhibit a wide dispersion in the collected data. A detailed analysis was performed of the attitudes of the geotechnical boreholes from the identification of the attitude patterns in the stereographic projections developed with the data from each boring. The stereographic projections were compared borehole to borehole to identify structural patterns, and then the combined data for all boreholes was analyzed and regrouped for each structural domain, defined according to the foliation.



In the absence of well-defined structural patterns, for each structural domain or specific region of the pit the combined data from nearby core holes were analyzed.

The configuration of the structural features allowed for the structural compartmentalization of the pits, seeking to group regions of the pit with similar structural behavior. By the behavior of the foliation and the fracturing pattern, the Ouro Verde Pit was considered as having a single structural domain named the Ouro Verde domain. In analogous manner, the Grota Seca Pit was divided into two structural domains called Grota Seca South Domain and Grota Seca North domain. The Grota Seca South domain has vertical and sub-vertical foliation dipping to southwest, while in the Grota Seca North domain the foliation has the same inclination of the previous domain, however it dips to south-southwest.

The foliation of the Grota Seca North Domain has a NW-SE direction with vertical dips of approximately 75° and is similar to the foliation found in the Ouro Verde. This reflects the lithological control of rock mass structure.

In the Grota Seca South Domain, the foliation has a slight inflexion to west-northwest-east-southeast and is more vertical, dipping to south-southwest. The change in the foliation dip is possibly due to the interference of the zone with greatest deformation concentration near the contact of the Três Palmeiras sequence and the diorite intrusion.

Despite the dispersion of the fracture data, a strong foliation control is observed in the fracturing pattern, evidenced by the similarity of the stereographic projections of foliation and fracture for each structural domain. The main family of fractures of the Ouro Verde Domain exhibits a dip direction and dip 148/53, and the second family that is prevalent in the pit has a dip direction and dip 212/64 coinciding with the foliation direction of this domain. The main family of discontinuities of the Grota Seca North Domain, 200/70, has the same direction of the second family of the previous domain; however, it is slightly more vertical. In the Grota Seca South, the main family of joints dips moderately to the north at approximately 50° inclination.

#### **16.1.4 Geomechanical Logging**

The geotechnical descriptions of the drill core samples from the boreholes completed in the region of the project data were used in the development of the geomechanical model. Twenty-four geotechnical boreholes (VOG) are described, totaling 4,250 m. Also 10 hydrogeological rotary drill boreholes were geomechanically characterized, in addition to 16 water level meters (MNA), totaling 2,535 m of described borings (610 and 1,925 m, respectively). The exploration holes executed by Verena (VVD) were described by VOGBR's team and considered in the geomechanical characterization of the rock



masses. Thirty-three of these boreholes were described, with a total of more than 6,300 m.

The parameters used in the descriptions were based on the Barton et al. (1974) and Bieniawski (1989) criteria and International Society for Rock Mechanics (ISRM) (Brown, 1981) guidelines adapted by VOGBR for use in tropical climates. The geomechanical parameters were:

- Soil Parameters – thickness, colour, plasticity, granulometry, genesis
- Intact Rock – strength and degree of weathering
- Rock Mass – RQD and Joint Set Number
- Discontinuities – type (foliation, fracture, fault, etc.), spacing of discontinuity, Joint Roughness Number, Joint Alteration Number, Joint Condition Index.

The description also took into consideration other important parameters in the geomechanical characterization of the soil/rock mass such as the existence of intense fracture zones (ZIQ) and hydrothermal alteration zones. The hydrothermal alteration zones that occur associated to the gold mineralization may modify the strength of the rock matrix or cause changes in the texture of the rocks. Generally, silicification when acting in pervasive manner increases the strength of the host rocks. However, carbonation decreases rock strength.

Each described parameter was statistically analyzed in order to gather enough information for interpretation and development of the geomechanical model.

The geomechanical classification of the rock mass under study was developed based on the geomechanical descriptions of the drill core samples. For this purpose Bieniawski (1989) and Barton et al. (1974) classification criteria were used, adapted for tropical climate regions. These adaptations are required in tropical climates due to the presence of deep weathered mantles that may preserve structures remaining from the original rock. Such structures may affect the geomechanical behavior of the referenced rock masses, which is not covered by the aforementioned systems.

In the pit areas the rock mass is constituted by five classes:

**Class V Rock Mass (very poor rock)** – surface rock mass covering the largest portion of the area; constitutes a very poor geomechanical rock mass, with low strength, completely altered and fractured. The highest Class V thicknesses, comprising mature residual soils, transported soils, and saprolite of about 10 m are concentrated to the south of both pits.



**Class IV Rock Mass (poor rock)** – poor rock mass comprising very altered and fractured rock; located near the surface covered by the Class V rock. It is the most restricted among the strata occurring mostly in the form of lenses. Its thickness varies between 2 m and 15 m, with an average of 5 m. Generally, this class represents the soil-rock transition zone.

**Class III Rock Mass (fair rock)** – comprises fractured rock mass. The rocks exhibit moderate to high strength and low alteration. The Grota Seca Pit has a variable thickness between 10 m and 60 m, with average thickness of 25 m that decreases to the north. With a localized occurrence in the northeast portion of the Ouro Verde, Class III exhibits thickness varying from 10 m to 50 m, and is exposed on practically the entire north slope of the pit.

**Class I-II Rock Mass (good/very good rock)** – the most relevant to the study, representing approximately 80% and 68% of the exposed area of the slopes of the Ouro Verde and Grota Seca final pits, respectively. Corresponds to a rock mass with very good geomechanical quality, characterized by a sound rock mass with high strength, unaltered and with little fracturing. Classes I and II were grouped in the same group, since for the purpose of the design of the slopes in question, both classes display similar geomechanical behavior.

These Geomechanical types are shown in typical sections for Ouro Verde and Grota Seca in Figure 16-1 and Figure 16-2.

**Figure 16-1 Typical Geomechanical Section – Ouro Verde Pit**

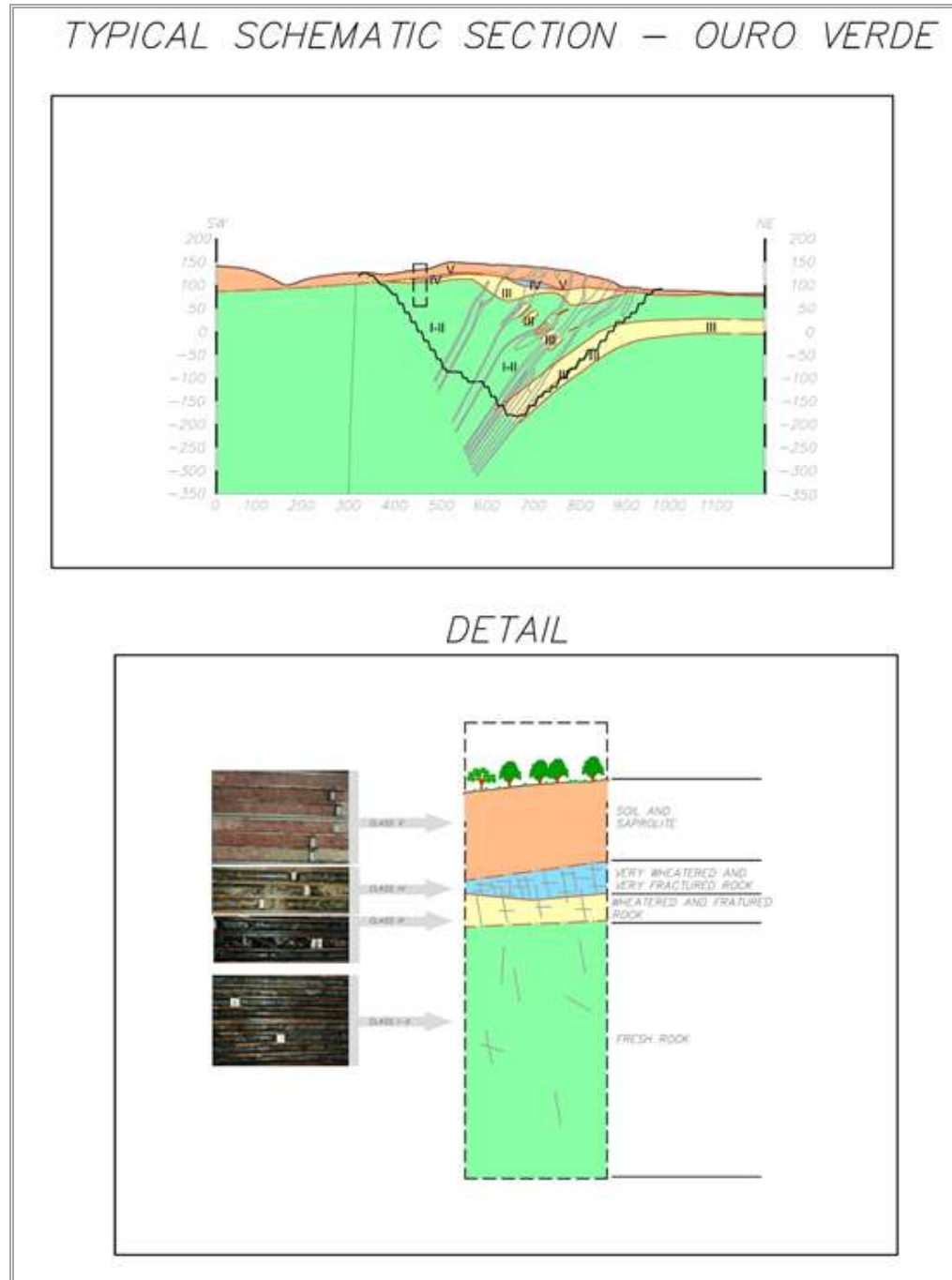
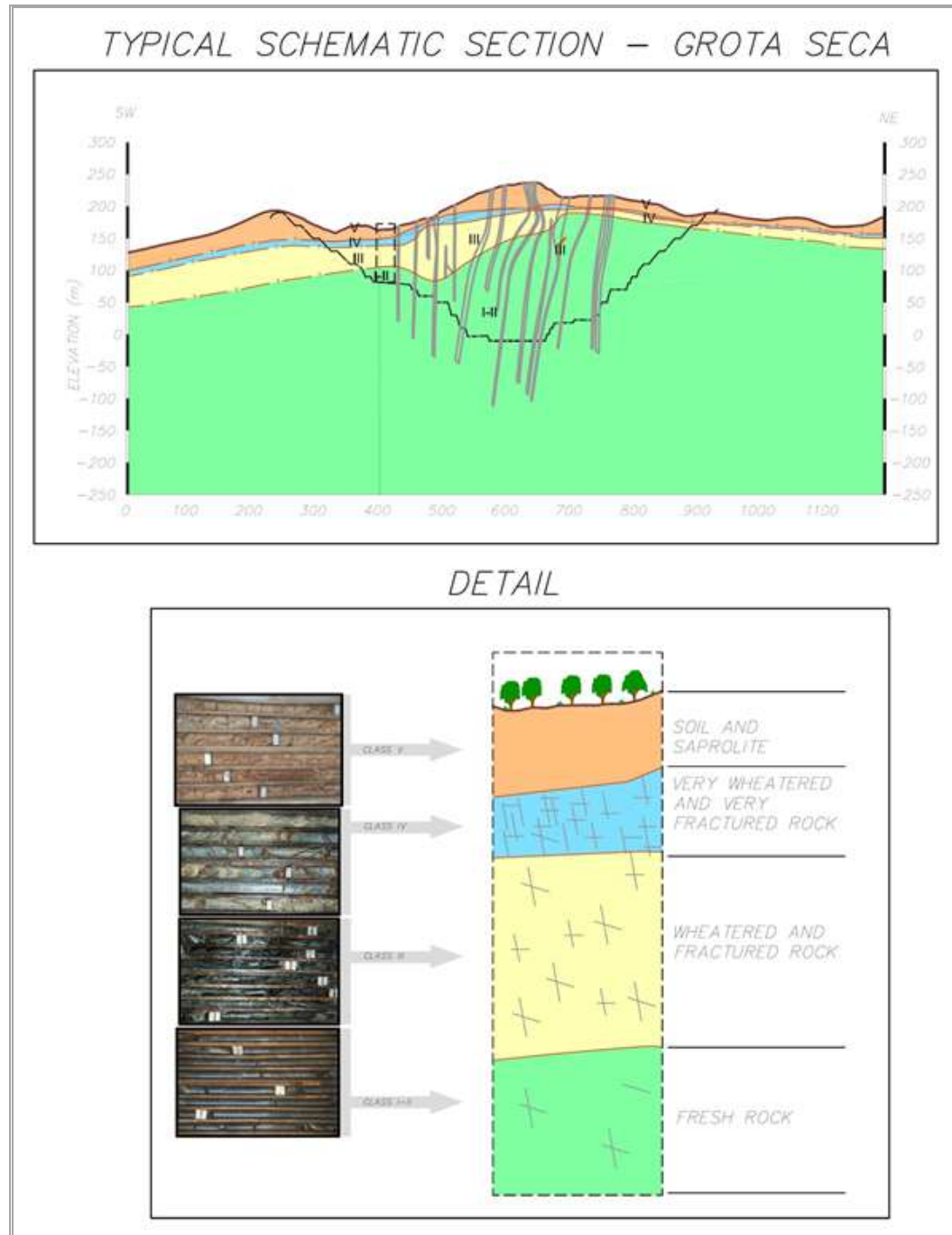


**Figure 16-2: Typical Geomechanical Section – Grota Seca**



The statistical analysis of the rock mass parameters (strength and weathering degrees, RQD and number of discontinuities) and the fractures (spacing of the discontinuities, roughness indexes, weathering of the walls and type of fractures) observed in the



borehole core was executed for each predominant lithology found in the study areas. The porphyric diorite (DRTP) and non-sheared diorite (DRT) lithotypes, despite exhibiting different textures show similar geomechanical behavior, so therefore for analysis purposes were considered as the same lithology.

The mass in general exhibits a high grade of strength for all lithologies. The metasediment shows a differentiated strength behavior and despite the predominance of the maximum value (R5) exhibits a considerable R4 value.

Regarding the degree of weathering observed in the rock mass in question, it also exhibits unaltered or slightly weathered rock (W1) for all the lithologies, with possibly discoloration of the bedrock, which does not affect the strength of the rock. Although the metasediment shows predominantly the maximum weathering grade (W5), there is a section of almost half the mass with a weathering grade of W2.

The diorite and sheared diorite showed RQD values above 80%, which represents a good to very good rock mass. The metasediment has an RQD of 100%, which represents a very good mass. In general the RQD values of metavolcanic rock are above 75%, however approximately 20% of the intervals of this lithology have RQD values below 20%, possibly reflecting zones with intense fracturing (ZIQ) that occur very frequently in this lithology.

The  $J_n$  index represents the number of discontinuities families present in the geotechnical interval. The most frequent value is generally observed to be  $J_n = 6$ .

The spacing of the discontinuities that were used according to the criteria proposed by Bieniawski (1989) were adapted by VOGBR. There was a preponderance of spacing between 60 and 200 cm for all lithologies.

The joint roughness ( $J_r$ ) refers to the form and surface condition of the discontinuity. More than 40% of the fractures shown in the diorite and sheared diorite show  $J_r = 1.5$ , whereby in this latter lithology 44% of the fractures show  $J_r = 3$ . A similar situation occurs in the metasediment and metavolcanic where there is a predominance of  $J_r = 1.5$ . The  $J_r = 1.5$  value represents a fracture with a flat and rough contact.

According to the table for the joint alteration ( $J_a$ ) adapted from Barton et al., 1974 by VOGBR, the most frequent values for this parameter are  $J_a = 2$  for the diorites and  $J_a = 3$  for the rocks of the metavolcanic-sedimentary sequence.

A total of 238 Point Load Tests (PLT) were conducted from the geotechnical drill core using diametric and axial test samples, as stipulated in the ISRM (2007) and Brown et al., 1981 directives. The diameters of the test samples tested were 50 mm selected from boreholes without alteration and the absence of preferential planes such as veins. Of



the 238 tests performed, 42 were discarded. The criteria for elimination were to validate only for the samples with rupture through intact rock. Eventual ruptures due to preferential planes, spalling, or samples that showed the surface rupture passing through only one load point were considered invalid.

From the results obtained it can be concluded that the tests executed on the diorites probably showed point load test results that were controlled by the internal structures present in the test samples, without rupturing the matrix.

The uniaxial and triaxial compression strength test results exhibited high values for all lithologies when compared to the values found in the literature. Although the correlation for the direct shear tests for the same lithology is elevated, the results indicate very high basic attrition angle values.

The strength and deformability parameters of the rock mass were determined based on the methodology proposed by Hoek & Brown (Hoek et al., 2002), and results of laboratory and field tests for similar materials of the area of study.

The internal attrition and cohesion angles obtained from the geotechnical laboratory tests for the diorite and sheared diorite provided similar values, and considering the geological model of the rock mass of the pits these lithotypes were grouped in the same lithology generally named diorite. The same occurred for the metasediment and metavolcanic lithotypes being grouped in the lithology named metavolcanic-sedimentary. This grouping of the rock mass into two predominant lithologies was the basis used for the kinematic and stability analyses.

The strength parameter estimates for the rock fractures were based on the data derived from the geotechnical logging of the borehole samples conducted in the study area.

For such, the average value of the attrition angle of the discontinuities was calculated according to Barton et al. (1974). Such values were validated by comparison with the results of the tilt tests executed in the field. In the case of the joint roughness coefficient– JRC, it was estimated from its relation to the average Jr (Barton-Bandis, 1990) value, which was measured in the geotechnical descriptions conducted by VOGBR.

The JCS value was calculated from the results of the uniaxial compression tests, duly depreciated according to the mass class. Table 16-2 displays the values used in this study.

**Table 16-2: Strength Parameters Used for the Barton-Bandis Criteria**

| Parameters             |           | Diorite                                               |           |            | Metavolcanic Sedimentary Rock |           |            |
|------------------------|-----------|-------------------------------------------------------|-----------|------------|-------------------------------|-----------|------------|
|                        |           | Class IV                                              | Class III | Class I-II | Class IV                      | Class III | Class I-II |
| Barton-Bandis Criteria | JRC       | 7                                                     |           |            |                               |           |            |
|                        | JCS (MPa) | 35                                                    | 75        | 107        | 35                            | 75        | 150        |
|                        | ϕr (°)    | 37                                                    |           |            | 38                            |           |            |
| Caption:               |           |                                                       |           |            |                               |           |            |
|                        | JRC       | joint roughness coefficient                           |           |            |                               |           |            |
|                        | JCS       | Uniaxial compression strength of the joint wall (MPa) |           |            |                               |           |            |
|                        | ϕr        | basic attrition angle (or residual) of fracture (°)   |           |            |                               |           |            |

#### 16.1.5 Hydrogeology

In order to evaluate the hydraulic load profile of the current underground water and load of the final pit, data from previous work on site was used and had been reported in an internal October 2012 report.

The more superficial horizons of the terrain, which includes the soil layer, saprolite, and the intensely fractured and altered rock, accommodate and govern the dynamic of the underground water in the region.

A site investigation program was developed and executed for assessing the connectivity between the pit and the Xingu River, which borders the northern side of Ouro Verde. In this investigation, soil infiltration and water loss in rock tests were scheduled. The studies were conducted primarily in the Ouro Verde Pit region, due to the proximity between the pit limits and the Xingu River.

Permeability tests were analyzed together with the rock mass classes, where it would be expected to find higher permeability values for the classes below II-I. However, when analyzing the data obtained from the tests on the fractured section, it was verified that there is not a significant permeability variation, and those found are low and show high homogeneity along the borehole. From the borings executed, it is noted that the rock mass does not exhibit persistent discontinuities, indicating that apparently there is no connection between the pit area and the Xingu River. Another important characteristic



that may be highlighted is that there was not any water supply observed from the rock mass to the interior of the borehole during the drilling process, artesian conditions were only observed in boreholes SR-09 and SR-10. However, it should be noted that this investigation was executed by means of ten boreholes, since they are considerably spaced, does not eliminate the possibility of a non-surveyed structure that may connect the river to the pit.

#### **16.1.6 Open Pit Design Parameters**

Based on the results of the geomechanical analysis, the Ouro Verde Pit was divided into seven sectors, Within these sectors, slope analysis was completed. The purpose of the stability analysis was to determine the minimum safety factors the final pits considering the different types of materials, and geometric and hydrogeological conditions. Slope designs were based on bench angles, inter-ramp angles and overall slope angles. The bench heights were discussed with Belo Sun and AGP prior to the design work initiating.

Figure 16-3, and the Grota Seca Pit was divided into 10 geometric sectors, Figure 16-4.

Within these sectors, slope analysis was completed. The purpose of the stability analysis was to determine the minimum safety factors the final pits considering the different types of materials, and geometric and hydrogeological conditions. Slope designs were based on bench angles, inter-ramp angles and overall slope angles. The bench heights were discussed with Belo Sun and AGP prior to the design work initiating.

Figure 16-3 Pit Slope Sectors – Ouro Verde Pit

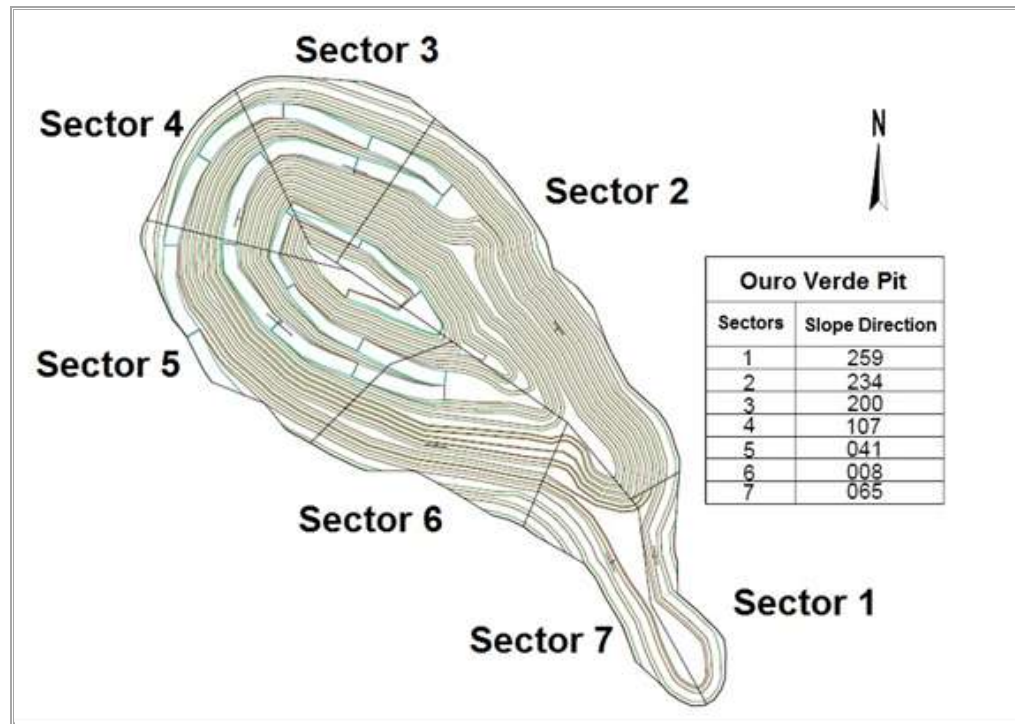
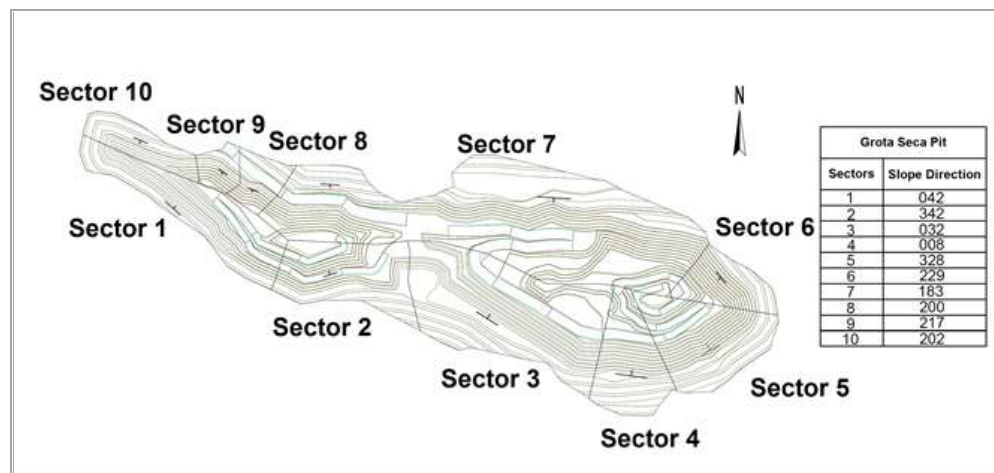


Figure 16-4: Pit Slope Sectors – Grota Seca Pit



Kinematic analysis was completed for each section with various configurations. Potential modes of failures examined and considered in the slope criteria. The sectors were examined for the potential of wedge failures and toppling failures. With 10 m high benches, the exhibited factors of safety were quite high. A preference for 20 m heights



between safety benches was discussed and examined. The results of that analysis were also favourable.

As a result of the analysis, the design parameters were provided for detailed design of the pits. The geometric sectors that have similar bench and inter-ramp angles were grouped in geotechnical sectors. A maximum inter-ramp height of 150 m was also included to provide sufficient catchment in the event of minor safety bench losses.

The inter-ramp stability analyses exhibited satisfactory safety factors. However, it is necessary for the drilling and blasting to be executed in well controlled manner, avoiding damage to the rock mass, minimizing block falls and ruptures due to undue fragmentation of upper benches that may affect the pit operations.

The proposed design criteria for mine design is shown in Table 16-3.

The studies provide the basis for the design phase regarding the geotechnical stability of the pits in question, allowing for a confidence level sufficient for the characterization and designs executed. The slope stability based on the geometries proposed for the pits offer acceptable stability at the bench face and inter-ramps angles, with safety factors above 1.3.

**Table 16-3: Proposed Geometry for the Final Pit**

| Class | Sectors | Berms (m) | Bench           |                | Inter-Ramp<br>"Bench toe-to-toe" |                |
|-------|---------|-----------|-----------------|----------------|----------------------------------|----------------|
|       |         |           | Max. Height (m) | Max. Angle (°) | Max. Height (m)                  | Max. Angle (°) |
| V/IV  | ALL     | 6.5       | 10              | 45             | 50                               | 31             |
| III   | 1       | 8.5       | 20              | 70             | 150                              | 52             |
|       | 2       |           |                 | 70             |                                  | 52             |
|       | 4 and 5 |           |                 | 65             |                                  | 48             |
|       | 3 and 6 |           |                 | 85             |                                  | 63             |
| I-II  | 1       | 8.5       | 20              | 70             | 150                              | 52             |
|       | 7       |           |                 | 70             |                                  | 52             |
|       | 2       |           |                 | 70             |                                  | 52             |
|       | 5       |           |                 | 75             |                                  | 55             |
|       | 4       |           |                 | 80             |                                  | 59             |
|       | 3 and 6 |           |                 | 85             |                                  | 63             |

**Note:** A 20 m wide safety bench is to be included every 150 m vertically.



The studies performed do not provide guidance regarding the geometries to be used during the implementation phase, but are sufficient for the design of the final pits at this level of study.

The boreholes executed were scheduled on the basis of the pits provided by Belo Sun prior to the PEA study. The pits currently provided by Belo Sun for the development of this study differ from the previous pits, for example, the depth is greater and sometimes displaced relative to the pits of the previous project. For this reason, some drill holes did not reach the final wall of the pits to a depth sufficient to allow a better geotechnical and structural understanding of these sectors. Therefore, to obtain a design with basic/detailed level it is essential to acquire more knowledge of the geometries of the geological discontinuities (structural model) of these regions, for these are the orientations governing the behavior of the rock masses regarding eventual occurrences with geometric potential for slides.

Therefore, for future studies the following is recommended:

- Sectors that exhibit bench face angles (60° a 75°) may be revised when new structural information is obtained, such as persistence and conditions of the discontinuities.
- Systematic study for characterizing the hydrothermal alteration zones observed in the drilling descriptions.
- Execution of pumping tests to confirm the assumptions made regarding the level of groundwater in the final pit slopes.
- Execution of the geophysical surveys, especially by electrical methods, in order to detect possible structures that may transport water from the river to the pit.
- Systematic update of the geomechanical model proposed as new geological-geotechnical surveys are executed in the pit area, as well as the hydro-geological model.
- Geological-geotechnical description of the new proposed surveys, and eventual exploratory surveys executed.
- Complementary geomechanical laboratory tests in the main lithotypes (diorite, sheared diorite, metavolcanic and metasediment) such as: uniaxial compression (with determination of the elasticity model and Poisson coefficient); shear strength; triaxial compression and indirect traction for definition of the material strength parameters. In terms of quantities, a minimum execution of one test for each lithotype is estimated. Special attention should be given to the values of the confining tension to be applied on the triaxial compression tests, in order to obtain a good adjustment of the failure envelope. If possible, test samples



with perpendicular, parallel and oblique orientations to the foliation should be provided in order to allow for evaluation of the anisotropic and deformability strength of the rocks.

- Field tests on the drill core samples scheduled, such as PLT “Point Load Test” and “Tilt Test.”
- Studies, surveys, monitoring and tests to be possibly completed in the future will have the purpose of localized detailing and possible optimization of the designs for the operational pits.
- Proposal of a geotechnical monitoring and slope stability control monitoring plan due to possible interference induced by rock blasting by explosives and their effects, as well as for a more refined knowledge of the geological, structural and hydrogeological models.

## **16.2 Open Pit Mining**

### **16.2.1 Introduction**

Open pit mining was selected as the method to examine the development of the Ouro Verde and Grota Seca deposits. This is based on the size of the resource, tenor of the grade, grade distribution, and proximity to topography. AGP is of the opinion that with current metal pricing levels and knowledge of the mineralization that open-pit mining offers the most reasonable approach for development.

Unless otherwise noted, all prices are in Q4 2013 US dollars.

### **16.2.2 Geologic Model Importation**

SRK audited the resource model developed by Belo Sun. This model was provided to AGP in October 2013. The model consisted of five-percentage models in an ASCII format from Gemcom. The percentage models included three for mineralized material and two for waste. The three mineralized files are separated into low, medium, and high grade with their cutoffs at 0.25 g/t, 0.50 g/t, and 1 g/t, respectively. Each ASCII file contained the rock type, density, percentage, grade, and classification.

The ASCII files were imported into a MineSight model of the same dimensions as the original resource model. MineSight was used for the mining portion of the study to take advantage of the included LG routine for economic pit-shell development. The boundaries for the model are shown in Table 16-4. The model is rotated 17° clockwise around the origin



**Table 16-4: Model Boundaries**

| Model Type           | X                                  | Y            | Z    |
|----------------------|------------------------------------|--------------|------|
| Origin               | 393,206.42                         | 9,604,126.42 | -620 |
| Rotation             | 17 degrees clockwise around origin |              |      |
| Model Space Corners  |                                    |              |      |
| Southwest            | 393,206                            | 9,604,126    | 260  |
| Northwest            | 393,875                            | 9,606,312    | 260  |
| Northeast            | 399,194                            | 9,604,686    | 260  |
| Southeast            | 398,525                            | 9,602,500    | 260  |
| Block Dimensions (m) | 6                                  | 6            | 10   |
| Number of blocks     | 927                                | 381          | 88   |

The specific gravity for the various lithology types were imported. The average SGs in the model are saprolite (1.36), and rock (2.75). Each block carries its own SG. All of the grade items in the model remain the same as in the geologic model.

It should be noted that the term “ore%” is used in the discussion that follows. This is normal nomenclature for discussion of potential mill feed percentages from a block modelling perspective quite often due to the limited number of characters allowed to designate a block model item. **The use of the term does not imply technical feasibility or economic viability, which is only attributed to mineral reserves. The PEA study is only working with mineral resources so the use of the term “ore” in this application is not stating reserves. The reader is cautioned to not construe this as denoting economics, which must be proven in a prefeasibility or feasibility study.**

For the mining model, the three mineralized percentages were combined into one total feed percentage:

$$\text{TORE\%} = \text{LORE\%} + \text{MORE\%} + \text{HORE\%}$$

Where: TORE% = total feed percentage

LORE% = low grade mineralized material (>0.25 g/t<0.5 g/t)

MORE% = medium grade mineralized material (>0.5 g/t<1.0 g/t)

HORE% = high grade mineralized material (>1.0 g/t)

The SG for the total feed percentage was calculated with a weighted average, as was a total block grade. In the same manner, if a block had a mixture of saprolite and rock, a weighted average of the material type was created, as well as the appropriate SG for the waste.



Since the classification of ore is split into three models, where a single block in space can have up to three classifications, Figure 16-5, simplifying a block down to one classification creates the issue of which methodology to use. To avoid this, while still using only M&I resources to run a pit optimization and calculate pit resources, a second percentage model called the OK model was created, using the model items shown in Figure 16-6. This model limits the classification to Measured or Indicated to simplify the pit optimization.

Figure 16-5 shows a block with a low-grade classification = 2, or Indicated and medium and high grade classifications of 1, or Measured.

**Figure 16-5: Example Block with Three Different Classifications**

Block's project coordinates

Easting: 395462.623

Northing: 9603622.995

Elevation: 105.000

Block's location within the model

Level: 16

Row: 79

Column: 544

| Item  | Value   |
|-------|---------|
| LORE% | 50.000  |
| MORE% | 25.000  |
| HORE% | 25.000  |
| TORE% | 100.000 |
| LCLAS | 2       |
| MCLAS | 1       |
| HCLAS | 1       |

**Figure 16-6: OK Percentage Model Items**

| Item  | Value |
|-------|-------|
| LOK%  | 0.000 |
| MOK%  | 0.000 |
| HOK%  | 0.000 |
| TOK%  | 0.000 |
| TAUOK | -     |

All percentage items were calculated as follows, where X = L for Low, M for Medium or H for High and CLAS is resource classification. Classifications of 1 or 2 refer to Measured or Indicated Resources respectively. A classification of 3 is Inferred material.



If  $1 \leq XCLAS \leq 2$ , then  $XOK\% = XORE\%$

$TOK\% = LOK\% + MOK\% + HOK\%$

and where

$TOK\% > 0$ ,

$TAUOK = (LOK\% \cdot LAU + MOK\% \cdot MAU + HOK\% \cdot HAU) / (TOK\%)$

Where:

TAUOK = total gold grade (g/t)

LOK% = low grade feed percentage

LAU = low grade gold grade (g/t)

MOK% = medium grade feed percentage

MAU = medium grade gold grade (g/t)

HOK% = high grade feed percentage

HAU = high grade gold grade (g/t)

This gives us the Measured and Indicated grade within the model, weighted by feed%. This grade item was used for calculating cutoff grades and dilution.

### 16.2.3 Economic Pit Shell Development

To determine the potential size of the open pit, various input parameters were required. These include estimates of the expected mining, processing, and G&A costs, as well as metallurgical recoveries, pit slopes and reasonable long-term metal price assumptions.

Metallurgical testwork, discussed in Section 13, was completed in advance of the mine planning work. The information resulting from this work included expected gold recovery by pit and some initial plant operating costs. Cost estimates were based on a large-scale operation.

**Table 16-5: Initial Pass Operating Costs**

| Operating Cost  | Unit      | 7 Mt/a |
|-----------------|-----------|--------|
| Base            | \$/t      | 2.26   |
| Processing Cost | \$/t feed | 10.50  |
| G&A             | \$/oz     | 56     |

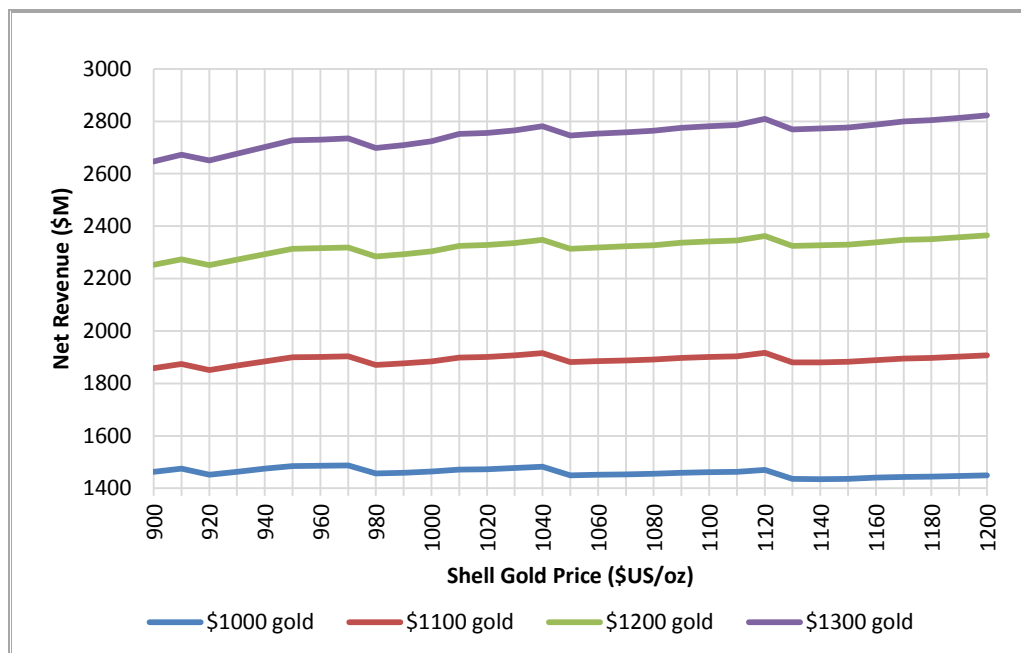


The G&A cost was associated with the refining and transportation costs as so is shown as a dollar per ounce. The initial gold recovery was set at 93% overall.

The gold price was varied from \$900/oz to \$1,200/oz initially at \$10/oz increments. Using the LG algorithm, a series of economic pit shells were developed. The tonnes and grade of waste and feed material were tabulated and a simple revenue calculation completed to determine net revenue, with which to rank the shells.

This was done at various gold prices to select the optimal pit shell, which will provide the largest economic return. As expected, as the gold price increased the larger pit shells with their larger resource, but lower grade showed the highest net revenue. However, the increase in net revenue was not as great as anticipated due to the increased stripping costs associated with the larger pits. This was a result of the incremental strip ratios and a limited resource of lower grade material. The net revenue difference between the \$900/oz pit shell and the \$1,200/oz pit shell was only \$112 million with no consideration for capital. AGP believed that the larger pit shells were not adding significant value. This is indicated in Figure 16-7. The variation in net revenue between pits was negligible and the only increase in net revenue was with the gold price. As the gold price rose, the overall net revenue across the span of pit shells increased.

**Figure 16-7 Pit Shells – Net Revenue at Variable Gold Prices at 0.34 g/t Cutoff**



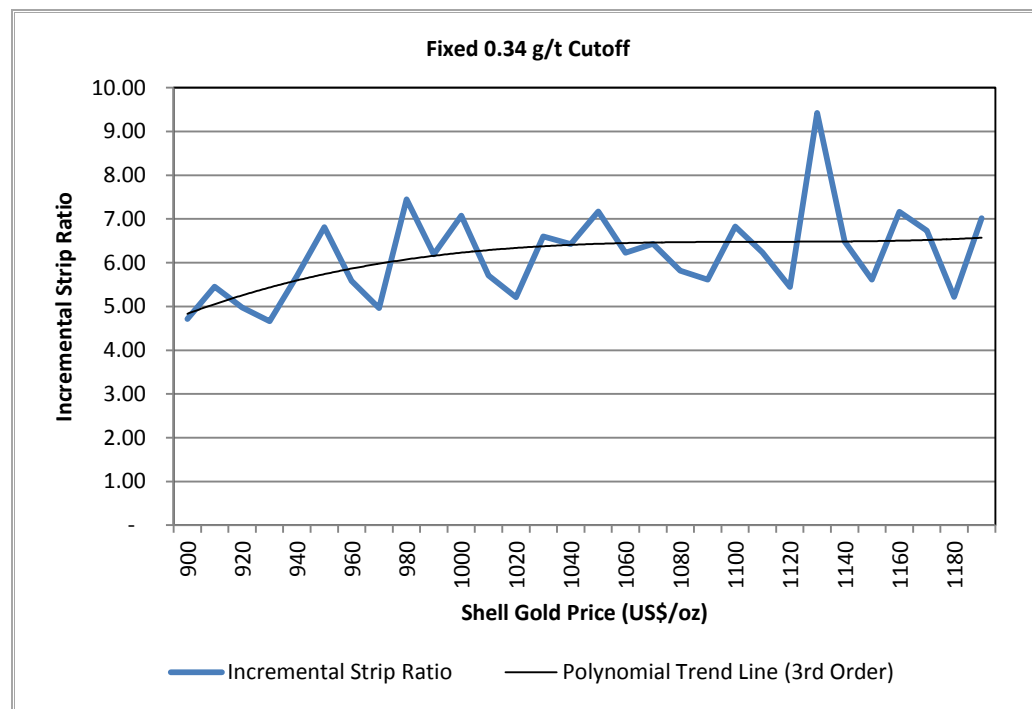
So using a fixed cutoff grade of 0.34 g/t, a comparison of the incremental strip ratios between the pits was completed. This is shown in Figure 16-8.



Examining the curve of the slope, the \$1,020/oz pit seemed to be the inflection point for the strip ratio. Beyond this pit shell, the incremental strip ratios tended to be roughly the same. Roughly as there was some oscillation in the actual strip ratios as different pockets of grade were mined.

Deciding on \$1,020/oz gold price due to reduced incremental strip ratio resulted in an initial pit shell with 4.6 Moz Au. The larger \$1,200 pit shell had 4.9 Moz in the shell, but the net revenue difference was only \$36 million, hardly worth the extra stripping required.

**Figure 16-8: Incremental Strip Ratio Comparison**



The decision was made to see the potential impact of dilution on the initial pit shells. It should be noted that the pit shells from a LG run come to a point at the base and do not always represent practical final designs. Although the proper wall slopes were placed in the program, the point at the base of the shell can sometimes add significant tonnes of feed material. This is why many final pit designs can have less feed and grade in the end than the original shells.

Three more pit shells were run using slightly modified parameters to see what the impact of dilution and a change in the G&A would do. The results are shown in Table 16-6.



**Table 16-6: Economic Pit Shell Comparison**

| Input Parameter                | Units     | Pit 45      | Pit 46      | Pit 47      |
|--------------------------------|-----------|-------------|-------------|-------------|
| Gold Price                     | \$/ oz    | 1,400       | 1,200       | 1,020       |
| Classification Used            |           | M + I       | M + I       | M + I       |
| Mining Cost                    | \$/t      | 2.26        | 2.26        | 2.26        |
| Mining Recovery                | %         | 100         | 100         | 100         |
| Mining Dilution                | %         | 12          | 12          | 12          |
| Process Cost                   | \$/t feed | 10.50       | 10.50       | 10.50       |
| Process Gold Recovery          | %         | 93          | 93          | 93          |
| G&A + Selling Costs            | \$/ oz    | 72          | 72          | 72          |
| Pit Shell – Feed Material      | t         | 154,388,900 | 123,371,300 | 98,328,300  |
| Pit Shell – Waste              | t         | 539,538,400 | 495,147,800 | 428,893,700 |
| Pit Shell – Total Material     | t         | 693,927,300 | 618,519,100 | 527,222,000 |
| Strip Ratio                    | W/F       | 3.5         | 4.0         | 4.4         |
| Gold - Grade                   | g/t       | 1.05        | 1.19        | 1.34        |
| Gold - Contained               | oz        | 4,804,300   | 4,398,300   | 3,943,400   |
| Gold - Recovered               | oz        | 4,468,000   | 4,090,400   | 3,667,300   |
| Gold Revenue – at \$1,200/oz   | \$M       | 5,467.5     | 4,968.2     | 4,443.9     |
| Operating Cost                 | \$M       | 3,189.4     | 2,693.3     | 2,224.0     |
| Net Revenue                    | \$M       | 2,278.1     | 2,275.0     | 2,220.0     |
| Mine Life at 7 Mt/a            | Years     | 22.1        | 17.6        | 14.0        |
| Net Revenue over \$1,020 Shell | \$M       | 58.2        | 55.0        | -           |
| Net Revenue per Year           | \$M       | 7.3         | 15.4        | -           |

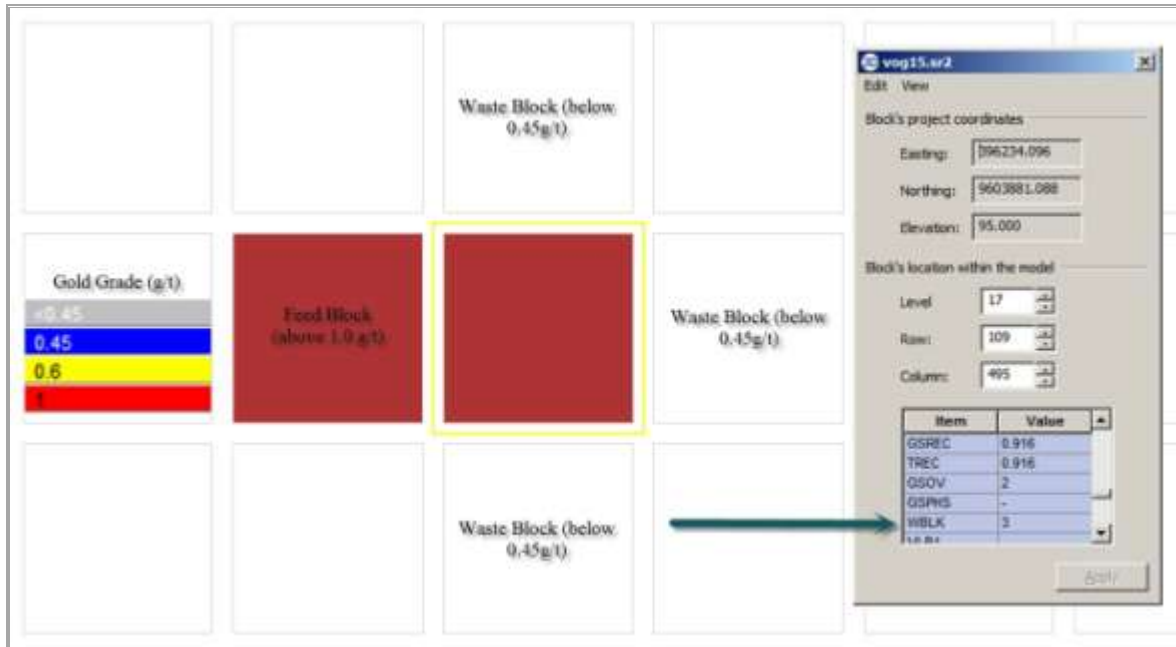
The analysis showed that while the larger pit did again show higher net revenue, the difference was within the accuracy of the analysis ( $\pm 30\%$ ). However, the \$1,400/oz shell would need a tailings management facility (TMF) that was 57% larger. Therefore, this analysis without capital shows that the smaller pit shell was more favourable.

Based on this, the \$1,020/oz pit shell was used as the basis for the PEA study design.

#### 16.2.4 Dilution Calculation

Based on a series of iterations of pit optimizations, a mining cutoff grade of 0.45 g/t was chosen and applied to the MineSight procedure GNDILN.DAT, which calculates the number of adjacent waste blocks on a given level or in plan view. An example result is shown in Figure 16-9, where a feed block with a grade above 1.0 g/t is surrounded by four blocks to the north, south, east, and west. Three of these blocks fall below the 0.45 g/t cutoff, while the block to the west grades above 1.0 g/t, which sits above the 0.45 g/t cutoff. This was then stored into the model item WBLK as a value of 3 for three waste blocks.

Figure 16-9: Example of Adjacent Waste Blocks



Within the model, blocks with a WBLK value of 0 are either internal feed blocks or waste blocks (as the procedure does not run on blocks below 0.45 g/t), while blocks with a WBLK value between 1 and 3 are either fringe blocks or border on internal dilution. Blocks with a WBLK value of 4 are orphan blocks, as they are feed blocks completely surrounded by waste. These were assumed to either not be mined or diluted 100% to become a waste block. Even if the grade was significantly above cutoff, i.e., greater than 1 g/t it was still wasted as AGP believed that it was not operationally feasible to locate and mine a single orphan block.

Using the WBLK value within the block, the following dilution logic was applied to create a diluted feed% item (DIL%) and a diluted grade item (DILOK). A waste grade of 0.223 g/t was decided upon as it represents the average grade outside of the 0.5 g/t wireframe within the resource model and a dilution percentage of 17.2% was used to signify a 1.25 m dilution edge on the block. The value of 17.2% was calculated based on the block dimensions and the 1.25 m of dilution.

$$\text{If } 0 \leq \text{TOK\%} \leq 82.8, \text{ then}$$

Where TOK% = Measured and Indicated undiluted feed% in the block and the block has less than 82.8% as a feed percentage.

$$\text{DIL\%} = 17.2 + \text{TOK\% and}$$



$$DILOK = \frac{TOK\% * TAUOK + 17.2 * 0.223}{DIL\%}$$

The DILOK = diluted Measured and Indicated grade in the block.

*If  $82.8 < TOK\%$  and  $1 \leq WBLK \leq 3$ , then*

$$DIL\% = 17.2 + TOK\% \text{ and}$$

$$DILOK = \frac{TOK\% * TAUOK + 17.2 * 0.223}{DIL\%}$$

It is the same case as the first option where the block is surrounded partially with waste blocks. The reason why this case is tested is to allow for the third case, which is a completely internal block.

*If  $80 < TOK\%$  and  $WBLK = 0$ , then*

$$DIL\% = 100 \text{ and}$$

$$DILOK = \frac{TOK\% * TAUOK + (100 - TOK\%) * 0.223}{DIL\%}$$

In this case if there is a low grade inferred percentage or internal dilution, then the block is diluted to 100% feed at 0.223 g/t and added to the Measured or Indicated depending on the classification of the original block.

In this manner, some Inferred material was upgraded to Indicated, or in a rare case, Measured, as a result of the dilution calculation.

The dilution grades were then stored in the model for under the item name DILOK and used for reporting grades in pit designs.

#### 16.2.5 Pit Design and Phase Development

Using a series of reduced gold price shells developed in the economic pit development and the diluted grades, a series of phases were designed for each pit area. These phases were sized based on targeting tonnage for several years of mill feed, with sufficient width to accommodate the size of mining equipment originally envisaged (181 tonnes). This meant haulroads with a width of 33 m to allow proper double lane traffic, and a minimum pushback for phase width of 80 m, with normal widths of 100+ m.

Double lane traffic in this case refers to three times the operating width of the trucks, plus room for berms and ditches. Ramp grades are 10% for uphill loaded configuration in the pits and 8% for uphill on the waste dumps.

Topography and access were also considered as in many instances in Grota Seca pit designs were limited by this. Due to the topography, a second or third phase was not



always possible to design with leaving reasonable operating width or the ability to access with a ramp. In those cases, a larger phase was designed than a nested shell would have indicated.

The detailed pit designs were based on the detailed parameters provided by VOGBR and shown in Table 16-3. As noted on the table, every 150 m vertically, an extra width geotechnical berm of 20 m was required in the overall design.

Three phases were designed for Ouro Verde in a concentric manner. Grota Seca, with its limitations due to topography and also more vertical zones of mineralization required six phases. These are summarized in Table 16-7.

**Table 16-7: Design Pit Phases – Tonnes and Grade**

| Phase             | Mill Feed (Mt) | Au (g/t)    | Waste (Mt)   | Total (Mt)   | Strip Ratio |
|-------------------|----------------|-------------|--------------|--------------|-------------|
| <b>Ouro Verde</b> |                |             |              |              |             |
| 1                 | 7.5            | 1.30        | 20.4         | 27.9         | 2.70        |
| 2                 | 8.5            | 1.21        | 42.0         | 50.5         | 4.93        |
| 3                 | 31.8           | 1.19        | 177.7        | 209.5        | 5.62        |
| Subtotal          | 47.8           | 1.21        | 240.1        | 287.9        | 5.02        |
| <b>Grota Seca</b> |                |             |              |              |             |
| 1 (E1)            | 17.2           | 1.09        | 42.2         | 59.4         | 2.45        |
| 2 (E2)            | 25.8           | 1.02        | 98.7         | 124.5        | 3.82        |
| 3 (WC1)           | 3.8            | 1.27        | 8.8          | 12.6         | 2.35        |
| 4 (EC)            | 1.1            | 1.12        | 9.1          | 10.2         | 8.29        |
| 5 (W)             | 1.8            | 1.53        | 15.3         | 17.1         | 8.58        |
| 6 (WC2)           | 5.3            | 1.08        | 27.8         | 33.1         | 5.29        |
| Subtotal          | 55.0           | 1.08        | 201.9        | 256.9        | 3.68        |
| <b>Total</b>      | <b>102.7</b>   | <b>1.14</b> | <b>442.1</b> | <b>544.8</b> | <b>4.30</b> |

Table 16-7 shows the diluted tonnes and grade. How these compare to the resource statement is explained in Table 16-8.

**Table 16-8: October 2013 – Resource Tonnes, Grade, and Ounces – Undiluted**

| Classification       | Resource (Kt) | Au (g/t) | Contained Gold (Koz) |
|----------------------|---------------|----------|----------------------|
| Measured             | 55,399        | 1.68     | 2,997                |
| Indicated            | 35,757        | 1.58     | 1,821                |
| Measured + Indicated | 91,156        | 1.64     | 4,818                |
| Inferred             | 40,728        | 1.52     | 1,994                |



Table 16-9 shows resources, as stated in October 2013, with a 0.5 g/t cutoff within a pit shell using a \$1,400/oz gold price.

**Table 16-9: PEA Pit – Resource Tonnes, Grade, and Ounces - Undiluted**

| Classification       | Resource (Kt) | Au (g/t) | Contained Gold (Koz) |
|----------------------|---------------|----------|----------------------|
| Measured             | 45,011        | 1.45     | 2,099                |
| Indicated            | 37,040        | 1.28     | 1,520                |
| Measured + Indicated | 82,051        | 1.37     | 3,619                |

The Inferred material was not considered, as only Measured and Indicated are used for the PEA study (Table 16-10). The PEA pit design contains 75.1% of the contained ounces reported in the resource statement from October 2013, using the same 0.5 g/t cutoff.

**Table 16-10: PEA Pit – Resource Tonnes, Grade and Ounces – Undiluted, Variable Cutoff**

| Classification       | Resource (Kt) | Au (g/t) | Contained Gold (Koz) |
|----------------------|---------------|----------|----------------------|
| Measured             | 46,328        | 1.42     | 2,112                |
| Indicated            | 40,825        | 1.20     | 1,571                |
| Measured + Indicated | 87,153        | 1.31     | 3,683                |

The use of the lower variable cutoffs (OV = 0.37 g/t, GS = 0.42 g/t) added 5.1 Mt of resource at approximately 0.39 g/t for an additional 64,000 oz.

Dilution was added to the model, and the resources within the PEA pit design were run, the results obtained are shown in Table 16-11.

**Table 16-11: PEA Pit – Tonnes, Grade and Ounces, - Diluted, Variable Cutoff**

| Classification       | Resource (Kt) | Au (g/t) | Contained Gold (Koz) |
|----------------------|---------------|----------|----------------------|
| Measured             | 51,811        | 1.29     | 2,146                |
| Indicated            | 50,950        | 1.00     | 1,634                |
| Measured + Indicated | 102,761       | 1.14     | 3,780                |

This shows that the dilution added another 15.6 Mt of feed material at an average grade of 0.193 g/t. With the dilution calculated at 0.223 g/t, this means there were 13.5 Mt of 0.223 g/t material added and another 2.1 Mt at zero grade. The zero grade material results from internal dilution blocks and some of the truncating that is occurring with the dilution calculation on the percentage model.

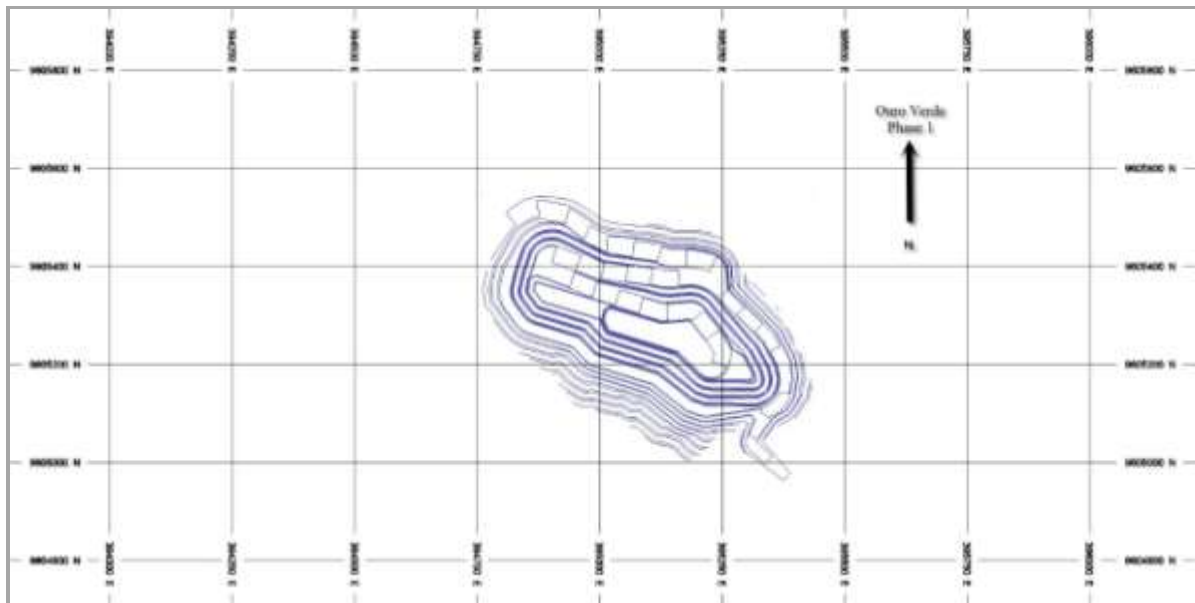
Overall, the dilution is 13.0 % for the LOM at a zero grade or 17.9% at an average grade of 0.19 g/t.

The design phases are described below and with their associated figures for reference.

### ***Ouro Verde – Phase 1***

Phase 1 development in Ouro Verde considers the development of two accesses (Figure 16-10). The main access, which enters on the north side of the pit, is double lane, with switchbacks on the north side (footwall) to provide proper access to the mineralized zone and avoid locking the higher grade on the south side within it. A single lane access is developed and maintained for one-way uphill traffic, primarily feed to the mill. This temporary access road shortens the mill feed haul by 500 m. It is also used to shorten the haul on some of the waste by being able to haul directly to Grota Seca for road construction or use in filling the low-grade stockpile pad. Other waste material can use the double lane route for the main Ouro Verde waste facility or for material to lift the tailings dam.

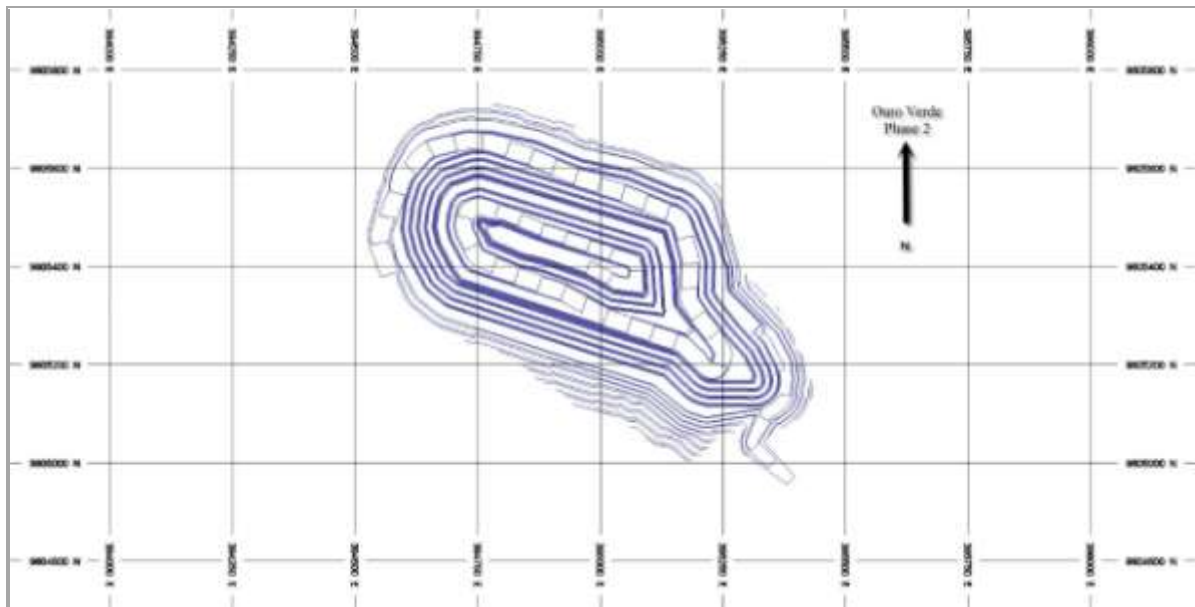
**Figure 16-10: Ouro Verde Phase 1**



### ***Ouro Verde – Phase 2***

Phase 2 in Ouro Verde expands on the development of Phase 1 but cuts off the temporary mill feed access road as downward development progresses. The phase expands to the northwest with a new access road and also deepens Phase 1. At this time, the ramp is also developed on the south side of the pit to reduce the initial switchbacks.

**Figure 16-11: Ouro Verde Phase 2**



### ***Ouro Verde – Phase 3***

A portion of Phase 3 is mined in Year -1 to act as a source of construction material (Figure 16-12). This will be used to widen roads, build the low-grade stockpile, and establish the drainage channels in the waste management facilities with rock. The phase expands the pit to final limits and depth for the PEA mine plan. It is limited on the north by the Xingu River and at depth by incremental strip ratio. The access for mill feed and waste exits on the south side as the other phases did for easy access to the waste facility and plant haul road.

Figure 16-13 shows a representative cross-section through the Ouro Verde Pit.

**Figure 16-12: Ouro Verde Phase 3**

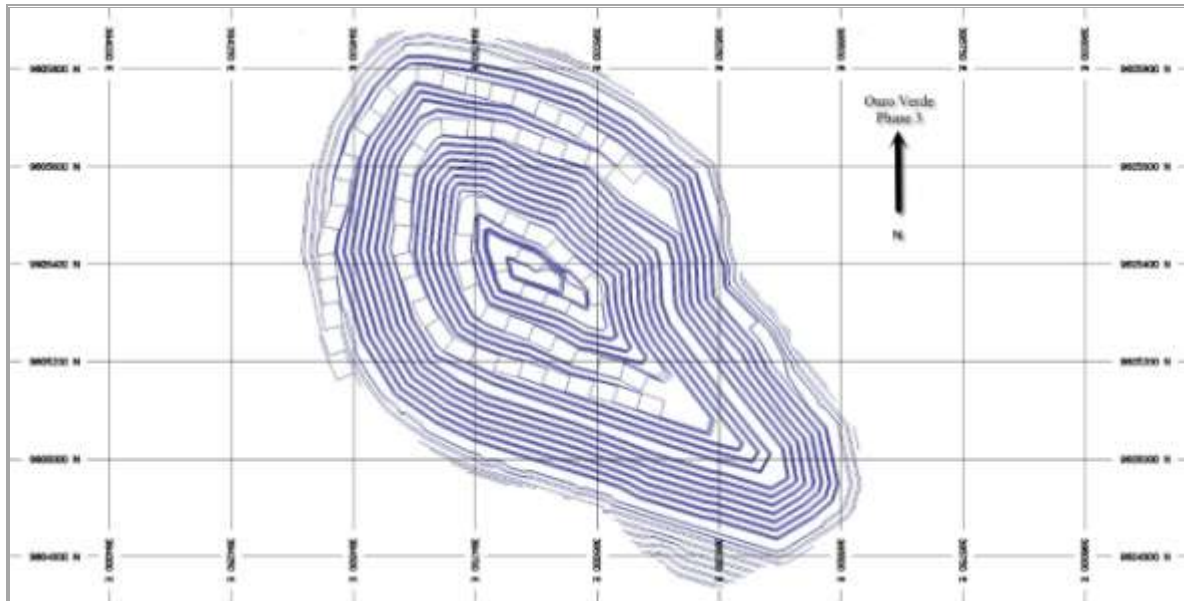
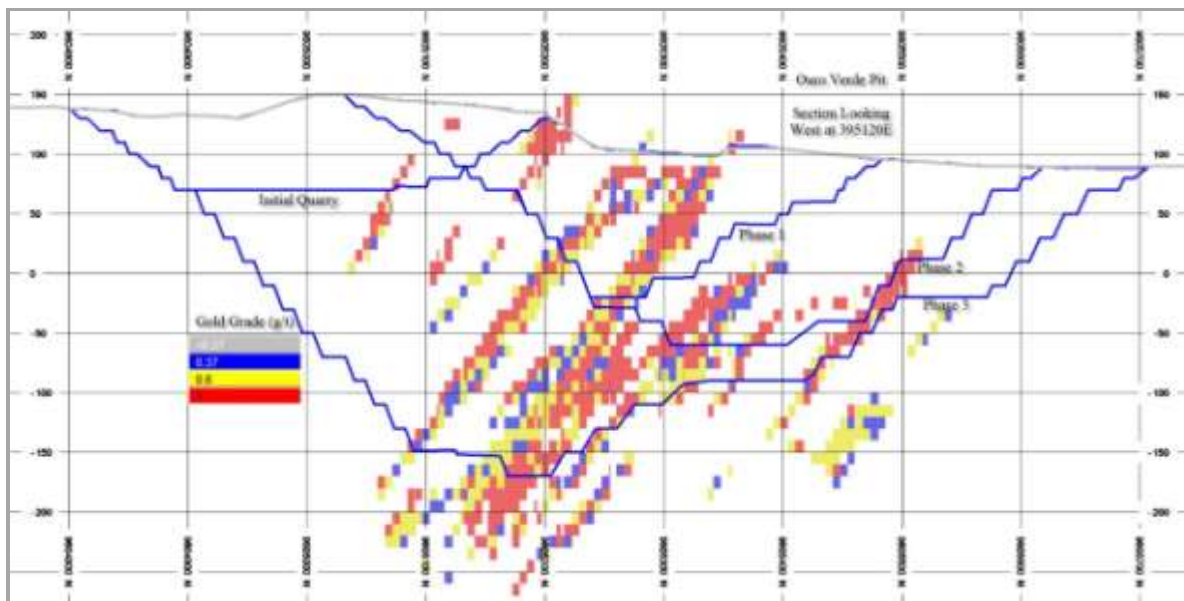


**Figure 16-13: Ouro Verde Cross-Section Looking West at Easting 395120**

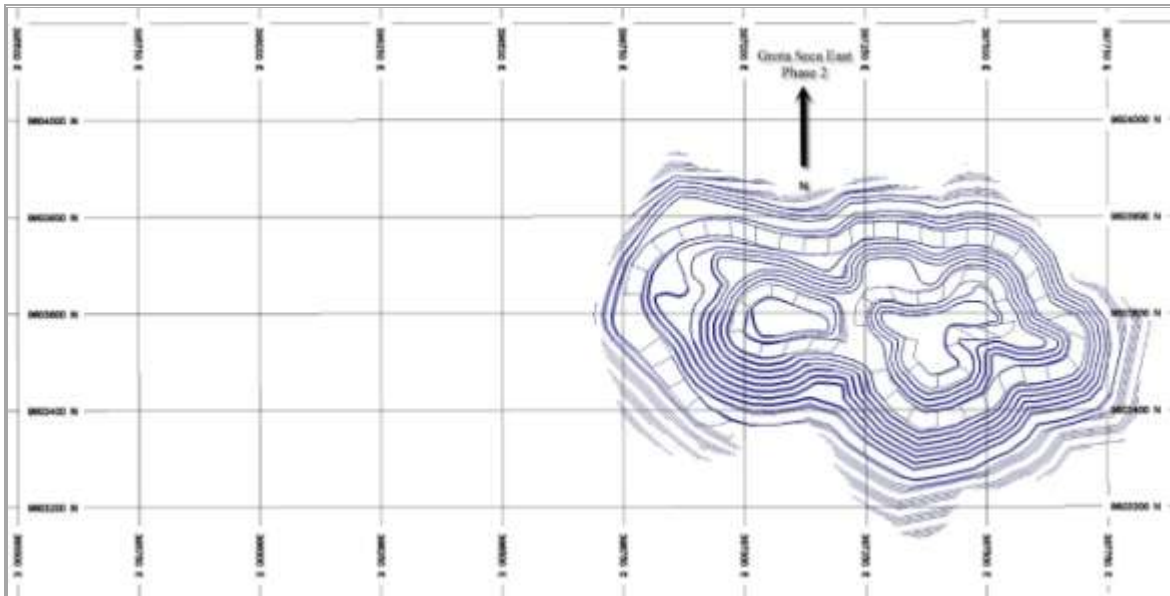


The Phase 1 design, like many of the other Grota Seca phase designs are stand alone as a result of the topography associated with the deposit. Access is from the south and takes advantage of a valley on the south side to reduce strip ratio. The ramp starts on the south side of the deposit and wraps around the steeply dipping mineralized zone.

### ***Grota Seca – Phase 2 (E2)***

Phase 2 is an expansion of Phase 1, but is mined later in the mining schedule due to the lower grade associated with the phase and the initial development tonnages. While it is one of the larger phases, the pre-strip and more difficult terrain pushes it to later in the sequence. The access for this phase takes advantage of a valley to the west of the Phase 1 access allowing for reduced disturbance during mining.

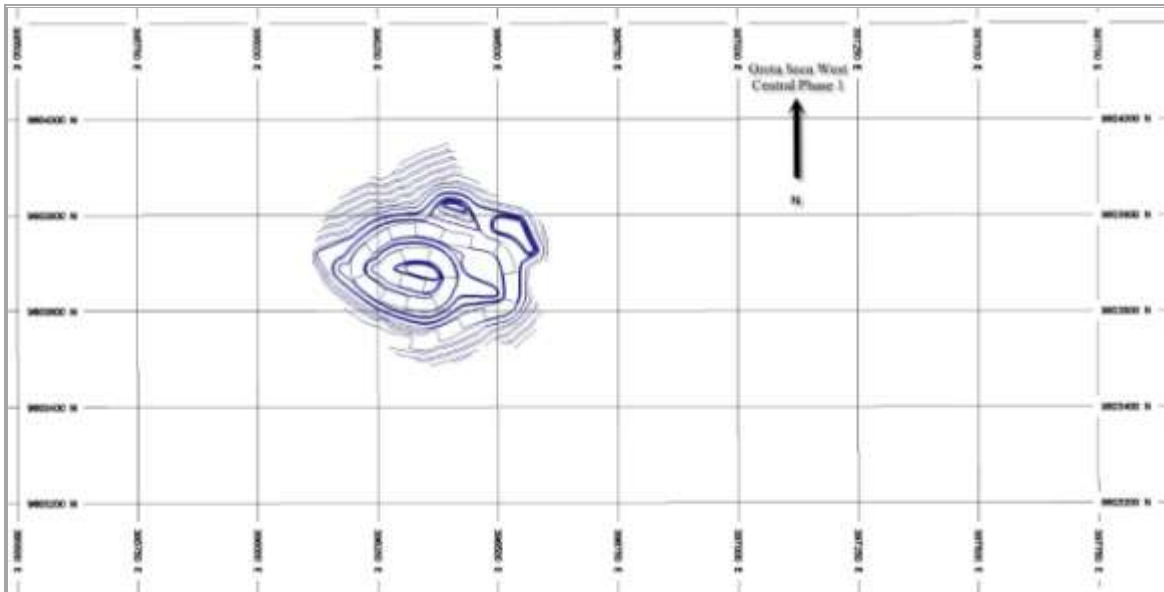
**Figure 16-15: Grota Seca Phase 2 (East 2)**



### ***Grota Seca – Phase 3 (WC1)***

Phase 3 is called WC1 or west central one. It is the first of two phases mined in the center of Grota Seca. In the same manner as the other Grota Seca phases, local topography plays a role in the access design. A small valley is used to initiate the ramp, which wraps around the pit chasing the higher grade to depth. This is a result of the variable nature of the grade in Grota Seca as well as pockets of higher grade existing.

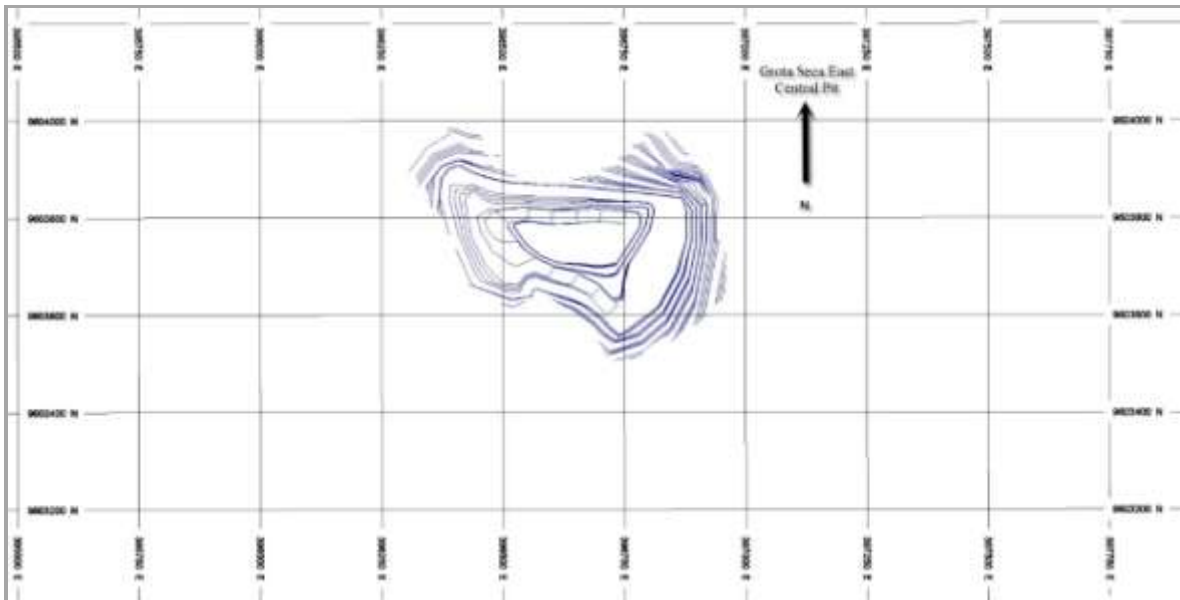
**Figure 16-16 Grota Seca Phase 3 (West Central 1)**



***Grota Seca – Phase 4 (EC)***

Phase 4 in Grota Seca is designed between the West Central pit and the East pits. Access is off the East Central pit and then dives after a zone of higher grade.

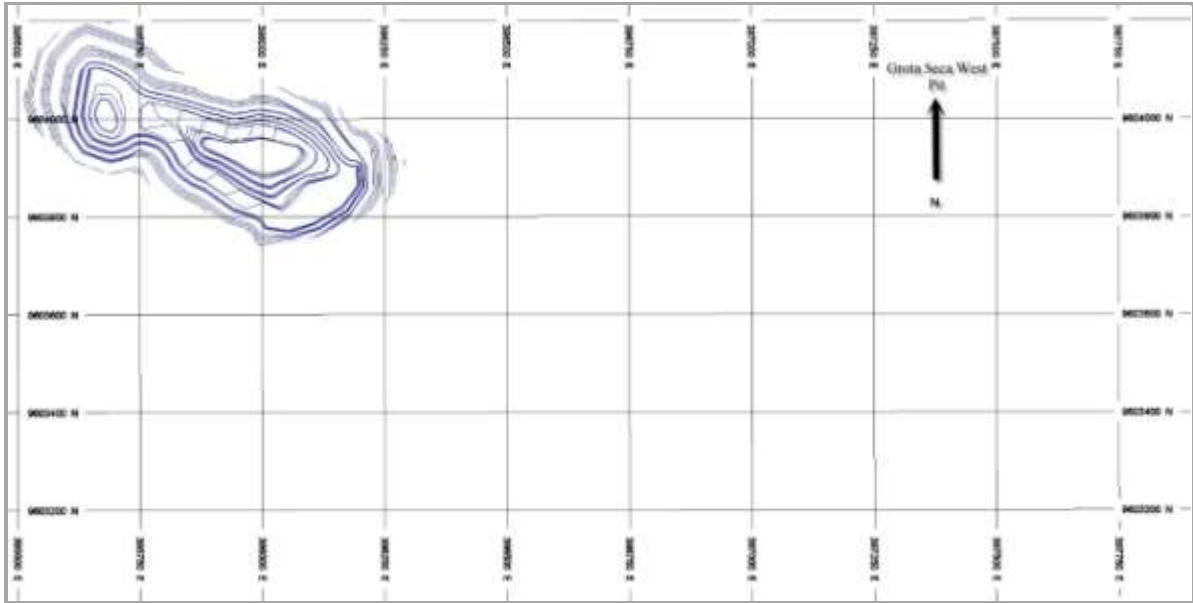
**Figure 16-17: Grota Seca Phase 4 (East Central)**



***Grota Seca – Phase 5 (W)***

The most westerly phase in Grota Seca also ties off the West design to save developing a new access ramp and increasing the strip ratio (Figure 16-18). It is extracting a series of higher-grade zones on the west side of Grota Seca.

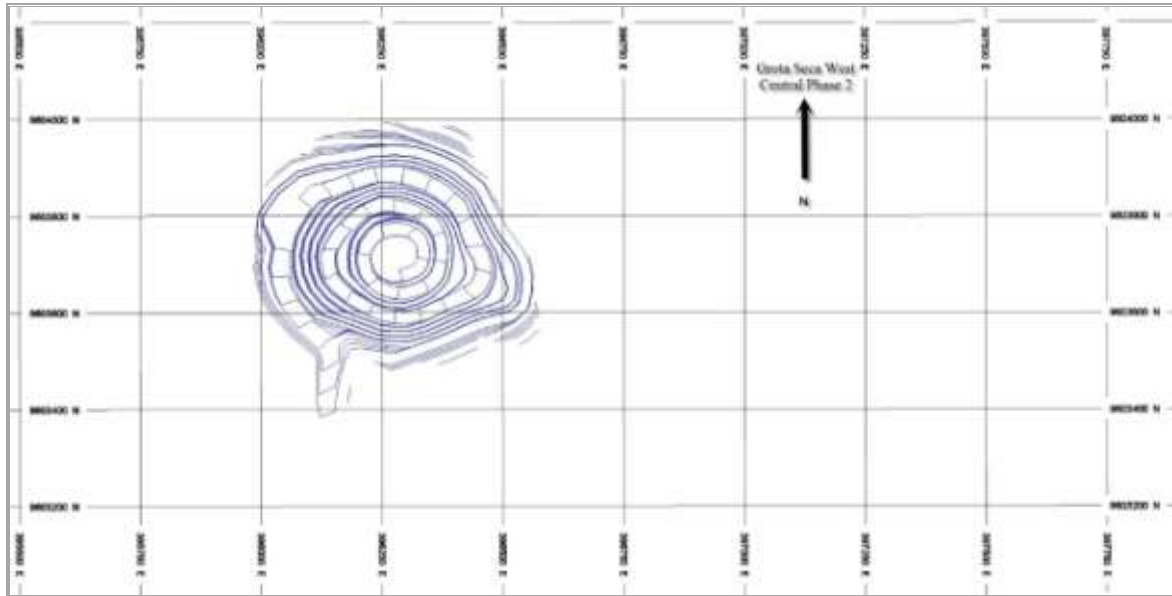
**Figure 16-18: Grota Seca Phase 5 (West)**



***Grota Seca – Phase 6 (WC2)***

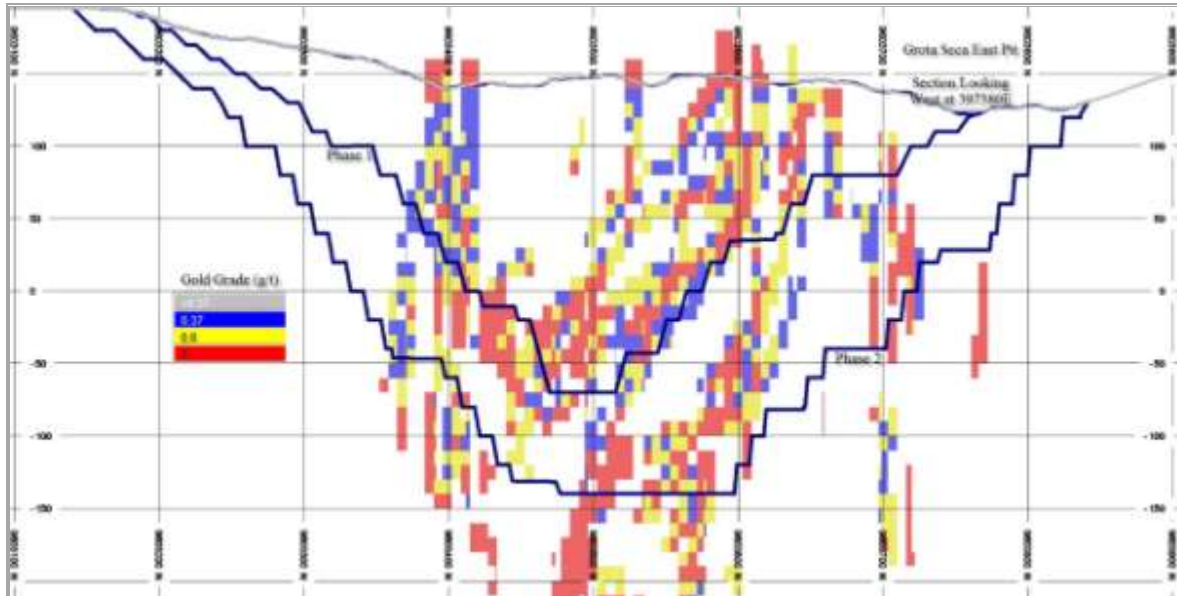
The final phase designed, Phase 6 West Central 2 (Figure 16-19), is an expansion of West Central 1. The access to this phase is near the WC1 access, but ramps down in an opposite direction.

**Figure 16-19: Grota Seca Phase 6 (West Central 2)**



A representative cross section for Grota Seca East is shown in Figure 16-20. This is where the bulk of Grota Seca's tonnage is mined.

**Figure 16-20: Grota Seca East Representative Cross-section Looking West (Easting 397380)**



Actual tonnages for each phase for scheduling were determined as high, medium, and low grade. High grade was defined as greater than 1 g/t. Medium grade equated to the mining cutoff, which varied by pit depending on recovery but was between 0.55 g/t and 0.6 g/t to 1 g/t. The low-grade cutoff used also varied slightly by pit due to recovery in each block but was approximately 0.37 g/t for Ouro Verde and 0.42 g/t for Grota Seca.

The breakdown of tonnes and grade were tabulated by phase then scheduled for the production rate evaluation.

#### 16.2.6 *Production Rate Evaluation*

The design phases were assessed at various production levels to determine a level of production that met Belo Sun's criteria for project advancement. While earlier design work had been completed with the concept of a 7 Mt/a process plant in mind, Belo Sun wished to investigate a staged approach which encompassed an initial smaller plant expanding later to a larger plant for the Project which would reduce upfront capital, mine higher grade early in the mine life, incorporate a low grade stockpiling strategy which might provide a higher overall return and thus make the project easier and less risky to finance.



A series of mine schedules were completed with the phase designs already developed. Phases were excluded in an effort to reduce stripping but with the effect of reducing mine life. As well, stockpiling of the medium and low grade was included to boost early mine life grades to assist in capital payback. Schedules with annual processing rates of 2 Mt/a up to 4.0 Mt/a were created with 0.5 Mt/a increments.

Operating costs were estimated for each of the options; mining, processing and G&A. Capital costs were also estimated based on previous internal work. The various schedules were then compared on a cash flow basis. Table 16-12 shows these results.

**Table 16-12: Production Rate Trade-off Results**

| Production Rate | NPV @ 7.5% (\$M) | IRR % | Initial CAPEX (\$M) | Pre-Tax Payback (Years) | Mine Life (Years) |
|-----------------|------------------|-------|---------------------|-------------------------|-------------------|
| 2.0 Mt/a        | 114              | 14.5  | 290.2               | 4.6                     | 19                |
| 2.5 Mt/a        | 149              | 15.8  | 302.1               | 4.2                     | 15                |
| 3.0 Mt/a        | 179              | 19.7  | 314.7               | 3.3                     | 13                |
| 3.5 Mt/a        | 160              | 17.9  | 365.2               | 3.5                     | 11                |
| 4.0 Mt/a        | 164              | 18.5  | 390.2               | 3.3                     | 10                |

The 2.5 Mt/a schedule met most of the criteria except for payback. AGP in discussions with Belo Sun decided to proceed with the 3.0 Mt/a schedule because it offered a better opportunity if the price of gold was to rise even marginally. The 3 Mt/a schedule met the criteria of reasonable net present value (NPV), higher internal rate of return (IRR), and payback of 4 years or less.

The production rate trade-off study concluded that a 3 Mt/a schedule for only eight years of in pit mining followed by another five years of stockpile reclaiming met the initial capital limitations to the project. Two phases of Ouro Verde were mined of the three that were designed. In Grota Seca only two of the six phases designed were mined. This did not fully utilize the resource that Belo Sun and AGP believed was worthwhile extracting.

Further discussion expanded upon the concept of a staged approach with the notion of trying to fully utilize the resources contained within the Ouro Verde and Grota Seca pits as designed. The mine schedule and cash flow were re-examined with the concept of leasing of the mine equipment and a plant expansion added once initial capital had been repaid. Of concern was trying to avoid a “double dip” in the cash flow, which would extend the payback period. Using cashflow to fund the expansion was preferable to having to pursue financing in the future unless it was warranted at the time.



Additional stripping would be required to bring the later phase of Ouro Verde, and higher strip ratio but high-grade phases in Grota Seca that had been excluded in the initial examination. The timing of bringing these into the schedule coincided with replacement of the major mining equipment. This offered the opportunity to expand equipment at the same time additional stripping was required and potentially reduce unit costs. If the waste stripping could be pushed further out this would also assist with the overall project payback. Because the original 3 Mt/a schedule had a significant low grade stockpile that was reclaimed from Year 8 onwards, the opportunity to continue stripping while still supplying feed to the mill existed.

This was then examined as an option for the mine schedule. When combined with leasing of the mine equipment, it appeared that:

- Pre-tax initial project capital was within the \$300 million target
- Net present value increased dramatically with the inclusion of the additional resources
- Payback was 4 years Pre-tax
- IRR was 17.7% pre-tax
- Mine life was 21 years.

The advantage of this direction with the mine plan, beyond the reduced capital was the ability to mine with smaller, more selective mining equipment while gaining an understanding of the deposit and the grade control requirements. This was preferable to initiating mining with larger equipment to reduce unit costs at potentially the expense of lower feed grade to the mill due to increased dilution.

#### **16.2.7 PEA Mine Schedule**

The selected PEA mine schedule is a staged sequence, providing 3 Mt/a initially, then ramping to and maintaining 6 Mt/a in the later part of the mine life starting in Year 8. This was Material selection for the mill feed tonnage was based on three cutoffs:

- Low Grade – Ouro Verde (0.37 g/t), Grota Seca (0.42 g/t)
- Medium Grade – approximately Ouro Verde (0.55 g/t), Grota Seca (0.60 g/t)
- High Grade – greater than 1 g/t.

The higher value phases are mined initially. This includes OV Phase 1, GS East 1 and GS West Central 1 as described in Section 16.2.5.

Year -1 starts primarily in Ouro Verde mining the knoll in Phase 3 for construction material to widen and improve the mine roads. The low-grade stockpile pad is



developed and the roads to Grota Seca established. At that time, Grota Seca comes online to start mining for higher-grade feed to commission the mill. Mill commissioning starts in month 10 of Year-1 and takes approximately three months to ramp up to full production.

Year 1 has the majority of the mill feed coming from OV Phase 1 as OV Phase 2 is pre-stripped. Grota Seca is primarily the West Central 1 pit as GS East 1 is being pre-stripped. The amount of saprolite feed to the mill is limited to 10% of the total feed per annum, although in the total schedule that amount is not exceeded.

Year 2 has the emphasis shifting to Grota Seca for feed to the mill. Ouro Verde is still providing approximately 40% of the feed.

Feed to the mill is primarily from Grota Seca in Year 3 with 81% of the total. From this point onwards, Ouro Verde then matches the feed output for a more balanced blend.

The plant expansion starts to come online in Year 8, with the plant processing 4.5 Mt that year. To help push the waste requirements out into the future, a portion of the stockpile material is reclaimed.

Year 9 has the plant expansion at full capacity of 6 Mt/a. This year is also when the new mining fleet arrives and starts mining in earnest. Stockpile reclaim is also significant in this year with 1.7 Mt reclaimed. Total material moved (ore and waste) rises from approximately 24 Mt/a to 47.6 Mt/a as the mine advances the larger, higher strip ratio phases in Ouro Verde and Grota Seca.

The elevated level of stripping continues for five years then starts to tail off. By Year 19, mining is complete in the pits and the remaining years are spent reclaiming the low-grade stockpile. The stockpile is exhausted in Year 21.

The Figures below show the variation of the plant feed tonnes by year, feed grade to the mill, and mined tonnage by year and phase.

**Figure 16-21: Plant Feed Tonnes by Year**

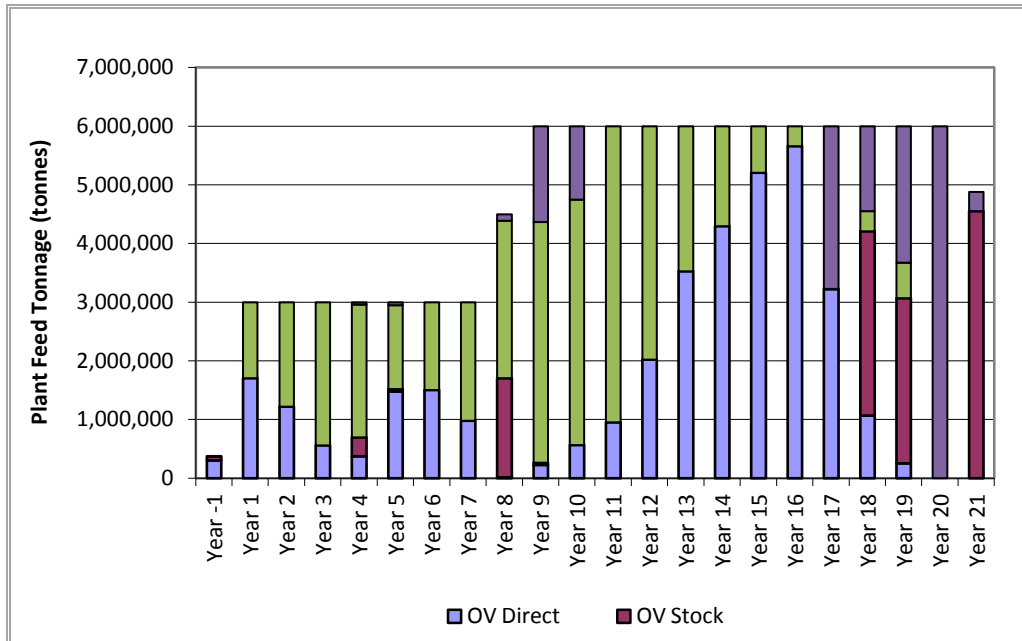


**Figure 16-22: Feed Grade to the Mill**

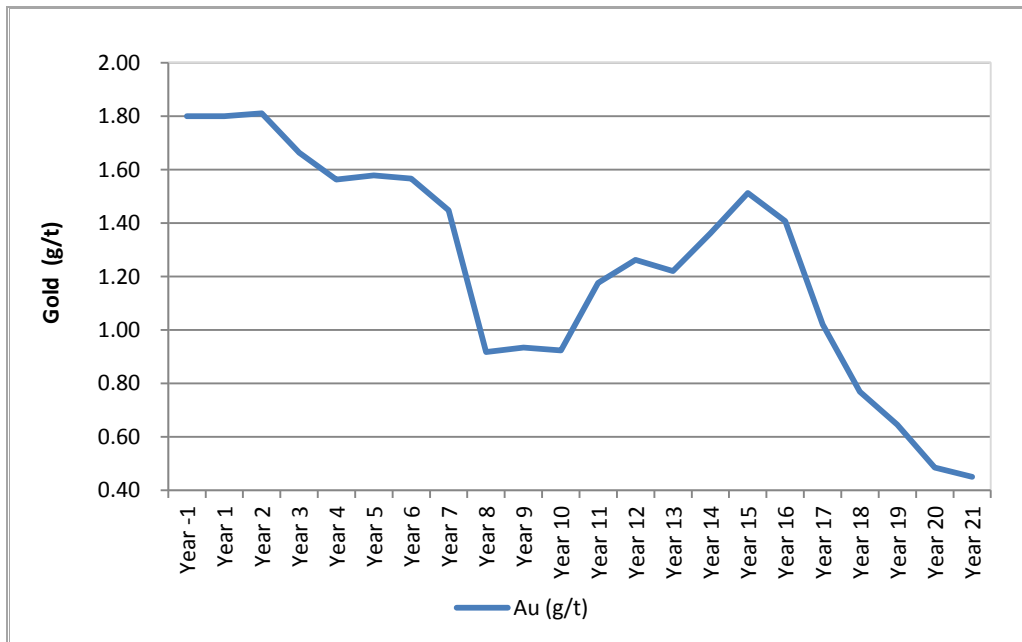
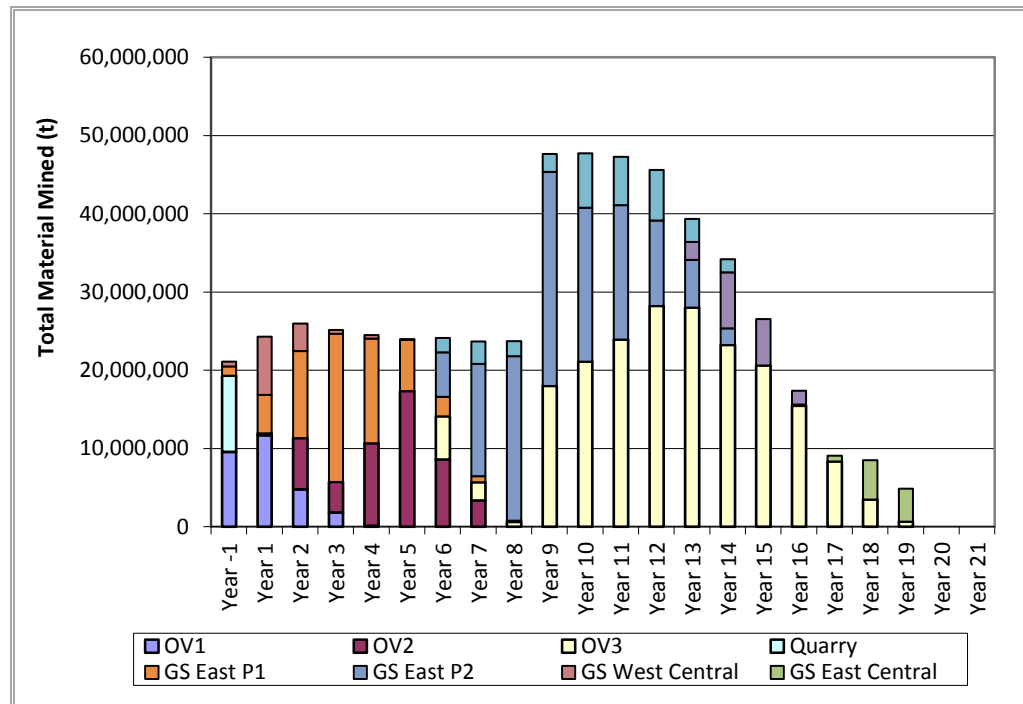




**Figure 16-23: Mined Tonnage by Year and Phase**



### 16.2.8 Grade Control

Grade control is an item that was considered from the beginning of the mine planning sequence. A review of other operations in the literature as well as site visits to current operations in similar geologic conditions was completed. The data from this review was incorporated into an analysis of the Ouro Verde and Grota Seca pits and the expected control required.

Due to the nature of the deposit and inclination of the mineralized zones, blast hole sampling was not considered an accurate method of mill feed definition. Other operations were using a reverse circulation (RC) program in advance of mining on tight inclined drill hole spacing to accurately define the feed/waste contacts. This information was then built into the short-range models and used to guide the loading equipment. This practice is widespread in Australia with great success and also in Canada and Brazil. This approach is also taken for the PEA study.

The method involved using a dedicated grade control drill rig and crew in the pit to drill a series of shallow inclined holes drilled as close as possible orthogonal to the dip of the mineralized zone and sample the material every 1 m to 2.5 m. The smaller sample size is for areas of known mineralization or expected mineralization. The larger sample frequency (2.5 m) is used in waste areas to locate unknown mineralization zones.



The entirety of the pit is drilled with the RC rig with different pattern sizes both for material type and pit area. The holes are inclined at 60° and drilled perpendicular to strike. The blast pattern spacing for mill feed is 6 m spacing and 12 m burden. For waste, the pattern spacing is increased to 24 m by 24 m (spacing x burden). Detailed examination of the mineralized zones in each pit area indicated that in Ouro Verde, 75% of the pit area would need to be drilled with the smaller mill feed pattern. In Grota Seca, with the more numerous and vertical veins, the percentage increased to 90%.

While the amount of drilling is significant (first 10 years average is 140,000 m/a), the effectiveness of the drill rigs in other operations has shown that it will not be a problem to stay ahead of mine operations with the drilling. Operational bottlenecks do occur, but with proper planning in the short range, they can be reduced.

The RC drills (one per pit) will operate for 24 h/d to minimize disturbance and be in advance of mine operations with the information. A three man crew per drill is required; one driller and two drill helpers. In addition, geology will provide guidance throughout the day and be on call if unknown issues arise.

The drill penetration rate is estimated at 19 m/h with setups, sampling, etc. Overall, the cost for the drill without labour will be \$233/h or about \$12.28/m drilled. From an overall mine operating cost perspective, the RC drill sampling program costs \$0.09/t mined. The cost of not sampling and mistaking waste for feed or feed for waste easily is repaid in proper feed: waste definition.

The data from the grade control drilling is then interpreted by the geologist and the mill feed is then remodelled and the production drilling and blasting designed to mine the feed material separate from the waste.

#### **16.2.9 Waste Rock Management Facility Design**

Waste material for this study has been assumed NAG. Internal testwork completed by Belo Sun has indicated no potential issues with acid generation or metal leaching due to the low sulphur content of the rocks.

Two types of waste rock are present in the Ouro Verde and Grota Seca pits: saprolite and rock. The saprolite overlies both pits and thus will be moved first in each of the various phases. The saprolite present is tending to be of a sandy nature rather than clay, which makes its handling characteristics somewhat easier to manage.

Mining for the project initiates on a knoll in the Ouro Verde pit where the saprolite is thinnest. The intent is to mine in this location to obtain rock for construction as soon as possible. The knoll is within Phase 3 of Ouro Verde so is advancing a portion of that



phase early for practical reasons. The saprolite mined initially will be placed in what is referred to as the North Dump. It is north of the plant but directly south of the Ouro Verde pit. The saprolite material from the knoll will be placed along the sides of the North dump and not in the valley bottom. This is to leave the bottom area open for rock placement.

Once rock is encountered in the initial mining, the roads to the plant, tailings dam, and Grotta Seca will be widened to proper operational width of 28 m, or more, to accommodate the open pit mining equipment. As the road is widened towards the crusher location, the stockpile pad will also be developed. It is anticipated that it will take two months to finish the road to the plant and low-grade stockpile pad and another two months after that to finish all the road network for Grotta Seca.

The stockpile pad acts as another waste storage area, and is built at the 135 m level and will be used to store low-grade mill feed on top. The stockpile pad will be a combination of rock and saprolite. A total of 4.6 Mm<sup>3</sup> is required to complete the pad to its full extent to accommodate all the low grade scheduled to be stored there. The stockpile pad will be complete prior to full mill production in Year 1. Drainage from the stockpile pad due to rainfall is directed to the east raw water pond and can be used as process water, or if of suitable quality, discharged to the environment.

The north waste rock management facility (WRMF) for Ouro Verde has two bases at the lower elevations which join later to become one large facility. The concept for development is the same. Initial saprolite is placed along the edges of the valley until suitable rock is available. The drainage paths present in the existing topography will be backfilled with larger rock from the mining operation. This rock will act as a rock drain for any water that is able to penetrate the WRMF and allow the fluids to drain rather than build up pore pressure. The drain then will direct this water to a settling pond at the base of the facility. This water will be used for fugitive dust suppression on the roads as needed or pumped to the tailings management facility. If the quality is suitable for discharge to the environment, that may also occur but after the other two uses have been met.

Once the drainage has been established at the base of the WRMF, the saprolite and rock will be mixed in the facility. Saprolite represents about 9.5% of the total waste material from Ouro Verde. Saprolite is estimated to be 23 Mt versus 217 Mt of rock.

Rock and saprolite from Ouro Verde will also be used to expand the main tailings dam as required. Smaller saddle dams along the north and east side of the TMF will also be provided rock and saprolite from Ouro Verde on an as required basis.



The south WRMF is located to the south of Grota Seca and east of the plant location. It will also be built in the same manner as the north facility. Saprolite will be placed along the edge of the valley until the rock drain has been established. Once drainage is set, the saprolite and rock will be mixed and placed over the drainage pathways. The rock drainage will be blasted rock from the mine and typically the larger size fractions, although no special sizing is planned or required.

The saprolite percentage in Grota Seca is slightly higher than Ouro Verde and represents 11.9% of the overall waste material at 24.8 Mt. The rock portion is 177.2 Mt.

The design of the WRMF considers a swell factor of 30%. While this is typical for rock, the saprolite swell is expected to be less than this and a factor of 15% is assumed. Lifts for the dump are placed every 20 m in height leaving a 10 m wide berm between the lifts. The angle of repose for the material is estimated to be 37.5° and with the configuration, the overall facility slope will be 20°. These parameters for the facility were provided by VOGBR as part of their geotechnical program.

The Ouro Verde facility will reach a height of 100 m and the top level is expected to be the 190 m level. It will cover an area of 189.0 ha. The Grota Seca facility will not cross over a topographic high surrounding it, thus requiring fewer settling ponds than previously envisaged. Grota Seca will reach a height of 120 m and the top level will be the 210 m level. It will cover an area of 157.1 ha.

Both facilities as they are currently designed can accommodate all the waste material. Additional capacity exists with additional lifts if required.

All material in the WRMF will be concurrently re-sloped and reclaimed as it reaches final design. This is easily managed as the height between lifts of the facility is only 20 m, sufficiently short enough for dozers to resloped the face efficiently.

A layout of the site is provided in Figure 18-1.



## **17 RECOVERY METHODS**

### **17.1 Introduction**

The proposed method of gold recovery from the Volta Grande deposit consists of conventional crushing, grinding followed by gravity concentration, and CIL cyanidation of the gravity tailings. This section describes the flowsheet, design criteria, and process description for a 6 Mt/a processing plant consisting of two 3 Mt/a phases.

### **17.2 Process Flowsheet**

From the testwork conducted a flowsheet was developed consisting of primary crushing, semi-autogenous grinding (SAG) milling, secondary ball milling, gravity concentration, concentrate intensive leach, gravity tailings CIL, elution, electrowinning and sludge refining to doré.

The implementation of the process plant is divided into two phases with the first phase comprises a single process train with a throughput of 3 Mt/a. A schematic of the proposed flowsheet for Phase 1 is presented in Figure 17-1.

The second phase upgrade to the process plant will effectively double the plant throughput to 6 Mt/a by replacing the primary crusher and the twinning of the following circuits:

- 200 – SAG Milling
- 300 – Ball Milling
- 400 – CIL Cyanidation.

In addition, upgrades will be made to the elution, gold room, and tailings detoxification areas to accommodate the additional throughput.

### **17.3 Design Criteria**

Based on the available testwork, a preliminary process design criteria was developed that provides all of the specific unit operation process detail required for equipment sizing and selection. A summary of some of the key criteria is presented in Table 17-1.

Figure 17-1: Flowsheet for the Phase 1 Volta Grande Processing Plant

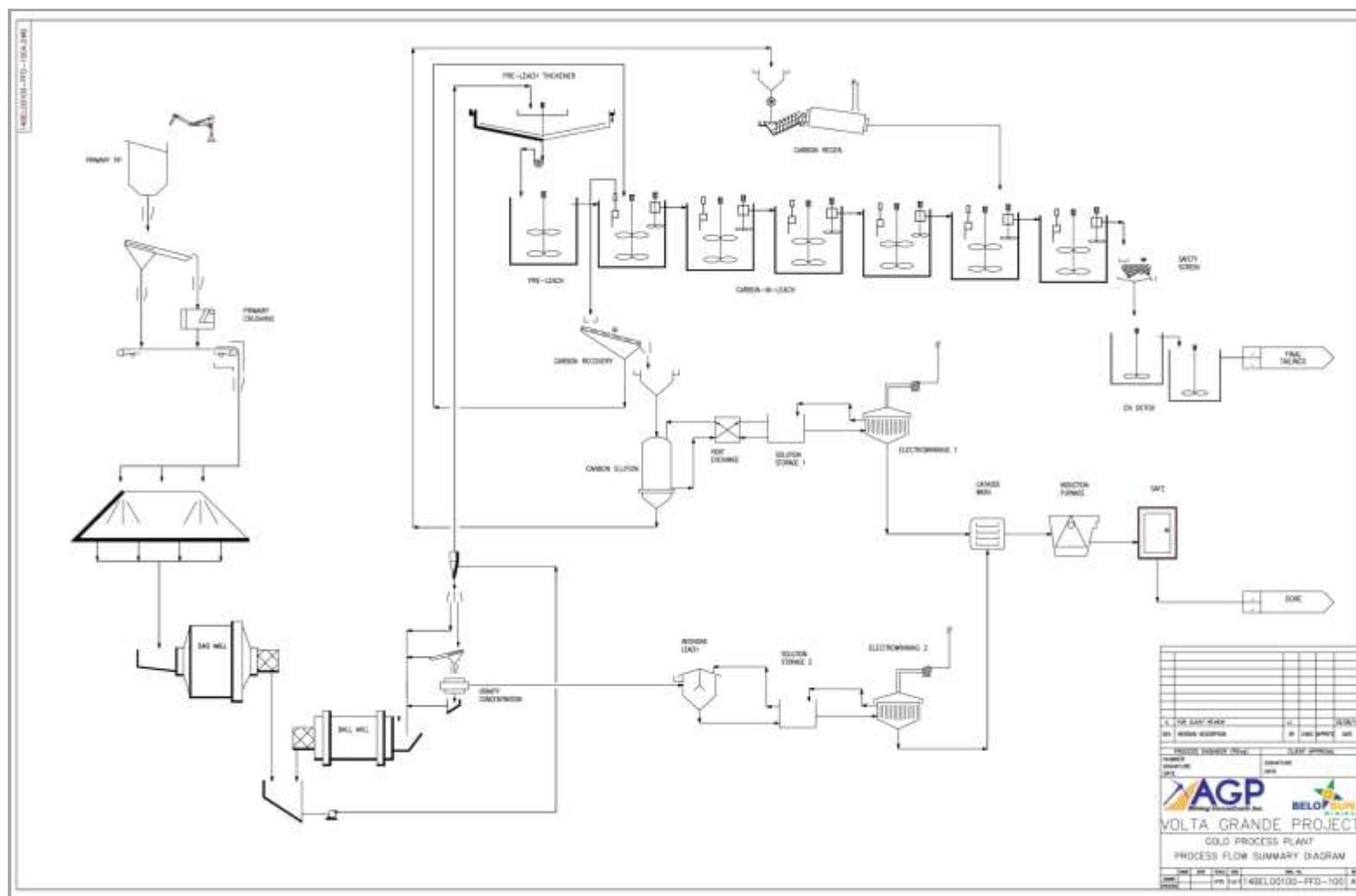


**Table 17-1: Summary of Process Design Criteria for the Volta Grande Project – Phase 1:  
 3 Mt/a**

| Criteria                                 | Unit                          | Design Data |
|------------------------------------------|-------------------------------|-------------|
| <b>1. Project Fundamentals</b>           |                               |             |
| Daily Throughput                         | t/d                           | 8,220       |
| Nominal Feed Rate for Crusher Circuit    | t/h                           | 495         |
| Nominal Feed Rate for Mill/Leach Circuit | t/h                           | 380         |
| <b>2. Physical Characteristics</b>       |                               |             |
| Solid Particle Density                   | t/m <sup>3</sup>              | 2.79        |
| Bond Ball Work Index (average)           | kWh/t                         | 15.4        |
| Bond Rod Work Index (average)            | kWh/t                         | 16.0        |
| Au Head Grade (Mill Feed)                | g/t                           | 1.66        |
| <b>3. Process Plant</b>                  |                               |             |
| Primary Crusher                          | Jaw                           |             |
| Product P <sub>100</sub>                 | mm                            | 200         |
| Product P <sub>80</sub>                  | mm                            | 150         |
| SAG Mill                                 | 30' x 15', grate discharge    |             |
| Installed Power                          | kW                            | 7500        |
| Transfer Size T <sub>80</sub>            | µm                            | 962         |
| Ball Mill                                | 18' x 30', overflow discharge |             |
| Installed Power                          | kW                            | 4750        |
| Nominal Cyclone Overflow P <sub>80</sub> | µm                            | 75          |
| Gravity Recovery                         | Centrifugal Concentrator      |             |
| Gravity Feed                             | Cyclone underflow (split)     |             |
| Gravity Gold Recovery                    | %                             | 45          |
| Concentrate Grade                        | g/t                           | 250         |
| Pre-Leach Thickener                      | 30 m High Rate                |             |
| Thickener Unit Area                      | t/d/m <sup>2</sup>            | 11.0        |
| Thickener Rise Rate                      | m/h                           | 0.33        |
| CIL Circuit                              | Seven Stage, Hybrid           |             |
| Flow                                     | m <sup>3</sup> /h             | 504         |
| Density                                  | kg/L                          | 1.47        |
| Residence Time Required                  | H                             | 24.0        |
| Anticipated Carbon Loading               | g/t                           | 2,000       |
| Elution/Recovery                         | AARL Strip                    |             |
| Elution Capacity                         | t/d                           | 5.0         |
| Elution Cycle Time                       | H                             | 12          |
| Overall Plant Power Requirement          | kWh/t                         | 42.5        |
| Freshwater Makeup                        | m <sup>3</sup> /t             | 0.59        |



## **17.4 Process Description**

This section describes the parameters used to design a new gravity concentration/CIL plant at the Volta Grande deposit in Para State, Brazil, at a total processing throughput of 6 Mt/a. The process plant is designed to be built in two phases of 3 Mt/a each. The second phase would be commissioned in approximately Year 6 of operations and would consist of replacing the mobile primary crusher with a larger, permanent installation and twinning the existing grinding and leach circuits to double the capacity of the process plant.

### **17.4.1 Process Summary**

The first phase of the Volta Grande processing facility is designed as a nominal 8,400 t/d plant. A front-end loader will tip into a surge bin feeding a primary jaw crusher designed for 75% availability. The crushed ore will be conveyed to a stockpile with 24 hours of live capacity.

The stockpile material is reclaimed by belt feeders and conveyed to the feed inlet of the 30 ft x 15 ft, grate-discharge SAG mill. The SAG mill product is fed by gravity to the combined mill discharge sump. The ball mill operates in a closed circuit with a cyclone cluster. The cyclone pack cuts at a  $P_{80}$  of  $\approx 75 \mu\text{m}$  providing the required liberation for gold extraction by cyanidation. Free gold in the milling circuit is recovered by gravity concentration on a split of the cyclone underflow with the gravity concentrate fed to an intensive leach circuit.

The cyclone overflow reports to a trash removal screen ahead of the pre-leach thickener. Thickener underflow is pumped to a seven-stage cascading CIL circuit. Loaded carbon from CIL is stripped in an AARL elution circuit with the strip solution going to electrowinning.

Washed cathode sludge from the electrowinning circuits is refined to doré in the furnace area.

CIL tailings gravity flow to an  $\text{SO}_2$ -air cyanide destruction circuit. Treated tailings are pumped to the TMF.

### **17.4.2 Detailed Process Description**

The following sections describe the plant layout for the initial 3 Mt/a Phase 1 configuration.



### ***Crushing – Area 100***

Process plant feed will be transferred from the ROM stockpile to the primary crusher surge bin by a front-end loader. A vibrating grizzly feeder at the bottom of the surge bin discharges +150 mm oversize into the primary crusher feed chute. Grizzly undersize drops onto a sacrificial conveyor. The primary crusher consists of a mobile jaw crusher plant with a closed side setting of 150 mm. Crushed ore also discharges onto the sacrificial conveyor discharges onto a transfer conveyor that loads the stockpile.

The crushing circuit is expected to operate at 75% availability on 2 x 12-hour shifts, seven days per week. A dust collection/suppression system is included on the primary crusher.

### ***SAG Milling – Area 200***

Stockpile feed material is withdrawn by four belt feeders in the reclaim tunnel and transfers to the mill feed conveyor. This conveyor discharges via a head chute into the mill feed hopper. The SAG mill feed material size distribution will be monitored and controlled using a high-speed camera system.

The SAG mill is a 30 ft diameter by 15 ft long, grate-discharge mill powered by a single pinion, variable speed, 7500 kW motor. Slurry exits the mill after passing through the mill discharge grate and reports to the cyclone feed sump. SAG mill slurry spillage is collected in a sump and then returned to process by a submersible slurry pump. A common overhead crane serves the milling area.

SAG mill grinding media is stored in a ball bunker located partway along the mill feed belt. The bunker is served with a small spillage pump and a ball loading crane and magnet. Balls are added to mill feed at timed intervals via a ball loading chute.

### ***Ball Milling – Area 300***

The grinding mill consists of an 18 ft diameter by 30 ft long overflow discharge ball mill powered by a 4750 kW, single pinion fixed-speed motor. The discharge end of the mill is fitted with a trommel screen with 10 mm openings. Oversize tramp material, woodchips, etc. drop through a chute into a drum or skip. The material passing through the trommel is collected in a chute and fed to the cyclone pump feed sump.

The mill discharge is diluted with process water in the cyclone feed pump box and is then pumped to a cyclone cluster consisting of ten, 510 mm (20") diameter cyclones; eight operating and two standby.

Cyclone underflow gravitates to a bifurcated chute, which splits out  $\approx 1/3$  of the flow to the gravity circuit with the remainder directed to the feed chute of the ball mill. Gravity feed reports to a 10-mesh guard screen ahead of centrifugal concentration. The screen



oversize and gravity tailings are fed to the mill feed chute. Gravity concentrate gravity flows to the intensive leach feed tank. The cyclone overflow reports to a sampling station that consists of a sampling launder and an automatic sampler. Spillage contained in the ball mill area is pumped to the back to the cyclone feed pump box for re-treatment.

Ball mill grinding media is delivered to the plant in bulk and is stored in the ball mill ball bunker. The ball bunker is serviced by a crawl and electric hoist arrangement allowing balls to be lifted into a kibble using the ball-loading magnet and tipped into the mill via a ball loading chute.

#### ***Pre-Leach Thickener – Area 350***

Cyclone overflow is transferred by gravity to a linear screen with 0.6 mm openings. Screen underflow reports to the pre-leach thickener-sampling box and sampler before entering the 30 m diameter pre-leach thickener for dewatering. This thickener is equipped with a rake lift, bed level detection, and bed mass monitoring. Thickener overflow gravitates to the process water tank for recycling while the thickener underflow, at 50% to 55% solids, is pumped forward to the CIL circuit.

Thickener area spillage is recovered by pumping back to the pre-leach thickener.

#### ***CIL Cyanidation – Area 400***

Thickened cyclone overflow is fed to a circuit of seven 1,680 m<sup>3</sup> (working volume), mechanically-agitated cyanidation tanks. The first tank consists of a cyanide pre-leach, with the remaining six tanks operated as CIL. The tanks are maintained under constant pH control using lime addition, and cyanide concentration is monitored and target levels achieved through operator-controlled peristaltic pumps. Slurry is advanced from one tank to the next using inter-stage screens and carbon is moved counter-currently using carbon transfer pumps to minimize attrition.

Final screened discharge from the last tank in the CIL circuit gravity flows to the detox area. Loaded carbon from Tank #2 is pumped to the carbon recovery screen feed box, which feeds the carbon recovery screen. The washed screen oversize is transferred by chute to the elution circuit. Recovery screen undersize is returned to the CIL circuit.

CIL area spillage is recovered by pumping back to the pre-leach tank.

#### ***Intensive Leach – Area 450***

Gravity concentrate from the ball milling circuit gravity flows to a dewatering cone in the intensive leach area. Underflow from the cone is fed batchwise into a drum reactor



where gold is extracted in a 6 to 8 hour leach at 2% NaCN concentration with oxygen sparging to improve leach kinetics.

Leached solids are transferred to a second dewatering cone with the pregnant solution fed to a dedicated electrowinning cell. The washed residue is pumped to the first stage of the CIL circuit. Barren electrolyte is returned to the leach solution storage tank.

#### ***Elution – Area 470***

Loaded carbon from the CIL circuit is treated, in the elution area, to recover gold and regenerate carbon. Loaded carbon is transferred on a batch basis from a storage tank to the elution column to be acid-washed and stripped using the AARL process.

The pregnant strip solution is transferred in batches to the electrowinning circuit where gold, silver and contaminants are recovered as sludge on the cathode. The sludge is recovered from the bottom of the cell, dewatered in a filter press, and transferred to the gold room for final upgrading to doré bar by an induction furnace. The barren solution from the filter press is recycled to the strip solution holding tank.

Barren carbon is removed from the stripping column and fed by rotary valve to the regeneration kiln. Spillage in the elution area is pumped back into the process at the operator's discretion.

#### ***Cyanide Destruction – Area 500***

Leach tailings are treated in the cyanide destruction circuit, which consists of two agitated 700 m<sup>3</sup> tanks. Cyanide destruction is achieved by the industry standard Inco SO<sub>2</sub>-air process.

Feed to the detox circuit consists of barren CIL tailings at a pulp density of ~50% and a pH of 10.5. In the first tank, the destruction of cyanide is achieved by the addition of sodium metabisulphite solution and copper sulphate catalyst as required. The pH of the pulp is controlled between 8 and 9 with the addition of lime.

The second provides additional residence time to ensure that the reaction proceeds to completion. A weak acid dissociable (WAD) cyanide detector mounted at the overflow of the second reaction tank provides continuous monitoring of effluent quality to ensure that the discharge limit is achieved.

The treated pulp overflows into the tailings pump box, where it is pumped to the TMF.



### ***Services – Area 600***

Process water is stored in a 2,000 m<sup>3</sup> tank and is distributed to the plant by the process water pump. Plant hosing and flushing water is provided by the hose-down water supply pumps.

Clean water is piped into the plant from wells and stored in the plant clean water tank. From the storage tank water is pumped around the process plant for use as reagent mixing water, slurry pump gland seal water and as required for mill lubrication system cooling.

A dedicated compressor provides plant and instrument air. A filter maintains air quality. Instrument air is dried using a refrigeration drier. A receiver is provided for compressed and instrument air lines to allow for surges in demand.

Low-pressure air is supplied to the CIL circuit by two dedicated compressors; one operating, and one standby.

### ***Reagents – Area 700***

#### ***Flocculant – Kemira Superfloc 180 HMW***

Flocculant powder is delivered to site in 1-tonne bags, and stored in the reagent storage area. Bags are lifted by the reagent area crane and added to the flocculant powder hopper. Powder is withdrawn by the flocculant screw feeder and blown through a venturi to a wetting head located on top of the mechanically-agitated mixing tank.

From the mixing tank, mixed flocculant can be fed forward to the storage tanks. A storage tank provides sufficient volume for storage of flocculant while the mixed batch hydrates in the mixing tank. From the storage tank, flocculant is pumped directly to the pre-leach thickener.

#### ***PH Modifier – Calcium Hydroxide***

Lime pebbles are delivered to the plant in bulk and loaded into the feed hopper to a closed-circuit Vertimill. Classifier overflow is diluted to 20% solids and pumped to an agitated dosing tank. A circulation pump supplies lime to the CIL and detox circuits via a ring main.

#### ***Gold Lixiviant – Sodium Cyanide***

Sodium cyanide (NaCN) powder is delivered to site in 1-tonne bags and stored in a bermed secure storage area. Bags are added to the mixing tank via the reagent area hoist and loading chute. NaCN is mixed to 25% solution strength within the tank and then transferred to the ILR storage tank or the CIL dosing tank, ready for distribution.



From the CIL dosing tank, cyanide solution is continuously pumped through a ring main with several dosing points in the CIL area.

*Elution Reagents – NaOH and HCl*

Reagents in the elution section consist of 50% strength caustic solution (NaOH) and concentrated hydrochloric acid (HCl). Both are delivered to the plant in totes and metered into the process directly using peristaltic pumps.

*Cyanide Destruction Reagents – Sodium Metabisulfite and Copper Sulphate*

Powdered sodium metabisulphite ( $\text{Na}_2\text{S}_2\text{O}_3$ ) is delivered to the plant in 1-tonne bulk bags. The bags are emptied into the agitated mixing tank via a feed chute. Mixed metabisulphite solution, at 10% concentration, is pumped to a dosing tank. A peristaltic pump delivers the solution to the cyanide destruction circuit.

If required, powdered copper sulphate ( $\text{CuSO}_4$ ) will be delivered to the plant in 25-kg bags, 40 bags to a pallet. The bags are emptied into the agitated mixing tank via a feed chute. Mixed copper sulphate solution, at 10% concentration, is pumped to a dosing tank. A peristaltic pump delivers the  $\text{CuSO}_4$  solution to the cyanide destruction circuit.



## **18 PROJECT INFRASTRUCTURE**

### **18.1 Infrastructure and Site Layout**

The Project infrastructure consists of the following:

- process plant, mobile equipment and maintenance buildings
- office /administration and support building
- main electrical substation and distribution system
- fuel storage and dispensing
- high voltage power supply
- settling dams and polishing ponds
- raw water storage facility
- tailings management facility
- camp accommodations with cafeteria.

This infrastructure is required to support a Phase 1 (3 Mt/a) open pit operation from 2 pits: Ouro Verde and Grota Seca. A Phase 2 project expansion involves doubling the process plant capacity to 6 Mt/a while mining from the same two pits. The Overall site plan is shown in Figure 18-1.

#### **18.1.1 Mine/Mill Site Operations**

The process plant is located to the south and west of the two open pits. The primary crusher and stockpile are situated near the process plant. Phase 1 would incorporate a crushing system which discharges via a short stacker conveyor onto the stockpile for the 3 Mt/a operation. For the Phase 2 expansion, this unit is replaced by a permanent jaw crushing station with a capacity of 6 Mt/a which discharges to a larger stockpile which feeds the expanded grinding circuit. .

Built in close proximity to the process plant will be administration offices, warehousing, welding shops, a service shop, and a mine equipment / maintenance shop. Refer to the plant site plan Figure 18-2.

**Figure 18-1: Overall Site Layout**

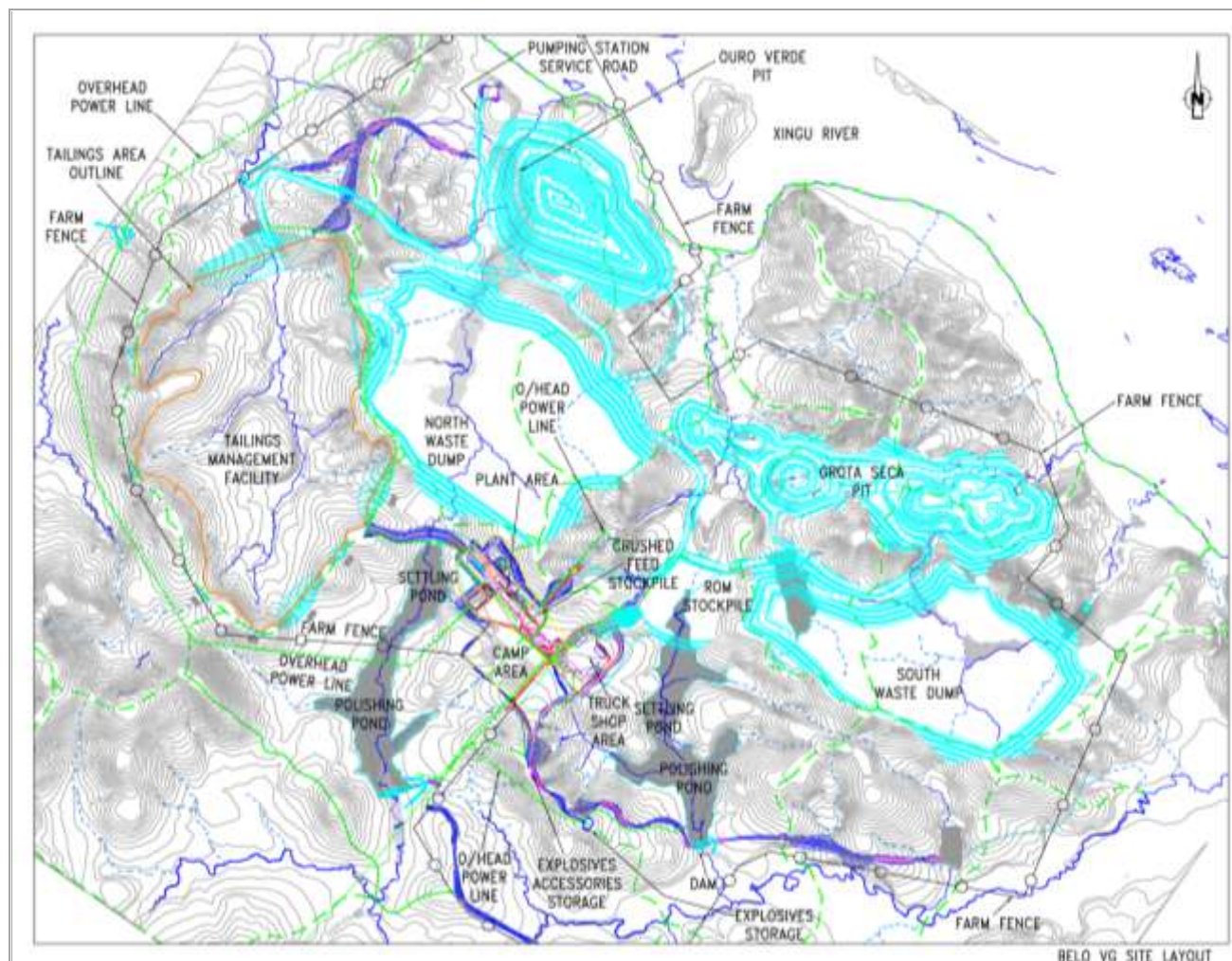
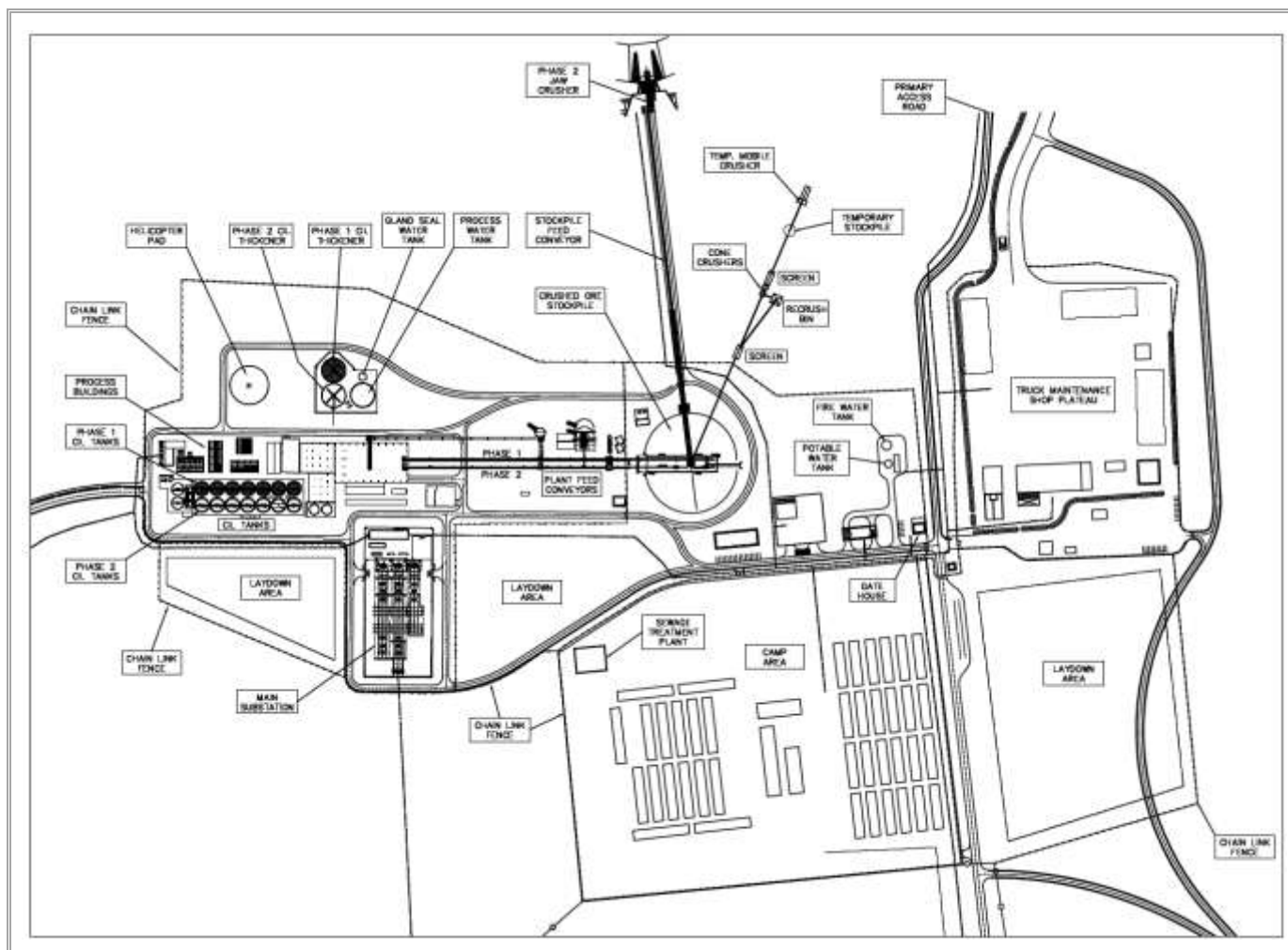


**Figure 18-2: Plant Site Layout**





#### *18.1.2 Warehouse and Office*

The main warehouse and office is located near the process plant. The office section accommodates administrative staff and warehouse personnel. Structures will be prefabricated, flat-packed and sent to site ready for quick erection. In most cases, the buildings will be double storied to limit their footprint.

#### *18.1.3 Truck Shop*

The truck shop will comprise a concrete pad with a fabric structure overhead. Each bay will have its own covering structure. There will be no overhead crane, instead a mobile crane will do the heavy lifts. Alongside the main structure will be an area reserved for servicing light utility vehicles. Separate areas for tire repair and welding will be included.

#### *18.1.4 Camp and Accommodations*

Belo Sun requires accommodation for approximately 300 permanent personnel on shift to operate and maintain the site in addition to temporary accommodation for 1,000 construction personnel at the peak staffing level. These camp structures will also be prefabricated, shipped and erected as described above. The accommodation facilities to support this number consist of the following major components:

- kitchen with dining and wet mess facility
- one 3-bedroom house for general management
- 6 x 2-room integrated bedroom units for senior management
- 4 x 4-room integrated bedroom units
- shared dormitories for the balance of the staff staying on site
- multiple laundry units
- recreation/gym centres
- parking area
- security building.

Additional capacity for permanent staff will be added when the process plant upgrade occurs to accommodate the additional workers.

#### *18.1.5 Security*

The Project footprint is configured to be as small as possible so that security personnel and systems have a minimum area to cover. Security will consist of managing access-



control, using electronic surveillance, physical and visual barriers, fencing, lighting and facility layout.

Security fencing (currently specified as farm fence) will enclose the entire Project site. The plant site, the mining contractor, contractor workshop and office area, and the explosive magazine will have additional security fencing comprising a 2,700-mm high cyclone chain-wire fence with rows of razor wire at the top of the support posts. Separate access control will be provided to the camp area, truck maintenance area, explosives magazine, process plant and electrical substation.

A security contractor will provide electronic security and will be audited by an independent security consultant with experience in gold mines and remote locations.

#### **18.1.6**    *Assay Laboratory*

The assay laboratory will handle samples from the mine and process plant and be built as part of the process facility. It will also be from a prefabricated type, flat-packed and sent to site ready for quick erection.

#### **18.1.7**    *Explosives Storage and Handling*

The explosive storage will be located along a shared road to the southern settling pond at least 1.5 km south of the camp and mill complexes. All explosive related structures will be located within an appropriately barricaded and fenced area in accordance with the applicable standards. The actual magazines will be of the prefabricated container type. They will be placed on a prepared pad with surrounding protective berms as applicable.

#### **18.1.8**    *Roads*

There are sections of the road that would need improvement to facilitate shipping larger items to the site. The site will be provided with approximately 11 km of roads connecting the pits to the processing plant, services complex, camp, water storage facility (WSF), TMF, and explosive storage.

Initial development of the site roads will include access to the TMF for construction purposes. This will be of single lane mining width. When mining starts, the mine fleet will widen these roads with pit material to full operating width of three times the operating width of the mine trucks.



#### **18.1.9 Water Balance System**

Approximately 5,900 m<sup>3</sup>/d of fresh water will be required to satisfy water demand for the process plant. This is pumped from the water storage areas adjacent to the plant site. Recycled water from the tailings basin makes up to 35% of plant process water requirements on average. The water storage facility (WSF) is charged during the wet season from the upstream catchment and from mine water to provide a consistent supply of water year-round.

#### **18.1.10 Service / Potable Water**

Water required for site services will be pumped from the WSF to a water storage tank, and then pumped to the locations where it is required. . Additionally, provision will be made for a well to be drilled, which will supply potable water to the site personnel. A water-testing regime will be put in place to ensure that the quality is maintained at the site.

#### **18.1.11 Sewage Treatment**

Sewage and wastewater will be treated in a standard design effluent plant with the treated effluent discharged to the environment.

#### **18.1.12 Refuse Management**

To minimize both industrial and domestic refuse, a recycling policy will be implemented. Recyclable products will be stored at an appropriate site storage facility and removed on a regular basis. Waste products will be transported to a suitable landfill at the south end of the site.

#### **18.1.13 Power Supply and Distribution**

The anticipated final average power demand for the entire site is 40 MW split approximately 60/40 between Phase 1 and Phase 2. The total HV capacity will need to be installed as part of the upfront infrastructure. The cost for the HV supply to the site will be borne by the utility on a BOOT(Build Own Operate Transfer) scheme. This will add a small premium to the power cost.

Power distribution will be installed in Phase 1. Phase 2 will install new transformers as required for the new grinding mills



The incoming 230 kV to the Project main substation will be stepped down to 13.8 kV and distributed around the site.

Emergency generation sets will be provided to supply energy to specific equipment in the case of power failures.

#### **18.1.14 Communications**

There is no telecommunication infrastructure in the immediate project area at the time of writing.

It is expected that telecommunications will be established by satellite link limited to 4 Mb/s and powered from the plant power supply. This will provide voice, email and internet bandwidth.

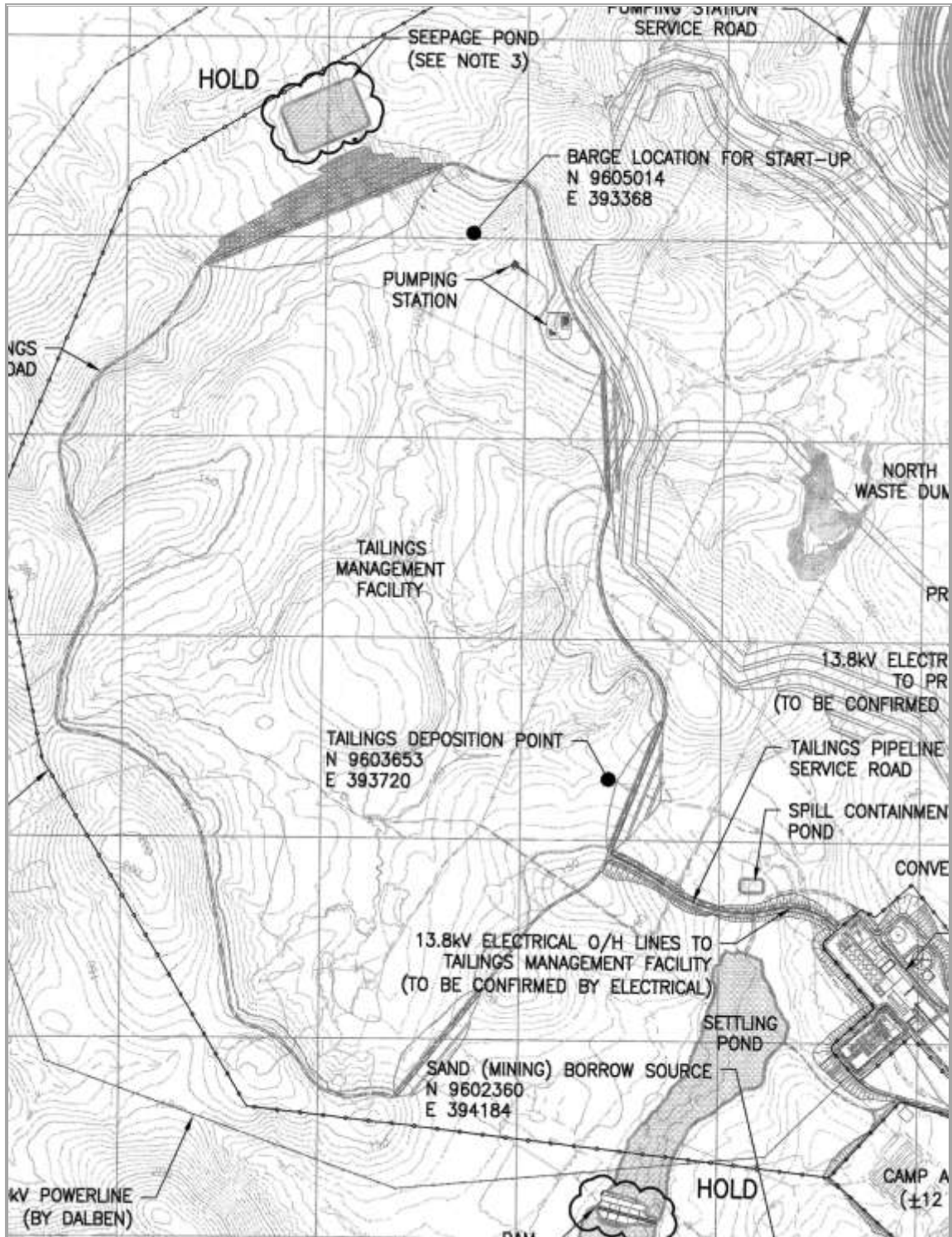
Mobile radios with repeater stations will be used on site for local communications and mine dispatch systems.

### **18.2 Tailings Management Facility**

#### **18.2.1 General**

The proposed TMF is illustrated on Figure 18-3. Detailed design work on this facility will be required in later levels of study.

**Figure 18-3: Tailings Management Facility**





### *18.2.2 Design Basis*

The purpose of the TMF is to provide secure containment of all the tailings solids generated by the milling process. The mill throughput is planned at 3 Mt/a for seven years then ramping to 6 Mt/a for the remainder of the 21 year mine life. Using an average of 1.2 t/m<sup>3</sup> tailings density, the facility has been designed to accommodate about 85.6 Mm<sup>3</sup> of tailings.

### *18.2.3 Tailings Management Facility Embankments*

The tailings dam design for this study considers a single dam initially, situated between topography to maximize stability. This dam will be constructed entirely of saprolite. A total of 190,000 m<sup>3</sup> of fill material is required to construct the initial embankment. Foundation preparation and deforestation of the TMF has been included in the cost estimate.

The initial tailings dam will be constructed in Year -2 to capture water for mill start-up in Year -1. The expansion of this dam will be completed with material from the mining operation and from suitable borrow areas for the filter material. The height of the dam will be 64 metres high when complete.

As the tailings fills the valley, an additional seven saddle dykes are required. Three of those will be completed with mine material. The remaining four saddle dykes are smaller and remote from access to the mine. They will be constructed as part of the sustaining capital.

Geotechnical instrumentation to monitor the dam has been included in the cost estimate.

### *18.2.4 Tailings Distribution and Reclaim Water Systems*

The tailings slurry will be pumped via a pipeline from the process plant to the TMF. Process water will be reclaimed from the TMF and returned to the plant via a dedicated reclaim water barge, with pumps and pipeline.

Both the tailings and water reclaim line will follow the access road from the process plant to the TMF. These will be contained in a membrane-lined ditch outside of the tailings basin. The tailings pipeline will be 14" and the reclaim water 8" in diameter, respectively.



#### **18.2.5 Water Management**

The TMF plays a key role in site water management by providing buffering of process water, direct precipitation and runoff. The effect of evaporation and a final water balance have not been completed for this study; however, they will be required in the next levels of study as the project advances.

Costing for surface diversion ditches around the edge of the TMF has been included in the capital costing. This is to capture and divert water away from the TMF without contact and released back into the environment. This will be directed to the water storage facility where possible or to the natural watercourse below the dam if not possible.

### **18.3 Plant/Mine Site Water Management**

The site drainage will be collected in settling ponds located on the west and eastern side of the process plant. Overflow from settling ponds is collected by a polishing pond before being discharged into the environment.

Mine water collection will be pumped to small settling ponds near the pits. This will be used for dust control on the roads and the excess will be sent to the TMF.

Surface drainage will be diverted away from the mine where possible to ensure contact with active mining areas does not occur. If contact does occur it will be directed to the mine-settling pond.

### **18.4 Waste Rock Management Facility**

The waste rock management facilities are discussed in detail in Section 16.



## **19 MARKET STUDIES AND CONTRACTS**

### **19.1 Market Studies**

Belo Sun has not conducted a market study in relation to the gold doré that may be produced by the Project. Gold is a freely traded commodity on the world market for which there is a steady demand from numerous buyers.

### **19.2 Contracts**

There are no refining agreements or sales contracts currently in place that are relevant to this PEA.



## **20 ENVIRONMENTAL STUDIES, PERMITTING, AND SOCIAL OR COMMUNITY IMPACT**

In preparation for potential mining activities, Belo Sun retained Brandt Melo Ambiente (Brandt) in 2010 to undertake a baseline study of the proposed Project site. The property boundaries and the proposed mine site layout provided by other consultants were used to define the study area for the baseline aquatic and terrestrial studies. The purpose of the baseline study was to characterize existing site conditions, identify potential environmental constraints associated with the Project and to gather information that will support the construction and operational permit applications.

### **20.1 Background**

Considerable environmental study work has been completed for the Project, and mitigation measures have been incorporated in the development of the PEA Study layouts, designs, and operational practices to mitigate potential environmental risks. There have been discussions with the local villages and communities regarding the environmental protection measures Belo Sun proposes to undertake.

Consultations have also been held with the Federal and State regulatory departments on various aspects of the Project, and detailed discussions will continue throughout the permitting process and Project execution.

A Project risk assessment was carried out prior to the PEA Study to identify environmental sensitivities, and a constraints matrix will be developed to help guide project planning. In addition, Environmental Resources Management Ltd (ERM) completed a Gap Analysis for Belo Sun in June 2013.

### **20.2 Geographical Setting**

The Volta Grande property is situated in an area of low topographic relief, generally in the order of 50 m to 100 m. The dominant topographic feature is the valley of the meandering and northeast flowing Xingú and Itatá Rivers, which drain into the main Xingú River tributary at the eastern part of the property. Low-lying areas range between 100 m and 120 m amsl. The Project property encompasses an area of approximately 178,000 ha, 60 km southeast of Altamira, in the municipality of Senador José Porfírio, State of Pará.



The state of Pará, in the Amazon biome, is a very complex environment, both ecologically and socially, with the Xingu River forming a sub-basin of the Amazon River Basin Region. Although part of the municipality of Senador José Porfírio, access to the municipal capital is very difficult due to the distance and available infrastructure. Moreover, the municipality is peculiar, highlighted by territories separated by another municipality, Vitória do Xingu. Because of these logistical issues, the area is dependent on Altamira for supply of goods and services. Figure 20-1 illustrates the territorial fragmentation and logistical challenges.

### **20.2.1    *Physical / Chemical Environment***

Environmental data on the project site area, surrounding regions, and access routes were obtained from literature sources, air photo interpretation, and site-specific investigations of climate, geology, geochemistry, soils, hydrology, hydrogeology, water quality, sediment quality, vegetation communities, fish, and wildlife.

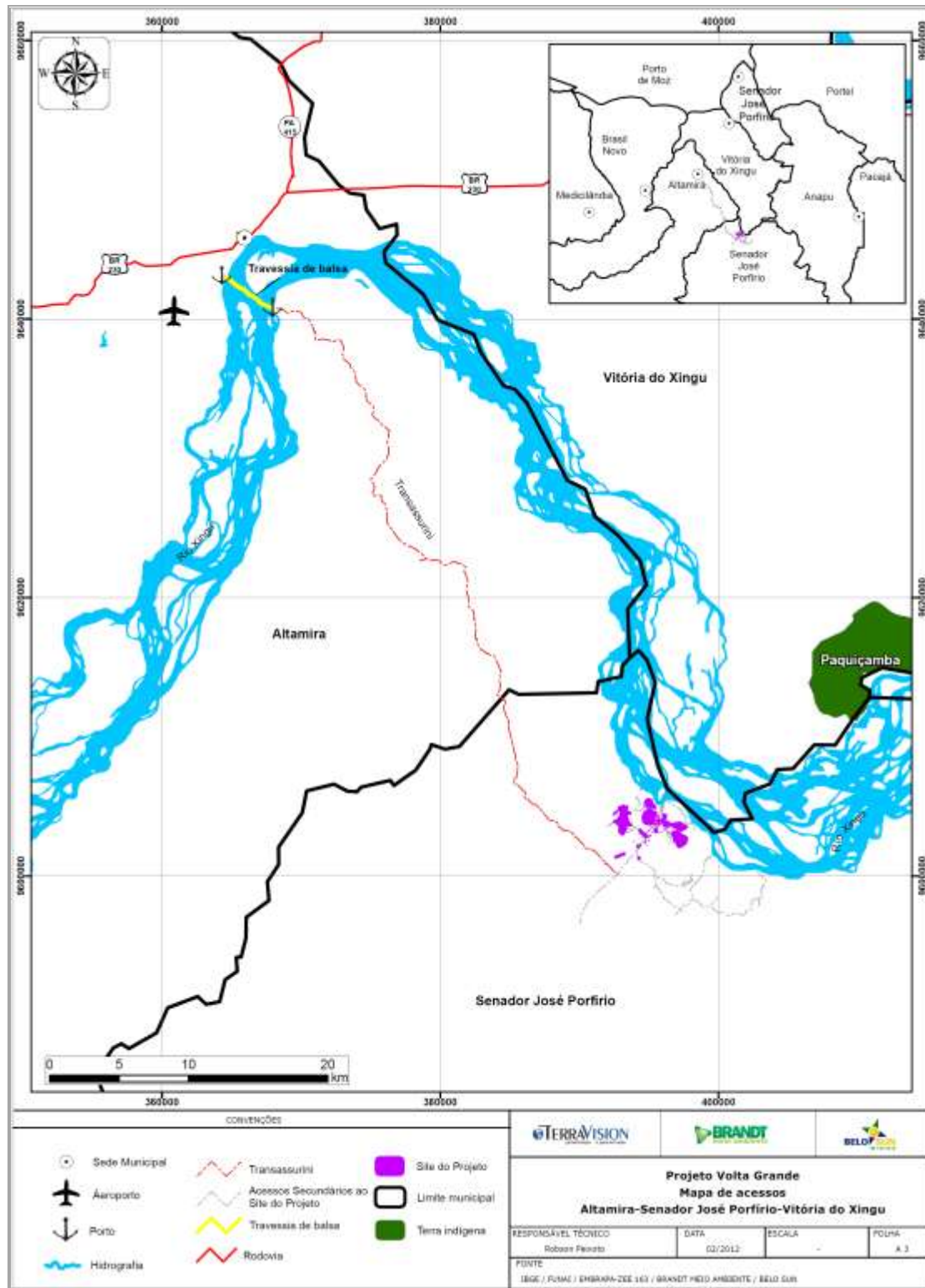
#### ***Climate***

Northeastern Brazil is a tropical rainforest, with the rainy season from January to April, and the dry season extending from June to December. The average length of day light is approximately 8 hours. The mean temperature is almost constant (25°C to 30°C) throughout the year. Relative humidity ranges from 65% to 85%. Average annual rainfall for the region is 2,300 mm, with a monthly average of 191 mm, ranging between the driest season and the very rainy season. In the wet season, the Xingú River may increase up to 5 m above the normal levels.

#### ***Geology***

The Volta Grande area is situated along a major ductile deformation zone within the Três Palmeiras Greenstone Belt. It is underlain by west-northwest-trending and steeply south-dipping gneisses of metasedimentary and/or metavolcanic origin and syntectonic diorite. Occasional chert horizons (chemical sedimentary rock) and banded iron formation (BIF) are included within the metasedimentary sequence. A number of anorogenic granitic plutons are also present along the southern contact of the greenstone belt.

**Figure 20-1: Project Location**





In the Volta Grande area, the Três Palmeiras Greenstone Belt is interpreted to consist of a basal portion of predominantly metasedimentary rock in the southern part of the belt, and predominantly mafic volcanic rock in the northern part, as well as synvolcanic intrusions. The sedimentary assemblage includes thin units of chemical sediments (chert, graphitic sedimentary rock, and oxide-facies iron formation), which serve as marker horizons in the interpretation of the local geology. Both assemblages commonly exhibit strong penetrative fabric (foliation and lineation) as well as metamorphic banding. In places where the rock has undergone migmatization, mylonitic zones with associated silicification are commonly observed.

The volcanic, sedimentary, and syntectonic rocks in the project area have been affected by a widespread hydrothermal alteration event. Surficial alteration is present in an extensive layer of red saprolite, which covers the entire property, including topographic highs and lows.

In general, subsurface geology can be interpreted from the subtle colour differences of the overlying saprolitic material, as follows:

- dark brick red to brown colour resulting from the weathering of underlying metavolcanic and metasedimentary rocks
- red to brown colour resulting from the weathering of underlying granodioritic rocks
- pale brown to beige colour resulting from weathering of the underlying gneisses of the Xingu Complex.

Observations on outcrops, drill core, and mineralogical (thin section) work show that the alteration assemblage within the red saprolite consists of clay minerals, opaque minerals (mainly pyrite and chalcopyrite), quartz, iron oxides, such as limonite.

## **20.2.2 Biological Environment**

### ***Vegetation***

The property is moderately forested; predominant soils are the yellow argisoles and latosol of low natural fertility. The vegetation that develops in these soils includes several variations of the Ombrophylous Forest.

In the studied area, the vegetation is already severely altered, showing different stages of natural regeneration. These changes are due to logging and the consequences of poorly planned and extended cattle farming. However, most of the biota's studied area is still occupied by forest formations without, or virtually without, disruption. The fragments, formed mainly due to the opening of pastures, are large and have high



potential for ecological connectivity. The area is configured as a central barrier to terrestrial fauna having scarce riparian vegetation in the middle of pastures providing low permeability to the movement of fauna. This is the biggest problem detected for the biota. Without actions to re-establish the proper connection between fragments of the area, the tendency of wildlife in this region will be the fauna drift.

#### ***Wild and Aquatic Life***

The predominant wildlife found in the area includes various primate species, including the howling monkey, the carnivores—puma and black panther—red turkeys, anteaters, deer, and molluscs. There are also numerous species of insects, including mosquitoes and ticks, and various snakes, fish—including piranhas, reptiles, and rodents.

### **20.3 Belo Sun's Corporate Policies and Standards**

This section outlines the Belo Sun corporate policies that apply to the Project. Belo Sun voluntarily adheres to certain international standards and guidelines, as well as to its corporate sustainable-development framework.

These policies provide the framework necessary to ensure that the Project is implemented in an ethical, safe, responsible, and open manner that protects the environment, and engages, in a meaningful way, employees, communities, regulatory agencies, and other stakeholders.

Belo Sun recently issued its HSEC and corporate social-involvement policies, one of which is its commitments to its employees. The sustainable development policy introduces Belo Sun's commitments to reflect its global leadership position. It also further integrates Belo Sun's commitment to communities and the broader societies within which they operate, and sets these within a context of sustainability. In addition to its commitment to the goal of sustainable development, Belo Sun strives to balance social, environmental, and economic considerations in how it manages its business.

As stated by Belo Sun, the primary components of its HSEC policy are:

- Belo Sun Mining insists that the Health, Safety, and Well-Being of every person associated with our operations is our highest priority.
- Our vision of Zero Harm is a core value. We believe that working together towards the effective realization of the health and safety policy provides the best opportunity to achieve our vision of Zero Harm.
- We believe that all incidents with the potential to cause harm to people and property are avoidable and we are committed to providing diligent leadership



and applying appropriate resources to promote and manage the health, safety and well-being of every employee, contractor's employee and bonafide visitor who enters our site or workplaces.

- We willingly accept responsibility for ensuring that every employee, contractor's employee and bonafide visitor who enters any of our site or workplaces has the appropriate knowledge and ability to safely perform their duties in a healthy and safe manner and to apply appropriate diligence to the workplace and all associated with it.
- We will continually strive to improve our health and safety systems and will hold ourselves accountable through audit, verification and reporting health and safety performance.
- We require all employees, contractor's employees and visitors to any of our sites or operations to be proactive health and safety leaders, appropriating the effective identification and reporting of hazards, the control or elimination of the risk and the maintaining of the best possible practice to promote the health, safety and wellbeing of themselves, and their fellow workers, visitors and the company.
- We require that all employees, contractors and visitors who enter our site or workplaces understand their Duty of Care and their requirement to share in the responsibility for the effective holistic management of their own health, safety and wellbeing, and the health, safety and wellbeing of all others.

Belo Sun's vision is to strive to be a respected leader in social responsibility, which it believes to be essential to its business success, and to build relationships based on trust and open, honest communication.

To realize their commitment to social responsibility, Belo Sun commits to:

- Complying with; as a minimum standard, all applicable legal requirements and commitments to which we subscribe.
- Acknowledge all cultural and other human rights that are relevant to our operations and ensure all levels of the workforce are provided with training to understand and respect these rights.
- Demonstrate our commitment to Indigenous rights by acknowledging and respecting local cultural beliefs and aspirations.
- Engage stakeholders on their concerns, aspirations, and values regarding the development, operational, and closure aspects of mineral projects, recognizing the strong links between economic, social, and cultural issues.



- Communicate openly and honestly to all stakeholders about our performance in a timely manner.
- Integrate social considerations into all aspects of the company's business decisions and activities, including exploration, project development, mine operation, mine expansion, acquisitions, divestments, and mine closures to avoid or mitigate adverse social impacts.
- Develop, implement, and maintain Corporate Standards and procedures to mitigate the risk of misleading communication to communities and stakeholders.
- Share economic benefit by maximising local procurement and enterprise development, local employment, training, and community development opportunities with local communities.
- Committed to mining practices focused on sustainable economic development, and to work with our employees, their families, the local communities in which we operate, and society at large to improve the quality of life in a way that is both good for local economic development and our shareholders.
- Identify social impacts by conducting regular audit and assessment programs, and to develop and implement continuous improvement plans to manage the significant impacts, risks, and opportunities.

Belo Sun's Vision is to integrate and promote sustainability in all facets of the company, through implementing environmental responsible practices throughout every level of their business.

Belo Sun acknowledges and believes that effective environmental management is paramount to a successful future. To promote our commitment to Environmental Management, Belo Sun commits to:

- comply with all corporate requirements, environmental legislation, licences, and regulations
- develop and maintain a comprehensive and effective Environmental Management System to maintain a sustainable environmental focus
- integrate the highest level of environmental consideration, strive to employ the best possible environmental management practices, and foster mutually beneficial environmental partnerships in all phases of our operations
- conduct business in a manner that minimizes any potential environmental impacts



- instil a behaviour of primary environmental performance responsibility in each person involved in our operations
- foster mutually beneficial environmental partnerships with host communities
- implement and maintain a culture where appropriate environmental, social, cultural, and economic considerations are effectively integrated into all planning and decision making processes
- seek continuous improvement in the management and use of resources in environmentally sustainable exploration, mining, processing, waste management, and rehabilitation
- understand, encourage, and promote eco-cultural and cross cultural awareness, and wherever able, identify protect sites of environmental or cultural significant
- maintain appropriate and effective communication with landowners locals and other stakeholders, who may be directly affected by our operations
- provide for the reclamation and rehabilitation of areas affected by our operations, considering future end land use.

To fulfill their commitment to the environment, Belo Sun aims to continually improve their environmental performance by regularly:

- reviewing objectives and targets
- monitoring performance against objectives and targets
- evaluating all environmental risks and striving to implement appropriate controls.

## **20.4 Permitting Requirements**

Discussions with the Pará state government in 2010 began prior to the advanced exploration program and are still ongoing. The lead agency is State Secretary of Environment of Pará (SEMA). Permits have been granted to enable site exploration and related activities (such as hydrogeological investigations) to take place, and officials have been apprised of Project planning related to the feasibility studies.

Working closely with SEMA, Belo Sun has identified the key environmental licensing requirements. The environmental license is the document, with a set expiration date, in which SEMA establishes rules, conditions, restrictions and environmental control measures to be followed. Upon receiving the Environmental License, Belo Sun assumes the obligations for maintenance of environmental quality at the project site and in surrounding areas.



The licensing process consists of three types of licences. Each is required at a specific step of licensing, namely:

***Preliminary Licence***

The first stage of licensing, wherein the licensing agency evaluates the location and design of the Project, confirms its environmental viability, and establishes the basic requirements for the next phases. The LP was approved in December 2013 and issued in February 2014. Certain conditions have been attached to the licence that Belo Sun is currently addressing.

***Installation Licence***

Once the initial design has been detailed and the environmental protection measures set out, the Installation Licence (LI) will be required, the grant of which authorizes the commencement of construction of the development and installation of equipment. The implementation of the Project should be done according to the model presented. Any change in the plant or systems installed must be formally submitted to the licensing agency for prior review and approval.

***Operating Licence***

The Operation Licence (LO) authorizes the operation of the enterprise. This will be required when the Project is installed, and after verifying the effectiveness of measures to control environmental conditions established in the previous licences. In the LO restrictions are certain control methods and operating conditions.

## **20.5 Construction Site Environmental Management Plan**

The construction site environmental-management plan (CSEMP) comprises an overall, governing environmental-management system for construction, supported by a series of environmental management plans (EMPs) for construction of the Project.

The EMPs for construction will include:

- water management plan, including storm water management, watercourses / water body protection, construction water, potable water, domestic sewage, water balance and monitoring
- hazardous materials management plan, including procurement and purchasing, receiving procedures, transport, storage, training, personal protection equipment, monitoring, auditing and emergency response
- waste management plan, including waste characterization and quantities, waste management and disposal facilities, and monitoring



- environmental protection plan, including surveying; cutting and clearing, grubbing and stripping; quarry and borrow source areas, erosion and sediment control, protection of watercourses and wildlife, archaeological and cultural heritage resources, dewatering, blasting, waste management, and dust control.
- environmental incidents response plan.

The CSEMP is intended to provide guidance to construction contractors, subcontractors, vendors, suppliers, and workers regarding the environmental requirements for the construction of the Project. It is a dynamic tool intended to permit a quick response not only to planned construction site activities, but also to unforeseen factors that can arise during the work, and which require an immediate response.

The CSEMP is designed to meet requirements pursuant to the laws and regulations. It permits a prompt response to any environmental disturbance to the surrounding area, through implementation of measures designed to alleviate or to compensate for any unanticipated impact. It provides a structured framework for the proactive identification and elimination, or acceptable management of, environmental issues that may be associated with executing the Project work scope.

The CSEMP describes the activities and resources that the EPCM contractor is required to apply during the construction of the Project, to minimize and prevent any environmental impact on the surrounding area. The CSEMP will be updated in later phases to include those activities and resources required to meet any subsequent commitments made in the EIS, and any terms and conditions of approval for environmental permits that are applicable to the construction of the Project.

The CSEMP is applicable to all employees and contractors while on the project site and associated support facilities during construction.

## **20.6 Environmental Data**

Several environmental baseline and assessment studies have been conducted in support of the EIA as well as the design to ascertain the existing conditions of the natural and social environment, identify the potential impacts that may occur as a result of the development, and develop mitigation measures to eliminate or lessen the impacts on the natural and social environment.

The objectives of the baseline studies were to:



- describe the existing physical, biological, and socioeconomic conditions, as well as trends in areas potentially affected by the Project, to understand potential impacts, and develop appropriate mitigation and management measures.
- describe the geochemical characteristics of the mineral resource extraction process, and the mine wastes that the Project will generate, to develop an understanding of the factors that could affect the environment
- establish benchmarks for monitoring programs that will be implemented during the construction, operation, closure, and post-closure phases of the Project, such that these impacts can be iteratively addressed as necessary as the Project proceeds
- interact, in the course of baseline data collection, with potentially affected populations to exchange information on the Project, and to provide people the opportunity to express their concerns and preferences with regard to the project development.

Baseline data collection programs included:

- climate
- geology and landscape
- hydrology
- hydrogeology
- water quality
- air quality, noise, vibration, and light
- biology, including terrestrial and aquatic resources
- soils and geochemistry
- waste rock and tailings
- social and archaeological baseline.

## **20.7 Product Stewardship**

As part of Belo Sun's governing environmental responsibilities, it will develop a product stewardship program that involves the care and management of a product through its life cycle, ensuring, to the extent reasonably practical, that all materials, processes, goods, and services are managed in a socially and environmentally responsible manner.

Belo Sun will adopt an integrative stewardship approach to resource management / use, material selection / use, and processes whereby the impacts of these are reduced, to the extent reasonably practical given other considerations. Recognizing that Belo Sun will



not always have direct control of the full life-cycle of their product, Belo Sun will build partnerships or select suppliers or services that address sustainable development considerations.

For the Project, this includes such activities as:

- ensuring topsoil conservation for on-site works
- reducing sand requirements for construction to the extent possible, thereby reducing the environmental footprint of sand pits
- re-using products, to the extent practical, including at closure, e.g., identifying end uses for mobile equipment at closure
- inventory control measures to avoid oversupply, which may result in unused product or parts entering into the waste stream
- working with suppliers to reduce unnecessary packaging, or entering into agreements and partnerships with suppliers to take back and dispose of wastes, particularly hazardous wastes, generated from their products.
- assuring that service providers have the processes, procedures, and facilities in place to ensure that hazardous or other wastes being shipped offsite are transported and disposed of in an environmentally responsible manner.

The philosophy is to develop strategic relationships with Belo Sun's suppliers based on the principles of healthy competition, lowest total cost of ownership, continuous improvement and a mutual focus on health, safety, and the environment.

## **20.8 Environmental Risks**

Risk management is the practice of assessing risks and implementing action plans to monitor and control them. Belo Sun has stated that risk management is an important part of its operating strategy. Formal reviews are undertaken to identify and assess risks, including:

- context definition
- risk identification
- analysis (likelihood; type of risk)
- risk evaluation (risk response planning)
- recording and ranking of risks



- risk treatment, including tracking identified risks, monitoring residual risks, identifying new risks, testing and executing response plans, and evaluating their effectiveness.

This information is used to guide developing and adopting designs to mitigate the risks. Prior to the PEA Study, a number of environmental risks were identified, including:

- Environmental Health Risks - The largest potential threat to environmental health will be the potential for inadvertent spills associated with the handling and transportation of fuel and consumables as well as truck and mobile equipment transport and transfers. Design and procedural safeguards will be documented through the CSEMP to ensure that significant spills do not occur.
- From a more general environmental perspective, there will be some degradation of terrestrial habitats within the area of site operations, mainly due to the direct displacement and disturbance of habitats associated with facility construction and related infrastructure. These impacts are unavoidable, but can be mitigated through proper planning.
- Cumulative Effects – at present, there are no other potential industrial developments in the general vicinity of the Project that would result in foreseeable cumulative impacts. The potential for future gold operations in the area cannot, however, be discounted. Cumulative effects relating to the Belo Monte power Project are likely to be minimal especially once construction at Belo Monte is completed.
- Accidents and Malfunctions - there are some aspects of project design that warrant further scrutiny as planning proceeds. These include:
  - risk of fuel spills within the Xingu river zone (because of the extreme consequence)
  - risk of consumable spills within the Xingu river zone (because of the extreme consequence)
  - risk of fuel spills associated with truck transport (particularly at creek and river crossings)
  - risk of tailings management facility dam failure, resulting in a sudden and uncontrolled release of effluent to the environment
  - risk of untreated water entering the receiving water environment
  - risk of fire to the natural environment and to facility infrastructure.

Management systems will be in place to mitigate most environmental risks and to limit consequences. The CSEMP will include emergency response plans to mitigate potential environmental effects in the event of a spill.



## **20.9 Ethics**

The Project has adopted the Belo Sun code of ethics.

Belo Sun has committed to robust and accountable corporate governance, operating within a framework that includes integrity, regulatory compliance, human rights, and fair business practices, free of bribery or fraud. Belo Sun considers it to be each person's responsibility to voice through their supervisor any concerns about compliance with Belo Sun's business principles, or, if that is not possible, through an anonymous, independently run '*ethics line*' that will be set up before construction begins on the Project site.

## **20.10 Stakeholders**

The project stakeholders include the investment community; employees; contractors; unions; national, regional, and local governments, intergovernmental bodies; regulators; communities associated with project operations; business partners; non-governmental and development organizations; suppliers; customers, and media.

Belo Sun has and will continue to apply a very broad range of methods to engage stakeholders and encourage dialogue and feedback throughout all phases of the Project. These include:

- face-to-face formal or informal meetings
- social and environmental impact assessment
- presentations to local communities and government authorities
- community engagement to assess community needs and priorities; and social involvement in resettlement planning
- alignment of sustainable development policies, practices and procedures amongst the owners, operator, principal contractors, and suppliers
- Belo Sun's website
- newsletters, circulars, and email updates
- dedicated e-mail and telephone facilities
- employee or multi-stakeholder forums and workshops
- group and commodity business intranet and extranet sites
- site visits
- reputation audits and perception studies
- whistle-blowing channels and formal grievance mechanisms
- financial and sustainability reports



- regular, customer, and supplier meetings
- formal consultation and audit processes.

Community engagement is a continuous process throughout the life of the mine, to receive public input and address concerns. Activities vary depending on the stage of an operation. More meetings are held during development and construction activities; sometimes government or community meetings occur weekly. Once the mine has been operating for a number of years, meetings may involve, for example, quarterly community / regional council updates and public advisory meetings. During pre-closure and closure, the number and type of community engagement activities will change again, as the changes to the operations and the plans for closure are explained.

To date several formal consultations have been held with the Municipality. The first meetings started in 2011 when plans were being developed for the advanced exploration program at the project site. Since that time, there have been numerous meetings with the municipal leadership and the general community to share information and obtain agreement from the community on the feasibility studies design and EIA concepts.

## **20.11 Environmental Compliance**

Since Belo Sun may be dependent on debt financing to develop and implement the Project it is Belo Sun's intention to strictly comply with all international sustainable development principles and standards through the conditioning of its loans. These conditions typically come in two forms:

1. EIAs use to screen projects in advance of approval
2. Imposing operating conditions and requirements on projects to promote sustainable development.

The first requirement of lenders is an EIA report to enable them to evaluate if environmental and social risks have been appropriately identified and addressed. A number of lenders have agreed on an approach to this assessment process. Should a loan be agreed, additional requirements may be imposed on the Project by means of conditions attached to the loan.

It is likely that any lender will appoint an independent reviewer to evaluate the EIA process taken and the results obtained. Ongoing independent review, throughout the life of the loan agreement, may also be required. In June 2013, Belo Sun received the results of an independent GAP Analysis completed by ERM. This forms part of the overall package of work being undertaken by Belo Sun.



### *20.11.1 Equator Principles*

The Equator Principles were published in June 2003 with the aim of providing an approach to determining, assessing, and managing environmental and social risk in Project financing. The intention of the Principles was to ensure projects receiving finance were developed, operated, and closed in a socially responsible manner, reflecting sound environmental-management practices.

Principle 1 of the Equator Principles divides projects into different categories. Category A and B projects are subject to an Environmental Assessment (EA), while Category Cs do not require an EA. Category A projects, and to the extent determined by the lenders, Category B projects, will be subject to implementation of an EMP, drawing on the conclusions of the EA. The category determines the depth of the EA and EMP. The Category A EAs and EMPs are subject to independent, expert review. Normally, Greenfield mining projects are classified as Category A due to the likelihood of significant environmental and social impacts. For the purposes of this document and the EIA process followed, it is assumed the Project is categorized as such.

Principle 3 specifies that, for projects located in non-Organization for Economic Cooperation and Development (OECD) countries, and those located in OECD countries not designated as High income, the EAs will refer to the applicable Performance Standards (PS) of the International Finance Corporation (IFC), and the World Bank Group Environmental, Health, and Safety Guidelines (EHS Guidelines). Thus, both the PS and the EHS Guidelines are considered applicable to the Project and the requirements are discussed further below.

### *20.11.2 EHS and Other Guidelines and Standards*

The EHS Guidelines were published in 2007 and 2008. They comprise technical reference documents, with general and industry-specific examples of Good International Industry Practice (GIIP), as defined in IFC's Performance Standard 3 on Pollution Prevention and Abatement. The EHS Guidelines are updated on a regular basis.

Both the Performance Standards and the EHS Guideline go on to make reference to other national and international guidelines and standards. The guidelines and standards were used by the Project's design team.

### *20.11.3 Project Socio-Environmental Policy*

Planning and development of the Project's mine facilities and off-site infrastructure will be governed by Brazilian state and federal regulations and permitting procedures.



Beyond meeting and exceeding the national-level legal requirements, the Project is committed to a standard of international best practice for sustainable development, in accordance with Belo Sun's corporate policies. To this end, the Project will generally adopt relevant Canadian environmental standards as voluntary compliance targets for components within Brazil, to the extent that they do not contravene any equivalent Brazilian regulations.

Project facilities in Brazil will generally be designed to meet World Bank and World Health Organization (WHO) environmental guidelines, in addition to Brazilian and Canadian regulations. The Project will also meet any conditions of approval associated with government permits and licences issued to the Project. These regulatory and permit requirements are legal Project commitments, and any deviation from the Belo Sun will seek prior approval from relevant government authorities.

The Project's socio-environmental policy is generally to adopt the most restrictive of these regulations and guidelines for establishment of the project environmental design limit values.

The Project will also establish certain sustainable-development objectives based on selected community development initiatives designed to improve specific socioeconomic conditions in and around Project facilities in Brazil.

## **20.12 Waste Management**

A waste management plan will be developed for the Project that meets Brazilian legislation and the IFC Guidelines for Hazardous Materials Handling for International Projects.

The EMP will include a waste management plan developed for safe handling and storage of materials in a manner that minimizes the potential for accidents, and provides for rapid mitigation of accidental releases. Wastes include domestic and industrial wastes, both hazardous and non-hazardous, as well as incinerator wastes.

The plan also addresses management of waste rock from mining, which will be stored on site. The plan requires that the waste rock storage area is designed, regularly inspected, and repaired as necessary such that potential environmental impacts are minimized.

The TMF area will be constructed and managed to incorporate spill-protection systems, including containment. Regular inspections and maintenance will be conducted to ensure the integrity of the dam structure. TMF management includes developing an operating, maintenance, and surveillance manual defining procedures for the safe



operation, maintenance, and surveillance of the tailings and water management throughout the facilities' life cycle.

## **20.13 Crisis Management**

The EMP will also include a preliminary environmental incident response plan (EIRP) which will reflect Belo Sun's environmental policy for implementation in the event of an environmental incident during construction. Belo Sun's environmental policy will require site personnel to take all the measures necessary to implement pollution prevention, comply with all applicable environmental laws and regulations, and thereby reduce the environmental consequences of an accidental discharge of contaminants. An environmental incident is defined as the accidental discharge of solids, liquids, or gases that are potentially harmful to the environment. Typically, these involve hydrocarbons, such as fuels, oils, solvents, and lubricants from motorized vehicles, mechanical equipment, or containers (e.g., portable tanks, fixed or mobile tanks, piping) at the work site, including workshops, garages, tank farms, and storage areas. The EIRP also applies to fire, explosions, noise, odours, paint, acids, bases, pesticides, gasses, other chemical products, and contaminated water emanating from the worksite.

An environmental incident may occur in the context of an emergency having potential health and safety consequences. In the event of such an emergency or incident, the health and safety of people takes precedence over all other considerations. Personnel responding to an environmental incident must first ensure their personal safety and that of others present at the incident site. It is absolutely critical to determine the nature of the incident as quickly as possible to act properly to protect the safety of those present and then to limit the environmental consequences of the incident.

The EIRP focuses on avoiding or limiting adverse environmental effects in the event of environmental incidents.

## **20.14 Closure and Rehabilitation**

Under the current mine plan for the Project, mining operations at the Project site are expected to continue for approximately 21 years. The Project closure and rehabilitation plan (C&RP) will address closing the mine and rehabilitating the mine site, as well as off-site infrastructure, at the cessation of operations.

The C&RP will focus on the engineering works and rehabilitative aspects of closure, along with the complex set of socioeconomic issues associated with mine closure and its impact on the community.



The principal goal of the closure planning process will be to ensure that the potential environmental impacts and risks of the decommissioned mine (together with associated financial and legal liabilities) are identified early on in the process, and measures are implemented to avoid or minimize these impacts and risks through the facility site, design, and operations of the Project. The primary objectives of the C&RP are to:

- achieve chemical, physical, and biological stability, in accordance with applicable regulations and standards, as soon as practicable
- protect the health and safety of the public over the long term
- avoid or minimize long-term environmental impacts
- restore disturbed land and watercourses as soon as possible and as close to pre-development conditions, as practicable
- minimize long-term site and facility maintenance requirements
- with input from the consultations with local communities, government agencies, and other stakeholders, develop an end-use plan, which is beneficial to the local communities and maximizes sustainable development
- provide a basis for estimating cost for closure.

The C&RP will continue to be developed throughout operations, incorporating new monitoring data, advancements in rehabilitation techniques / technologies and local community input regarding end uses.

## **20.15 AGP Comments**

AGP has not reviewed the Environmental Investigation Assessment (EIA) prepared by Brandt, or has it ascertained whether the submission to SEMA, the Pará State Environmental Agency, complies with applicable Brazilian regulations and laws. As such, AGP cannot be assured of the success of the permit application.

AGP recognizes that although the environmental, permitting, and socioeconomic studies and reporting completed by Brandt may comply with Brazilian regulations, there may still be shortcomings with respect to the Canadian regulatory reporting requirements as per NI 43-101. It is recommended that in future studies and reports emphasis be placed on—costing of current environmental liabilities; detailed costing and funding of mine closure plan, including ARD/ML considerations (should they exist); explaining detailed permitting requirements; additional socioeconomic impact assessments; and enhanced baseline studies.



## 21 CAPITAL AND OPERATING COSTS

### 21.1 Capital Costs

#### 21.1.1 Summary

The capital costs for the Project are summarized in Table 21-1. All costs are expressed in Q4 2013 United State Dollars (US\$). The Brazilian Reals to United States Dollar exchange rate was R\$2.35 to US\$1.00 for this estimate. The costs are based on the estimate for an initial 3 Mt/a processing plant which is expanded to 6 Mt/a with construction of the expansion starting in Year 6 and production on line in Year 8. The mine has a 21-year processing life.

**Table 21-1: Capital Cost Summary**

| Capital Category       | Preproduction Capital<br>Year -3 to Year -1<br>(\$M) | Production Capital<br>Years 1 - 5<br>(\$M) | Sustaining Capital<br>Year 6 - 21<br>(\$M) | Total Capital<br>(\$M) |
|------------------------|------------------------------------------------------|--------------------------------------------|--------------------------------------------|------------------------|
| Open Pit Mining        | 12.6                                                 | 5.4                                        | 32.8                                       | 50.8                   |
| Processing             | 114.4                                                | 0.8                                        | 87.0                                       | 202.3                  |
| Infrastructure         | 76.0                                                 | 6.4                                        | 12.4                                       | 94.8                   |
| Environmental          | -                                                    | -                                          | 10.0                                       | 10.0                   |
| Indirects/Owners Costs | 68.9                                                 | 16.1                                       | 61.5                                       | 146.5                  |
| Contingency            | 28.4                                                 | 6.6                                        | 33.5                                       | 68.5                   |
| <b>Subtotal</b>        | <b>300.3</b>                                         | <b>35.3</b>                                | <b>237.2</b>                               | <b>572.9</b>           |
| Importation Tax        | 28.4                                                 | 4.4                                        | 31.4                                       | 64.1                   |
| <b>Total</b>           | <b>328.7</b>                                         | <b>39.7</b>                                | <b>268.6</b>                               | <b>637.0</b>           |

Initial capital requirements (pre-production) are estimated to be \$328.7 million. Production starts in Year -1 with the plant commissioning and full production for Year 1. It is anticipated that operating net revenue will pay for the plant expansion in Year 6 to increase the plant throughput. The time to expand the plant is estimated at 18 months. At that time, a new mining fleet will be purchased to accommodate the increase in production.

Mining capital costs include a 20% down payment for the mining lease. Leasing is assumed to continue for the entire mine life as an expensed operating cost.

The indirect and contingency percentages are shown in Table 21-2.



**Table 21-2: Capital Category Indirect and Contingency Percentages**

| Capital Category | Indirects (%) | Contingency (%) |
|------------------|---------------|-----------------|
| Open Pit Mining  | 10.0          | 10.0            |
| Processing       | 40.0          | 15.0            |
| Infrastructure   | 45.0          | 15.0            |
| Environmental    | 5.0           | 15.0            |

### 21.1.2 Open Pit Mining Capital

The open pit capital costs are based on conventional open pit mining equipment. Costs for the equipment come from quotations provided by the various equipment vendors. Production drills with 200 mm down-the-hole (DTH) hammer bits will be matched with 14.5 m<sup>3</sup> front-end loaders initially. The truck fleet will have 90 tonne capacity and be equipped with suspended dump bodies for reduced carry back and abrasion resistance. When the plant capacity increases to 6 Mt/a, the mine equipment is upgraded to larger units. The drills remain the same size but the loading units increase to 18 m<sup>3</sup> front-end loaders and 22 m<sup>3</sup> hydraulic shovels. The truck size also increases to 136 tonne units with suspended dump bodies. Support equipment sizing remains the same for the track dozers, graders, support backhoes, pumps, and additional equipment.

The capital costs for the open pit reflect only the 20% down payment required for leasing. The remaining cost of the mining equipment units is carried in the operating cost under the leasing cost category. Pre-production mining costs are treated as an operating cost and therefore are not capitalized. Table 21-3 and Table 21-4 show the open pit capital unit costs by equipment and by period.

**Table 21-3: Major Equipment – Open Pit Capital**

| Equipment        | Unit           | Capacity | Unit Cost for Lease (\$) | Operating Life (h) |
|------------------|----------------|----------|--------------------------|--------------------|
| Production Drill | mm             | 200      | 2,357,000                | 40,000             |
| Front-End Loader | m <sup>3</sup> | 14.5     | 2,802,000                | 35,000             |
| Front-End Loader | m <sup>3</sup> | 18.0     | 5,093,000                | 35,000             |
| Hydraulic Shovel | m <sup>3</sup> | 22.0     | 6,576,000                | 60,000             |
| Haulage Truck    | t              | 90       | 1,732,000                | 60,000             |
| Haulage Truck    | t              | 136      | 2,536,000                | 60,000             |
| Tracked Dozer    | kW             | 433      | 1,468,000                | 35,000             |
| Grader           | kW             | 233      | 856,000                  | 20,000             |
| Support Backhoe  | kW             | 390      | 908,000                  | 10 years           |



**Table 21-4: Open Pit Capital by Period**

| Equipment                              | Total Capital (\$) | Preproduction Capital Year -3 to Year -1 (\$) | Capital Year 1 - 5 (\$) | Sustaining Capital Year 6 - 21 (\$) |
|----------------------------------------|--------------------|-----------------------------------------------|-------------------------|-------------------------------------|
| Production Drill                       | 4,243,000          | 471,000                                       | 943,000                 | 2,829,000                           |
| Front-End Loader – 14.5 m <sup>3</sup> | 3,923,000          | 1,121,000                                     | 1,682,000               | 1,120,000                           |
| Front-End Loader – 18 m <sup>3</sup>   | 4,074,000          | -                                             | -                       | 4,074,000                           |
| Hydraulic Shovel – 22 m <sup>3</sup>   | 2,630,000          | -                                             | -                       | 2,630,000                           |
| Haulage Truck – 90 t                   | 6,235,000          | 4,503,000                                     | 1,732,000               | -                                   |
| Haulage Truck – 136 t                  | 14,202,000         | -                                             | -                       | 14,202,000                          |
| Tracked Dozer                          | 2,349,000          | 1,174,000                                     | -                       | 1,175,000                           |
| Grader                                 | 1,540,000          | 514,000                                       | -                       | 1,026,000                           |
| Support Backhoe                        | 908,000            | 182,000                                       | 182,000                 | 544,000                             |
| Support Equipment                      | 10,687,000         | 4,632,000                                     | 813,000                 | 5,242,000                           |
| <b>Total Mine Capital</b>              | <b>50,791,000</b>  | <b>12,597,000</b>                             | <b>5,352,000</b>        | <b>32,842,000</b>                   |

### 21.1.3 Process Plant Capital Cost

The capital cost estimate for the processing plant, based on the proposed flow sheet as described in Section 17, is summarized in Table 21-5. Total direct costs for Phase 1 are estimated at \$114.4 million with the Phase 2 expansion estimated at an additional \$85.8 million.

**Table 21-5: Summary of Process Plant Direct Capital Costs for Phase 1 and Phase 2**

| Description          | Plant Area Direct Costs |                   |                    |
|----------------------|-------------------------|-------------------|--------------------|
|                      | Phase 1                 | Phase 2           | Total (P1+P2)      |
| Civil and Earthworks | 12,276,517              | \$9,338,347       | 21,614,864         |
| Mechanical Supply    | 45,606,769              | 35,443,097        | 81,049,866         |
| Mechanical Install   | 4,963,001               | 3,588,972         | 8,551,972          |
| Structural Supply    | 8,698,441               | 6,674,547         | 15,372,988         |
| Structural Install   | 3,223,698               | 2,281,948         | 5,505,646          |
| Platework Supply     | 4,160,913               | 2,894,144         | 7,055,056          |
| Platework Install    | 2,631,010               | 1,838,651         | 4,469,661          |
| Piping               | 7,328,775               | 5,615,733         | 12,944,508         |
| E&I                  | 15,509,158              | 12,140,130        | 27,649,288         |
| Buildings            | 4,560,677               | 1,772,155         | 6,332,832          |
| Transportation       | 5,472,812               | 4,253,172         | 9,725,984          |
| <b>Total</b>         | <b>114,431,770</b>      | <b>85,840,896</b> | <b>200,272,666</b> |



To the process plant capital cost, sustaining capital of 1% of the initial capital is also distributed over the life of the project. This amounts to \$2 million over the life of the project. The estimation method for processing plant described in this study is presented in the following section.

#### **21.1.4 Basis of Estimate**

##### ***Mechanical Equipment***

- Estimated costs for major mechanical equipment (i.e., mills, conveyors, crushers, thickener, etc.) were taken from budget quotes and from recent projects and database information.
- An installation rates for all mechanical equipment were factored based on database information from similar projects.

##### ***Civil Works***

- An estimate of civil works costs was made by factoring from the mechanical equipment cost based on recent projects of similar size and scope.

##### ***Structural***

- An estimate of structural costs was made by factoring from the mechanical equipment supply cost based on recent projects of similar size and scope.
- The direct cost includes transportation to site.
- Erection costs are factored from the structural supply cost.

##### ***Platework***

- An estimate of platework costs was made by factoring from the mechanical equipment supply cost based on recent projects of similar size and scope.
- The direct cost includes transportation to site.
- Erection costs are factored from the platework supply cost.

##### ***Piping***

- Factored using database information from other studies.
- The direct cost includes transportation to site and installation.

##### ***Electrical and Instrumentation***

- Factored using database information from other studies.
- The direct cost includes transportation to site and installation.



### **Building Costs**

- Factored using database information from other studies.

#### **21.1.5 Infrastructure Capital Costs**

The infrastructure capital costs required for mining and milling operations are listed in Table 21-6. These costs are based on information from vendor quotations and work on similar operations. The incoming power supply is covered as part of a Build Own Operate Transfer (BOOT) agreement so is not included in the capital costs.

**Table 21-6: Infrastructure Capital Costs**

| Capital Category                                | Total Capital (\$M) | Capital Year -3 to Year -1 (\$M) | Capital Year 1 - 5 (\$M) | Capital Year 6 - 21 (\$M) |
|-------------------------------------------------|---------------------|----------------------------------|--------------------------|---------------------------|
| Truck Shop                                      | 3.7                 | 1.8                              | -                        | 1.9                       |
| Explosives Magazine                             | 0.5                 | 0.5                              | -                        | -                         |
| Mine Maintenance Building                       | 2.8                 | 1.4                              | -                        | 1.4                       |
| Camp Facilities (construction & permanent)      | 18.3                | 9.2                              | -                        | 9.1                       |
| Site Buildings (gatehouse, clinic, scale, etc.) | 1.0                 | 1.0                              | -                        | -                         |
| Plant Maintenance Building                      | 0.9                 | 0.9                              | -                        | -                         |
| Plant Warehouse/Shop                            | 0.5                 | 0.5                              | -                        | -                         |
| Assay Laboratory                                | 1.8                 | 1.8                              | -                        | -                         |
| Administration Building                         | 0.8                 | 0.8                              | -                        | -                         |
| Tailings Pipelines                              | 1.3                 | 1.3                              | -                        | -                         |
| Tailings Management Facility Equipment          | 0.6                 | 0.6                              | -                        | -                         |
| Tailings Pipeline Service Road                  | 1.2                 | 1.2                              | -                        | -                         |
| Tailings Dam Access Road                        | 1.0                 | 1.0                              | -                        | -                         |
| Tailings Management Facility Access Road        | 0.9                 | 0.9                              | -                        | -                         |
| Tailings Management Facility – Main Dam         | 7.2                 | 7.2                              | -                        | -                         |
| North Waste Management Facility Development     | 3.1                 | 3.1                              | -                        | -                         |
| South Waste Management Facility Development     | 2.5                 | -                                | 2.5                      | -                         |
| Mine Roads – Initial development by contractor  | 1.8                 | 1.8                              | -                        | -                         |
| Pump Station Access Road                        | 0.2                 | 0.2                              | -                        | -                         |
| Landfill area                                   | 0.2                 | 0.2                              | -                        | -                         |
| Spill Containment Pond                          | 0.2                 | 0.2                              | -                        | -                         |
| Site Mobile Equipment                           | 6.4                 | 6.4                              | -                        | -                         |
| On site Raw/Fresh Water                         | 3.9                 | 3.9                              | -                        | -                         |
| Potable Water                                   | 1.8                 | 1.8                              | -                        | -                         |
| Fire System                                     | 2.9                 | 2.9                              | -                        | -                         |
| Sewage System                                   | 2.4                 | 2.4                              | -                        | -                         |
| Raw Water Ponds                                 | 4.4                 | 0.5                              | 3.9                      | -                         |
| Communication Network                           | 3.0                 | 3.0                              | -                        | -                         |
| On Site Power Distribution                      | 2.9                 | 2.9                              | -                        | -                         |
| Upgrade Existing Road to Site                   | 10.0                | 10.0                             | -                        | -                         |
| Access Road Bridges                             | 1.4                 | 1.4                              | -                        | -                         |
| Barge Crossing                                  | 0.1                 | 0.1                              | -                        | -                         |
| Site Preparation                                | 5.1                 | 5.1                              | -                        | -                         |
| <b>Total</b>                                    | <b>94.8</b>         | <b>75.8</b>                      | <b>6.4</b>               | <b>12.4</b>               |



To the infrastructure direct capital costs, an indirect percentage of 45% was applied as well as a contingency of 15%.

Power to the site is provided under a BOOT arrangement with a local vendor. This results in a slight increase in the operating cost for power but eliminates the capital cost from the estimate.

Access to the site will require the upgrade of the existing barge crossing near Altamira plus upgrade of the existing road access and bridges. This will occur at the start of the project. With access to the site established, contractors will develop site roads sufficient for the development of the main tailings dam. These site roads will be widened by mine operations when rock is mined in the pit. This is covered in the operating cost of the mine in Year -1.

Maintenance facilities for the truck shop are sized for the truck fleet. The truck shop will comprise a concrete pad with a fabric structure overhead. Each bay will have its own covering structure. There will be no overhead crane; instead the heavy lifts will be done by a mobile crane outside. Alongside the main structure will be an area reserved for servicing light utility vehicles. Separate areas for tire repair and welding will be included.

Camp facilities will be established for both permanent and construction workers. These structures will be prefabricated, shipped, and erected on site. They are complete with dining facilities, recreation areas, laundry, and kitchen. At the same time, potable water, landfill and sewage facilities will be developed for use during construction and mine operation.

The camp facilities will be expanded during the construction of the Phase 2 plant expansion. They will accommodate the construction and permanent employees.

The vendor responsible for the fuel supply provides the fuel storage. An additional operating cost covers storage facilities and delivery.

Tailings facilities developed by the contractor in the preproduction period include the construction of the main dam as discussed earlier, access roads for the TMF, pipeline access and pipelines, and the necessary seepage ponds.

Raw water storage ponds will be developed in two of the valleys to collect rainfall for use in plant processing. Settling ponds for control of drainage in the mining area will be established early in the development to avoid discharge of water not meeting requirements of the licence.



Site mobile equipment is also included in the capital costs. This covers items such as bobcats, cranes, fork lifts, pickups and other smaller equipment not covered in the mine or plant budgets.

#### **21.1.6 Environmental**

Daily environmental monitoring is included in the G&A cost category as an operating cost. Concurrent waste rock management facility re-sloping is considered a best practice for mining operations, and has been assumed and included as part of the mine operating cost. It is anticipated that, as lifts are developed, lower lifts and sections will undergo re-sloping. The final sloping and closure of the mine is shown as a capital cost item. This cost was estimated at \$10 million. This includes fencing of the open pit upon closure, final re-sloping and seeding of the waste rock management area, removal of infrastructure and reclamation of site areas, and reclamation associated with the tailings management area.

#### **21.1.7 Indirects and Owners Cost**

The indirect costs vary between capital cost categories. Table 21-7 shows the percentages that were applied to each category. This is to account for various items, including construction supervision, erection of equipment, first fills, construction offices, and other such items.

**Table 21-7: Indirect Percentages Applied**

| <b>Capital Category</b> | <b>Indirects (%)</b> |
|-------------------------|----------------------|
| Open Pit Mining         | 10.0                 |
| Processing              | 40.0                 |
| Infrastructure          | 45.0                 |
| Environmental           | 5.0                  |

Also included in the indirect costs are an estimate of the Owner's costs associated with initial construction and supervision of the project. This also includes the G&A for Years -3, and -2.

#### **21.1.8 Contingency**

Contingency costs have been estimated using various percentages by category and applied to the direct capital cost of a particular category. Table 21-8 shows the percentages, which illustrates the level of confidence in each of the direct capital estimates.



**Table 21-8: Capital Cost Category Contingency Percentages**

| Capital Category | Contingency (%) |
|------------------|-----------------|
| Open Pit Mining  | 10.0            |
| Processing       | 15.0            |
| Infrastructure   | 15.0            |
| Environmental    | 15.0            |

### 21.1.9 Taxes – Importation

Equipment not purchased in Brazil is subject to importation taxes. These have been estimated including the leased equipment that is also subject to taxation.

## 21.2 Operating Costs

### 21.2.1 Summary

Operating costs were developed for an initial 3 Mt/a mining and milling operation ramping up to 6 Mt/a in Year 9 and continuing until Year 21. The pre-strip requirements add an additional nine months prior to milling commencement in Month 10 of Year -1. Three months of mill commissioning have been included in the overall production schedule prior to full production.

All prices in the PEA study are quoted in 4Q 2013 US\$ unless otherwise noted. Diesel fuel pricing is estimated at \$0.761/L. This estimate was derived from a price quotation for off-road low sulphur diesel fuel delivered to site with applicable taxes considered. The price for electrical power was set at \$0.0669/kWh, based on current pricing discussions by Belo Sun inclusive of the BOOT payback tariff.

The Ouro Verde and Grota Seca pits will be developed using conventional open pit technology. Initial fleet sizing is with 90 tonne trucks and 14.5 m<sup>3</sup> loaders. Backhoes will assist in dilution control on the mill feed material. Drilling is accomplished with diesel drills utilizing DTH hammers with bits 200 mm in diameter. Timing of the plant expansion in Year 8 coincides with the need for major equipment replacement. Slightly larger equipment is purchased which assists in lowering the unit operating cost to accommodate the increased stripping requirement. The drill fleet specification remains the same but the trucks increase in size to 136 tonnes and the loaders increase to 18 m<sup>3</sup> in bucket capacity for proper matching. Two hydraulic front shovels are also included in the fleet with 22 m<sup>3</sup> buckets.



The open pit LOM strip ratio is 4.3:1 (waste: feed). One year of pre-stripping is required to initiate full-scale production of 3 Mt/a mill feed to the plant. A portion of this pre-strip is allocated to road widening for the mine, expansion of the initial tailings dam construction and development of low-grade stockpile near the crusher. This material will come from a quarry located within the mine design, which contains predominantly rock for construction. The operating strip ratio in the first seven years averages 6.3:1 with lower grade material stockpiled adjacent to the crusher. The purpose of the elevated cutoff was to increase the mine feed grade for faster capital repayment. In Year 8 the plant expansion to 6 Mt/a is complete and the stockpile is used as a source of feed material. The average strip ratio for the remaining years of the mine is 4.12:1 (waste: feed). LOM a total of 102.7 Mt of material will be feed to the mill over the 21 years. Waste rock totaling 442.1 Mt will be placed in waste rock management facilities over the mine life. At its peak, the low-grade stockpile will contain 22.6 Mt of low-grade feed. This peak occurs in Year 16, and is then drawn down as the mine is completed, finishing in Year 21.

Mill feed material will be available from Year -1 and stockpiled adjacent to the proposed primary crusher. A total of 1.2 Mt of high grade and low grade will be stockpiled. The 66,000 tonnes of high grade in the stockpile will be reclaimed during plant commissioning in Year -1. Plant commissioning is expected to occur in the last 3 months of Year -1. Mill feed for Year 1 onwards will be predominantly from the mine directly. This will be at a rate of 3 Mt/a. The plant expansion to 6 Mt/a will start in Year 8 and reach full capacity in Year 9. During the ramp up to full production and until Year 10, some additional low grade will supplement feed to the mill while the mine increases its output. Mill processing will continue at 6 Mt/a until the end of the mine life in Year 21. From Year 17 onwards, the stockpile will be reclaimed to maintain the process plant feed rate at 6 Mt/a.

The process plant is designed to operate at a nominal rate of 3 Mt/a for the first seven years. In Year 8, plant production will ramp up to 6 Mt/a achieving that rate in Year 9 and onwards. The plant will use conventional crushing and grinding followed by gravity concentration and CIL cyanidation of the gravity tailings. Tailings will be pumped 5.5 km horizontally to the tailings management area west of the plant.

G&A costs are based on an average of 59 employees initially then 74 after the plant expansion. The G&A cost includes camp costs with meals for employees, life and health insurance, recruitment, personal transportation, public relations, etc. The expenses for maintaining offices in Belem, Belo Horizonte, and Altamira are also included in the G&A. Mine employees in those offices will be located in the immediate area, and no camp will be provided or required.



Table 21-9 shows a summary of all the operating cost categories on a cost per ounce basis and Table 21-10 on tonne mill feed basis.

**Table 21-9: Total Operating Costs (\$/oz payable)**

| Cost Category           | Years 1 to 6 | Years 7 to 21 | LOM        |
|-------------------------|--------------|---------------|------------|
| Open Pit Mining         | 383          | 373           | 388        |
| Processing              | 182          | 279           | 253        |
| G&A                     | 69           | 63            | 65         |
| Refining/Transportation | 23           | 23            | 23         |
| Royalties               | 13           | 13            | 13         |
| <b>Total Cash Cost</b>  | <b>670</b>   | <b>750</b>    | <b>742</b> |

**Note:** LOM includes commissioning mill feed

**Table 21-10: Total Operating Costs (\$/t mill feed)**

| Cost Category           | Years 1 to 6 | Years 7 to 21 | LOM          |
|-------------------------|--------------|---------------|--------------|
| Open Pit Mining         | 19.27        | 11.42         | 13.25        |
| Processing              | 9.13         | 8.53          | 8.64         |
| G&A                     | 3.49         | 1.93          | 2.22         |
| Refining/Transportation | 1.16         | 0.71          | 0.79         |
| Royalties               | 0.64         | 0.39          | 0.44         |
| <b>Total Cash Cost</b>  | <b>33.69</b> | <b>22.98</b>  | <b>25.33</b> |

**Note:** LOM includes commissioning mill feed

### 21.2.2 Open Pit Mining

Mine operating costs were developed from base principles using local vendor rates on equipment.

Key inputs into the mine operating cost estimate are fuel, and labour. Electrical power was not a consideration as all the mine equipment is diesel powered. The diesel fuel is based on quotations obtained from local vendors and is \$0.761/L.

Labour costs for the various job classifications were obtained for Belo Sun by a Brazilian consultant. These rates were used and included the appropriate burden for each category to cover items such as health care, vacation, and federal holidays. No profit sharing was included in the labour rates. The mine labour is based on a 12-h shift schedule.

The open pit mine includes two separate pits: Ouro Verde and Grota Seca. They are designed to be mined with proven technology and equipment. The saprolite overlain on



the deposits will require no drilling and blasting. The rock beneath this will be drilled with 200 mm DTH drills with a 10-m bench. The initial mining fleet comprises 14.5 m<sup>3</sup> front-end loaders and 90 tonne haulage trucks with suspended dump bodies. Support in separating mill feed from waste is provided by backhoes in each of the pits. They will assist in dilution control. A 14.5 m<sup>3</sup> loader is also present at the crusher to tram material to the crusher. Track dozers, graders round out the major equipment list. Support equipment includes water trucks, small backhoes with rock hammers, utility loaders, pickup trucks, and dewatering pumps for control of in-pit dewatering and storm events.

The suspended dump bodies are designed to reduce carryback of the saprolite material and also increased life from increased abrasion resistance with their rubber beds. This technology is in use in other operations in Brazil and around the world for exactly those reasons. In some applications these dump bodies have provided additional carrying capacity but that has not been considered for the PEA study. It will be investigated further as the project advances.

When the plant capacity expands from 3 Mt/a to 6 Mt/a the equipment fleet will be scaled up to maintain reasonable operating costs. The timing of the fleet replacement coincides with the plant expansion. The drill size will remain the same. The loading fleet will utilize 18 m<sup>3</sup> front-end loaders and add 22 m<sup>3</sup> hydraulic front shovels. The trucks will increase one-step up in size to 136 tonnes in carrying capacity, again with the suspended dump bodies. Dilution control in the pit will continue to use the same size backhoes. Support equipment requirements remain the same and will be replaced as needed over the mine life.

Mine equipment requirements are reduced in the initial years due to shorter waste hauls and lower strip ratios. Peak stripping in the 3 Mt/a phase of the mine occurs in Year 2 and is maintained up until the plant capacity expansion. Total material movement averages 24.7 Mt/a until Year 9. With the higher requirements for mill feed and the higher strip ratio phases being mined, total material movement increases to a peak of 49.3 Mt in Year 9. The larger fleet is available at that time with the replacement of the smaller fleet. The elevated material movement is maintained for four years averaging 47.8 Mt/a. After this, the stripping requirements are reduced and continue to decline until the end of the mine life.

Major equipment requirements are shown for a couple of points in the mine life in Table 21-11.



**Table 21-11: Major Mine Equipment Requirements**

| Equipment        | Unit           | Capacity | Year -1 | Year 5 | Year 9 | Year 12 |
|------------------|----------------|----------|---------|--------|--------|---------|
| Production Drill | mm             | 200      | 2       | 3      | 6      | 6       |
| Front-End Loader | m <sup>3</sup> | 14.5     | 4       | 4      | -      | -       |
| Front-End Loader | m <sup>3</sup> | 18       | -       | -      | 2      | 2       |
| Hydraulic Shovel | m <sup>3</sup> | 22       | -       | -      | 2      | 2       |
| Breaker Loader   | m <sup>3</sup> | 14.5     | 1       | 1      | 1      | 1       |
| Haulage Truck    | t              | 90       | 13      | 18     | -      | -       |
| Haulage Truck    | t              | 136      | -       | -      | 16     | 28      |
| Tracked Dozer    | kW             | 433      | 4       | 4      | 4      | 4       |
| Grader           | kW             | 233      | 3       | 3      | 3      | 3       |
| Support Backhoe  | kW             | 350      | 2       | 2      | 2      | 2       |

Mine engineering and general operating costs are included in the mine operating cost. This covers the mine operations department, both supervision and staff, and the mine engineering and geology costs.

Drilling in the open pit will be performed using DTH drills, each with 200 mm diameter bits. The pattern size varies, depending on whether it is for mill feed or waste to assist the plant operations. The drill pattern parameters are shown in Table 21-12.

**Table 21-12: Drill Pattern Specifications**

| Specification               | Unit | Mill Feed | Waste |
|-----------------------------|------|-----------|-------|
| Bench Height                | m    | 10        | 10    |
| Sub-Drill                   | m    | 2.0       | 2.0   |
| Blasthole Diameter          | mm   | 200       | 200   |
| Pattern Spacing – Staggered | m    | 6.0       | 6.2   |
| Pattern Burden – Staggered  | m    | 5.2       | 5.4   |
| Hole Depth                  | m    | 12.0      | 12.0  |

The slightly wider pattern for waste material was designed to provide coarser rock for the waste management facility. The sub-drill was included to allow for caving of the holes in the weaker zones, avoiding re-drilling of the holes or short holes that would affect bench floor conditions, thereby increasing tire and overall maintenance costs.

Table 21-13 outlines the parameters used for estimating drill productivity. This is based on other operations reviewed and vendor supplied information. The drill is configured



for single pass drilling of a 12-m hole. Additional steel can be added from a carousel if the pit floor exceeds that depth to ensure the bench floor control is maintained.

**Table 21-13: Drill Productivity Criteria**

| Drill Activity                   | Unit  | Mill Feed | Waste |
|----------------------------------|-------|-----------|-------|
| Pure Penetration Rate            | m/min | 0.49      | 0.49  |
| Hole Depth                       | m     | 12.0      | 12.0  |
| Drill Time                       | min   | 24.49     | 24.49 |
| Move, Spot, and Collar Blasthole | min   | 3.00      | 3.00  |
| Level Drill                      | min   | 0.50      | 0.50  |
| Add Steel                        | min   | -         | -     |
| Pull Drill Rods                  | min   | 0.50      | 0.50  |
| Total Setup/Breakdown Time       | min   | 4.00      | 4.00  |
| Total Drill Time per Hole        | min   | 28.5      | 28.5  |
| Drill Productivity               | m/h   | 25.3      | 25.3  |

An ANFO product will be used for blasting. A review by Orica with the rock and explosives parameters provided the design and also gave guidance on fragmentation. The powder factors used in the explosives calculation are shown in Table 21-14.

**Table 21-14: Design Powder Factors**

|               | Unit              | Mill Feed | Waste |
|---------------|-------------------|-----------|-------|
| Powder Factor | kg/m <sup>3</sup> | 0.707     | 0.695 |
| Powder Factor | kg/t              | 0.257     | 0.253 |

Loading costs were estimated using the front-end loaders as the only loading unit for the first six years. In Year 7, the larger loading units are phased into the mining operation. This included the hydraulic front shovels. In Year 8 the loading fleet comprises 18 m<sup>3</sup> loaders and 22 m<sup>3</sup> shovels. The average percentage of each material type that the various loaders is responsible for is shown in Table 21-15. This highlights the focus of the loaders on the mill feed and the shovels on the waste material. This was in an effort to reduce dilution.

The trucks present at the loading unit refers to the percentage of time that a truck is available to be loaded. To maximize truck productivity and reduce operating costs, it is more efficient to slightly under-truck the loader or shovel. The single largest operating cost item is the haulage, and minimizing this cost by maximizing truck productivity is crucial to lower operating costs. The value of 80% comes from the standby time shovels typical encounter due to a lack of trucks.



**Table 21-15: Loading Parameters**

|                                    | Unit           | Front-End Loader | Front-End Loader | Cable Shovel |
|------------------------------------|----------------|------------------|------------------|--------------|
| Bucket Capacity                    | m <sup>3</sup> | 14.5             | 18               | 22           |
| Years Active                       | years          | -1 to 7          | 7 to 21          | 7 to 21      |
| Truck Capacity Loaded              | t              | 90               | 136              | 136          |
| Waste Tonnage Loaded               | %              | 100              | 25               | 75           |
| Mill Feed Tonnage Mined            | %              | 100              | 80               | 20           |
| Bucket Fill Factor                 | %              | 95               | 95               | 95           |
| Cycle Time                         | Sec            | 39               | 39               | 35           |
| Trucks Present at the Loading Unit | %              | 80               | 80               | 80           |
| Loading Time                       | min            | 2.65             | 2.65             | 1.28         |

Haulage profiles were determined for each pit phase for the primary crusher or the waste rock management facility destinations. From these profiles, Caterpillar's FPC software (FPC) was used to determine haulage cycle times. These cycle times were applied to the appropriate yearly tonnage by destination and phase to estimate the haulage costs.

Support equipment costs were determined using a percentage applied to either the truck hours or the loading hours. As indicated earlier, these percentages resulted in the need for four large track dozers, three graders, and two support backhoes. Their tasks include cleanup of the shovel/loader faces, roads, dumps, and blast patterns. The graders will maintain the plant feed and waste haul routes. In addition, water trucks have responsibility for patrolling the haul roads and controlling fugitive dust for safety and environmental reasons.

The equipment rates applied, less the operating labour costs are shown in Table 21-16. All rates include consumables such as fuel, tires, drill steel, bits, and required maintenance parts. Fuel consumption is estimated from basic principles and, where possible, with the FPC software as a check. Operating labour is calculated separately.

Grade control envisaged for the project uses dedicated grade control drill rigs and crews in the pit to drill a series of shallow holes and sample the material every 1 m to 2.5 m. The smaller sample size is for areas of known mineralization or expected mineralization. The larger sample frequency (2.5 m) is used in waste areas to locate unknown mineralization zones. The entirety of the pit is drilled with the RC rig with different pattern sizes both for material type and pit area. This is discussed in detail in Section 16. A three man crew per drill is required; one driller and two drill helpers. In addition, geology will provide guidance throughout the day and be on call if unknown issues arise.



**Table 21-16 Major Equipment Hourly Operating Rates**

| Equipment                              | Hourly Rate (\$/h) |
|----------------------------------------|--------------------|
| Production Drill                       | 277                |
| Front-End Loader – 14.5 m <sup>3</sup> | 279                |
| Front-End Loader – 18 m <sup>3</sup>   | 367                |
| Hydraulic Shovel – 22 m <sup>3</sup>   | 483                |
| Haulage Truck – 90-t                   | 142                |
| Haulage Truck – 136-t                  | 207                |
| Tracked Dozer                          | 159                |
| Grader                                 | 85                 |
| Support Backhoe                        | 115                |

The drill penetration rate is estimated at 19 m/h with setups, sampling, etc. Overall, the cost for the drill without labour will be \$233/h or about \$12.28/m drilled. The cost of not sampling and mistaking waste for feed or feed for waste easily is repaid in proper feed: waste definition.

The sampling cost for the RC program is carried in the plant operating cost. The drilling cost is included in the mine operating cost shown here.

To assist in financing the development of the Volta Grande project various methods of equipment purchase were examined. The choice of leasing of the majority of the equipment was made given reasonable terms from the various vendors. The leasing terms were based on 20% down payment and a 5-year lease. A lease rate provided by one of the vendors was applied and incorporated in the yearly lease cost. All of the major equipment followed this format and some of the support equipment. If the equipment had a life greater than the lease then years 6 onwards did not have a lease payment applied. In the case of the mine trucks, with an approximately 10-year mine life, the lease would be complete and the trucks would just incur operating costs. For this reason, the operating cost would vary annually depending on equipment replacement and timing of the leases.

The mining cost is calculated by year to take into account changing haulage routes, and the resulting equipment requirements. The LOM average cost for total material moved is shown in Table 21-17. It is also shown for several key years to show the variation due to equipment in use at those times.



**Table 21-17: Open Pit Mine Operating Costs (\$/t Total Material)**

| Open Pit Operating Category  | Unit        | Year 5      | Year 9      | Year 12     | LOM Cost    |
|------------------------------|-------------|-------------|-------------|-------------|-------------|
| General Mine and Engineering | \$/t        | 0.17        | 0.12        | 0.13        | 0.15        |
| Drilling                     | \$/t        | 0.18        | 0.17        | 0.18        | 0.16        |
| Blasting                     | \$/t        | 0.39        | 0.33        | 0.37        | 0.33        |
| Loading                      | \$/t        | 0.22        | 0.24        | 0.22        | 0.25        |
| Hauling                      | \$/t        | 0.76        | 0.67        | 0.85        | 0.78        |
| Support                      | \$/t        | 0.34        | 0.16        | 0.16        | 0.27        |
| Grade Control                | \$/t        | 0.09        | 0.08        | 0.08        | 0.09        |
| Leasing                      | \$/t        | 0.18        | 0.32        | 0.40        | 0.34        |
| <b>Total</b>                 | <b>\$/t</b> | <b>2.33</b> | <b>2.08</b> | <b>2.38</b> | <b>2.37</b> |

### 21.2.3 Process Plant

The process plant operating cost for the Phase 1, 3 Mt/a case, is estimated at \$9.13/t processed. When Phase 2 comes increases to 6 Mt/a the operating cost decreases to an estimated \$8.51/t processed. The majority of these costs are attributable to power, reagents, and grinding media/liners. Table 21-18 provides a breakdown by major area.

**Table 21-18: Operating Cost Estimate for the Volta Grande Processing Plant**

| Operating Costs          | Cost, \$/t       |                  |
|--------------------------|------------------|------------------|
|                          | Phase 1 – 3 Mt/a | Phase 2 – 6 Mt/a |
| <b>Labour</b>            |                  |                  |
| Plant Management         | 0.16             | 0.12             |
| Plant Operation          | 0.48             | 0.24             |
| Plant Maintenance        | 0.20             | 0.15             |
| Assay Lab                | 0.19             | 0.10             |
| Plant Maintenance Spares | 0.79             | 0.60             |
| Power                    | 2.85             | 2.85             |
| Reagents                 | 1.80             | 1.80             |
| Mill Balls               | 1.37             | 1.37             |
| Crusher/Mill Liners      | 0.93             | 0.93             |
| Assay Laboratory         | 0.16             | 0.16             |
| Primary Feed Handling    | 0.19             | 0.19             |
| <b>Total OPEX</b>        | <b>9.13</b>      | <b>8.51</b>      |

Details of the estimating methods in each of the major cost areas are now presented.



### ***Labour***

Labour costs have been calculated using typical plant staffing levels. Pay scales are based on recent database rates. The plant schedule is assumed to be 12-h shifts, with two shifts at the site and two shifts on leave at all times.

For the Phase 1 operating scenario, the mill is estimated to require total complement of 115 persons and an annual cost of \$3.12 million, or \$1.04/t. When the throughput increases to 6 Mt/a in Phase 2, the process plant is expected to add an additional 20 personnel, but the labour operating cost will drop to \$0.61/t.

### ***Mill Electricity***

Electricity supply is the largest single operating cost, accounting for ~31% of the overall total in Phase 1. Table 21-19 present a summary of the cost calculation.

**Table 21-19: Process Plant Phase 1 Electricity Cost Estimate**

|                          | Unit | Phase 1   |
|--------------------------|------|-----------|
| Total Connected Power    | kW   | 20780     |
| Load Factor              | %    | 70.0      |
| Estimated Power Consumed | kW   | 14560     |
| Annual Consumption       | MWh  | 127,570   |
| Cost per MWh             | \$   | 66.94     |
| Annual Total Cost        | \$   | 8,539,540 |
| Cost per tonne milled    | \$/t | 2.85      |

The total connected power is taken from the mechanical equipment list, with load factors applied for each piece of equipment. Belo Sun has provided a power supply rate of \$66.94/MWh inclusive of the BOOT tariff. This equates to an annual operating cost of \$2.84/t of milled, independent of the change in throughput from Phases 1 and 2.

### ***Reagents***

Reagent costs are estimated using unit costs from vendors and consumption rates from the laboratory testwork. A summary of the costs for each reagent is presented in Table 21-20. The total reagent cost amounts to \$ 1.80/t of mill feed.



**Table 21-20: Summary of Estimated LOM Reagent Operating Costs**

| Reagent               | Cost (\$/t) |
|-----------------------|-------------|
| Flocculant            | 0.20        |
| Quicklime             | 0.18        |
| Sodium Cyanide        | 0.73        |
| Activated Carbon      | 0.05        |
| Sodium Hydroxide      | 0.10        |
| HCl                   | 0.04        |
| Sodium Metabisulphite | 0.50        |
| <b>Total</b>          | <b>1.80</b> |

### ***Balls and Liners***

The cost of grinding balls and crusher/mill liners are estimated using quoted supply rates and consumption estimates based on the grindability testwork.

### ***Maintenance and Supplies***

An allowance for plant maintenance has been factored from the mechanical supply cost for each area. The cost includes transportation, but the labour costs for replacement, installation and maintenance are included in the labour allowance.

Similar amounts have been factored from the overall mechanical supply cost to cover electrical/instrumentation maintenance and piping.

Fixed allowances have been included to cover minor costs associated with lubricants, assay laboratory supplies, and safety equipment. Costs in this area include training, monitoring equipment, first aid supplies and personal protective equipment.

## **21.2.4 General and Administrative**

The G&A costs include the salaries of 59 personnel initially and later rising to 74 employees with the increase in mine production in Year 8. Employees will be housed in the camp located at the mine site.

Additional expenses have been included in the G&A for offices and employees in Belem and Altamira. The number of employees at the offices has not been shown in the G&A labour as they are not required at site nor are camp facilities required for them.

Costs normally attributed to G&A in Year -3 and -2 have been included in the Owner's cost and capitalized. LOM cost per tonne of mill feed is estimated at \$2.22/t; however, it



will vary over time due to changes in the production rate in later years. Table 21-21 highlights the costs and categories for Years 5 and 10 to illustrate examples at the two plant processing rates.

Power costs are estimated on average at 500 kWh at \$0.0669/kWh. Catering costs are based on current quotations.

**Table 21-21: G&A Cost Calculation**

| Category                       | Annual Costs Year 5<br>(\$) | Annual Costs Year 10<br>(\$) |
|--------------------------------|-----------------------------|------------------------------|
| G&A Salaries                   | 2,220,000                   | 2,849,000                    |
| Life and Health Insurance      | 1,658,000                   | 2,155,000                    |
| Meals                          | 2,972,000                   | 3,863,000                    |
| Personal Transportation        | 561,000                     | 729,000                      |
| Light Vehicles                 | 500,000                     | 500,000                      |
| Hosting + Fly-in/Fly-out       | 71,000                      | 71,000                       |
| Clothes                        | 135,000                     | 176,000                      |
| Safety Equipment               | 97,000                      | 127,000                      |
| Occupational Health            | 87,000                      | 113,000                      |
| Other Admin Benefits           | 96,000                      | 96,000                       |
| Belem Office Expense           | 28,900                      | 28,900                       |
| Belem Office Labour            | 263,600                     | 263,600                      |
| Belo Horizonte Expense         | 14,900                      | 14,900                       |
| Altamira Office Expense        | 37,200                      | 37,200                       |
| Altamira Office Labour         | 187,600                     | 187,600                      |
| Communications or Satellite    | 25,500                      | 25,500                       |
| Computer supplies and software | 15,300                      | 15,300                       |
| Insurance                      | 1,276,600                   | 1,276,600                    |
| Recruitment and Relocation     | 51,000                      | 51,000                       |
| Site Power                     | 287,000                     | 287,000                      |
| <b>Total G&amp;A</b>           | <b>10,584,600</b>           | <b>12,866,600</b>            |
| Tonnage Milled                 | 3,000,000                   | 6,000,000                    |
| G&A Costs (\$/t mill feed)     | 3.53                        | 2.14                         |

### 21.2.5 Refining and Transportation

Total refining and transportation charges are estimated at \$23/oz. This is comprised of refining costs estimated at \$3.85/oz, local transportation of \$18.16/oz for the doré from the mine site using helicopters and international transportation at \$0.99/oz. Insurance is also included in the estimated cost.



### 21.2.6 Royalties

The royalty rate for gold is currently 1% arising from the sale of the mineral product less the sales tax of the mineral product, transportation and insurance costs.

### 21.2.7 Project Labour Force

Labour force requirements for the Volta Grande Project vary from year to year by department depending on the quantity of mill feed processed. Detail on the various labour forces are discussed in their appropriate sections. A summary is illustrated in Figure 21-1.

The increase in mill throughput in Year 8 onwards is also reflected in the labour force levels. As shown, the mine represents the largest increase in workers due to the increase waste and mill feed production. This elevated level in the mine is maintained until Year 14 and then drops off to the end of the mine life.

**Figure 21-1: Annual Labour Force Levels**





## 22 ECONOMIC ANALYSIS

### 22.1 Summary

The project has pre-tax NPV with a 5% discount rate of \$533 million using a base price for gold of \$1,300/oz. Post-tax NPV with the same 5% discount rate and \$1,300 gold price was \$418 million. IRR are respectively 17.7% pre-tax and 16.1% post-tax. Payback on the project capital is expected to be 4 years pre-tax and 4.2 years post-tax. Table 22-1 shows the detailed results.

**Table 22-1: Discounted Cash Flow Results**

| Cost Category              | Unit         | Low Case     | Base Case    | High Case    | Sensitivity Case |
|----------------------------|--------------|--------------|--------------|--------------|------------------|
| Gold Price                 | (\$/oz)      | <b>1,250</b> | <b>1,300</b> | <b>1,400</b> | <b>1,450</b>     |
| <b>Operating Costs</b>     |              |              |              |              |                  |
| Open Pit Mining            | (M\$)        | 1,361.3      | 1,361.3      | 1,361.3      | 1,361.3          |
| Processing                 | (M\$)        | 887.7        | 887.7        | 887.7        | 887.7            |
| G&A                        | (M\$)        | 228.6        | 228.6        | 228.6        | 228.6            |
| Subtotal Operating Costs   | (M\$)        | 2,477.6      | 2,477.6      | 2,477.6      | 2,477.6          |
| <b>Capital Costs</b>       |              |              |              |              |                  |
| Open Pit Mining            | (M\$)        | 50.8         | 50.8         | 50.8         | 50.8             |
| Processing                 | (M\$)        | 202.3        | 202.3        | 202.3        | 202.3            |
| Infrastructure             | (M\$)        | 94.8         | 94.8         | 94.8         | 94.8             |
| Environmental Costs        | (M\$)        | 10.0         | 10.0         | 10.0         | 10.0             |
| Owners Costs/Indirects     | (M\$)        | 146.5        | 146.5        | 146.5        | 146.5            |
| Contingency                | (M\$)        | 68.4         | 68.4         | 68.4         | 68.4             |
| Subtotal Capital Costs     | (M\$)        | 572.8        | 572.8        | 572.8        | 572.8            |
| Taxes                      | (M\$)        | 64.2         | 64.2         | 64.2         | 64.2             |
| <b>Total Capital Costs</b> | <b>(M\$)</b> | <b>637.0</b> | <b>637.0</b> | <b>637.0</b> | <b>637.0</b>     |
| Gold Revenue               | (M\$)        | 4,387.5      | 4,563.0      | 4,913.9      | 5,089.5          |
| Less Refining              | (M\$)        | 80.8         | 80.8         | 80.8         | 80.8             |
| Less Royalty               | (M\$)        | 43.1         | 44.8         | 48.3         | 50.1             |
| Net Gold Revenue           | (M\$)        | 4,263.6      | 4,437.3      | 4,784.8      | 4,958.6          |
| Pre-Tax Cash Flow          | (M\$)        | 1,148.9      | 1,322.7      | 1,670.2      | 1,843.9          |
| <b>Total Tax</b>           | <b>(M\$)</b> | <b>223.0</b> | <b>260.6</b> | <b>335.5</b> | <b>372.0</b>     |
| Post-Tax Cash Flow         | (M\$)        | 925.9        | 1,062.1      | 1,334.7      | 1,471.9          |
| Pre-Tax NPV at 5%          | (M\$)        | 442.0        | 533.0        | 717.0        | 808.0            |
| Pre-Tax IRR                | (%)          | 15.7         | 17.7         | 21.5         | 23.4             |
| Pre-Tax Payback Period     | Years        | 4.4          | 4.0          | 3.3          | 3.0              |
| Post-Tax NPV at 5%         | (M\$)        | 344.0        | 418.0        | 564.0        | 637.0            |
| Post-Tax IRR               | (%)          | 14.3         | 16.1         | 19.5         | 21.1             |
| Post-Tax Payback Period    | Years        | 4.6          | 4.2          | 3.6          | 3.3              |



The PEA utilizes only Measured and Indicated resources from Grota Seca and Ouro Verde for calculation of the economics. Some Inferred material has been incorporated as dilution and upgraded in category if a minor percentage occurs in the block. There is no certainty that the assumptions utilized in the PEA will be realized. Inferred mineral resources are presently considered too speculative geologically to have economic considerations applied to them that would enable them to be categorized as reserves. Mineral resources that are not mineral reserves and do not have demonstrated economic viability. The resources used for the PEA study were reported in the 3 October 2013 resource statement.

Variable gold recoveries were applied by pit area and rock type. These recoveries vary by feed grade to the mill. The initial five years of the mine are expected to achieve a 94.1% gold recovery and the life of mine average is expected to be 92.8%.

The Project base case (\$1,300/oz Au) costs are also expressed in terms of dollars per ounce and dollars per tonne of mill feed in Table 22-2 and Table 22-3.

**Table 22-2: Base Case Costs - \$/oz**

| Cost Category                            | Year 1 to 6 | Year 7 to 21 | LOM <sup>(1)</sup> |
|------------------------------------------|-------------|--------------|--------------------|
| <b>Cash Cost</b>                         |             |              |                    |
| Open Pit Mining                          | 383         | 373          | 388                |
| Processing                               | 182         | 279          | 253                |
| G&A                                      | 69          | 63           | 65                 |
| Total Operating Cost                     | 634         | 715          | 706                |
| Royalties                                | 13          | 13           | 13                 |
| Total Operating Cost including Royalties | 647         | 727          | 719                |
| Refining                                 | 23          | 23           | 23                 |
| <b>Total Cash Cost</b>                   | <b>670</b>  | <b>750</b>   | <b>742</b>         |
| <b>Capital Cost</b>                      |             |              |                    |
| Open Pit Mining                          | 7           | 12           | 14                 |
| Processing                               | 20          | 27           | 58                 |
| Infrastructure                           | 12          | 3            | 27                 |
| Environmental Costs                      | 0           | 4            | 3                  |
| Owners Costs/Indirects                   | 36          | 17           | 42                 |
| Contingency                              | 16          | 10           | 19                 |
| Tax (importation)                        | 12          | 10           | 18                 |
| <b>Total Capital Cost</b>                | <b>104</b>  | <b>83</b>    | <b>181</b>         |
| Taxes (income with credits)              | 32          | 90           | 74                 |
| <b>Total Mine Site Cost (inc. tax)</b>   | <b>805</b>  | <b>923</b>   | <b>997</b>         |

**Note:** <sup>(1)</sup> LOM includes pre-production values



**Table 22-3: Base Case Costs - \$/t Mill Feed**

| Cost Category                            | Year 1 to 6  | Year 7 to 21 | LOM <sup>(1)</sup> |
|------------------------------------------|--------------|--------------|--------------------|
| <b>Cash Cost</b>                         |              |              |                    |
| Open Pit Mining                          | 19.27        | 11.42        | 13.25              |
| Processing                               | 9.13         | 8.53         | 8.64               |
| G&A                                      | 3.49         | 1.93         | 2.22               |
| <b>Total Operating Cost</b>              | <b>31.89</b> | <b>21.88</b> | <b>24.11</b>       |
| Royalties                                | 0.64         | 0.39         | 0.44               |
| Total Operating Cost including Royalties | 32.53        | 22.27        | 24.55              |
| Refining                                 | 1.16         | 0.71         | 0.79               |
| <b>Total Cash Cost</b>                   | <b>33.69</b> | <b>22.98</b> | <b>25.34</b>       |
| <b>Capital Cost</b>                      |              |              |                    |
| Open Pit Mining                          | 0.37         | 0.37         | 0.49               |
| Processing                               | 1.00         | 0.83         | 1.97               |
| Infrastructure                           | 0.61         | 0.09         | 0.92               |
| Environmental Costs                      | 0.00         | 0.12         | 0.10               |
| Owners Costs/Indirects                   | 1.84         | 0.53         | 1.43               |
| Contingency                              | 0.81         | 0.30         | 0.67               |
| Tax (Importation)                        | 0.60         | 0.45         | 0.62               |
| <b>Total Capital Cost</b>                | <b>5.23</b>  | <b>2.69</b>  | <b>6.20</b>        |
| Taxes (Income with credits)              | 1.60         | 2.75         | 2.54               |
| <b>Total Mine Site Cost (inc. tax)</b>   | <b>40.51</b> | <b>28.42</b> | <b>34.07</b>       |

**Note:** <sup>(1)</sup> LOM includes pre-production values

## 22.2 Mill Feed Schedule

The mine will provide feed for the mill starting in the pre-production period to allow for commissioning of the mill. Commissioning will be accomplished over a three-month period with full plant production occurring at the beginning of Year 1. Pre-production processing totals 378,000 tonnes of mill feed grading 1.8 g/t.

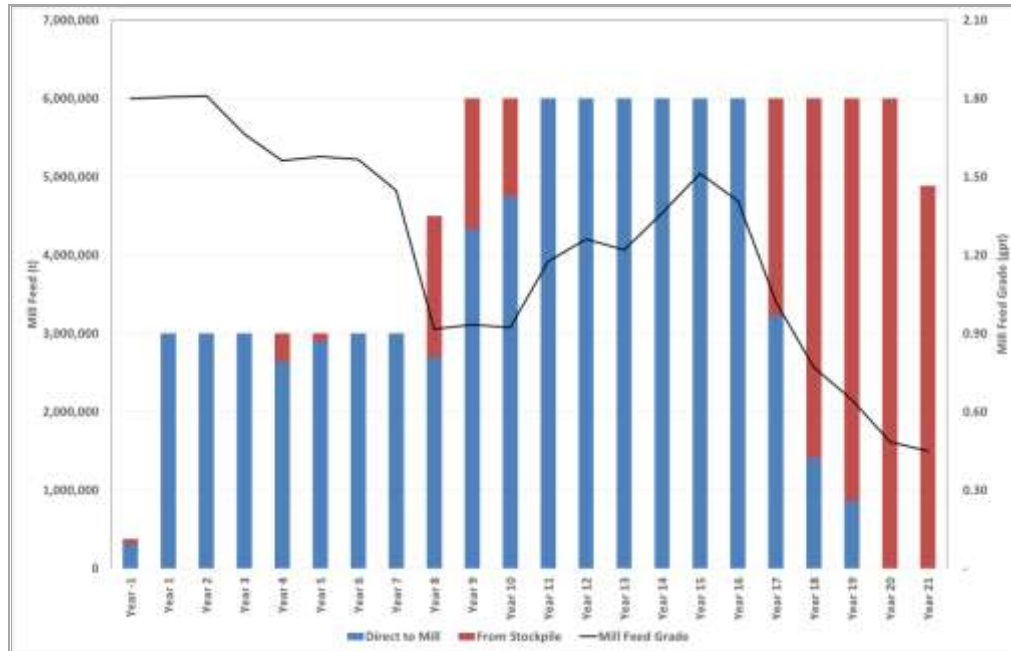
Mill production is maintained at 3 Mt/a for seven years. Average grade to the mill is forecast at 1.63 g/t. In Year 6, development of an expansion in the plant capacity is initiated taking approximately 18 months to complete. Ramp up of that capacity occurs in Year 8 with 4.5 Mt of feed processed at an average diluted grade of 0.92 g/t. Pre-strip of subsequent phases occurs during the plant expansion and some of the additional feed is provided by reclaim of some material from the low-grade stockpile. This allows deferral of the stripping cost of those phases by results in a slight dip in the mill feed grade.



A production rate of 6 Mt/a is maintained from Year 9 to the end of the mine life in Year 21 with an average grade of 1.02 g/t. The lower grade is partly the result of the reclaim of low-grade stockpile material in the last five years at an average grade of 0.52 g/t.

Figure 22-1 shows the tonnes of mill feed and grade by year.

**Figure 22-1: Mill Feed Schedule**



## 22.3 Gold Pricing Assumptions

Typical metal pricing for projects is based on a three-year trailing average price, which has averaged \$1,540/oz (February 2011 to 2014). This methodology has not been used here because of recent gold price volatility. Until gold returns to a more stable price AGP and Belo Sun have adopted less risky and more conservative approach.

A review of recent studies and market consensus showed a range from \$1,250/oz to above \$1,300/oz. A \$1,020/oz price for design purposes was considered reasonable based on pit geometry and strip ratio. The base case for the economic analysis was set at \$1,300/oz. The high price case gold price was set just over this at \$1,400/oz and the lower price set at \$1,250/oz. The sensitivity case price was set to \$1,450/oz.

Gold payable is estimated to be 99.9% with a refining and transportation charge of \$23/oz. Local and international transportation of the doré formed the bulk of the cost at \$19.15/oz with the actual refining at \$3.85/oz.



## **22.4 Taxes and Royalties**

### **22.4.1 Royalty**

Royalties are paid to the Federal government – Compensação Financeira pela Exploração de Recursos Minerais (CFEM). The royalty rate for gold is currently 1% arising from the sale of the mineral product less the sales tax of the mineral product, transportation and insurance costs.

### **22.4.2 Taxation**

The tax planning for the Project was developed by L&M, Belo Sun's Brazilian tax advisors, taking into consideration the existing current tax laws applied to capital costs, operating costs, sales of gold and profits.

The work was developed from the basic taxes applicable to various activities of the Project and the tax benefits provided for by the legislation of each tribute, whether at the Federal, State, or municipal level.

An important premise that comes from setting most of the tax benefits is the total export of the gold production. Therefore, the results presented in this economic analysis are based on the tax benefits provided for mainly export companies and also those benefits targeted to new investments in the State of Pará:

- RECAP: Suspension of PIS and COFINS on the acquisitions of machinery, instrumentation, and equipment in the construction phase. The rules and the granting of the benefit are determined by the Secretaria da Receita Federal do Brasil (SRF).
- GOLD LAW: Construction phase – Deferral of ICMS levied on imports of machinery and equipment and of the ICMS DIFAL on acquisitions of machinery and equipment from other States.
- Operation phase: Deferral of ICMS levied on the consumption of electrical energy and diesel oil used in the production.
- The State of Pará has a large incentive program applicable to companies investing in the mining sector in the State. It is highlighted that currently existing laws benefiting the mineral industries of iron, nickel and copper provide exemption and/or deferral of ICMS during the construction and operation phases. In this PEA Study equivalent tax benefits on ICMS, granted to mining companies, which are investing or are operating in these segments of iron, nickel and copper in Pará have been considered.



- **DRAWBACK:** Suspension of PIS and COFINS on imported inputs and raw materials.
- The tax regime of Drawback consists of the suspension of payment of PIS and other taxes due, in customs clearance of inputs (raw materials, intermediate products and packaging materials), for a maximum period of up to one year, providing that the products resulting from the manufacturing process are effectively exported.
- **PREPON-EX:** Suspension of PIS and COFINS on purchases of inputs and raw materials including energy and fuels to be consumed in the production process for companies that exports the minimum of 60% of its production.
- **SUDAM:** Given its location and characteristics, the Project is considered eligible for the tax incentive conceded by SUDAM (Amazon Development Superintendence). The incentive consists of the reduction of 75% of the income tax due by the Project for a ten-year period for new investments in the area of Legal Amazonia and has to be approved by SUDAM, prior to 31 December 2013 (refer to Ordinance No. 2,091 of 28 December 2007, issued by the Minister of National Integration).

#### **22.4.3 Base Date and Exchange Rate**

The analysis was completed using 4Q 2013 values with no escalation assumed. The exchange rate is based on 2.35 Brazilian Reals to 1 United States dollar; (BRL:US\$ = 2.35:1)

### **22.5 Discounted Cash Flow Analysis**

The PEA utilizes only Measured and Indicated resources from Grota Seca and Ouro Verde for calculation of the economics. Some Inferred material has been incorporated as dilution and upgraded in category if a minor percentage occurs in the block. There is no certainty that the assumptions utilized in the PEA will be realized. Inferred mineral resources are presently considered too speculative geologically to have economic considerations applied to them that would enable them to be categorized as reserves. Mineral resources that are not mineral reserves and do not have demonstrated economic viability.

Mill feed totals 102.76 Mt grading 1.14 g/t diluted over the 21-year mine life. Pre-production stripping accounts for 378,000 tonnes of the LOM tonnage at an average grade of 1.80 g/t. The first seven years of processing are at rate of 3 Mt/a. Year 8 processes 4.5 Mt of feed. Year 9 until the end of the mine life has a processing rate of 6 Mt/a.



Base case gold price is \$1,300/oz with the Low and High cases at \$1,250/oz and \$1,400/oz, respectively. A fourth case using a \$1,450/oz price was also considered. A 5% discount rate is used as the basis for comparison of all the gold price cases with values of 0% and 10% also examined.

The pre-tax NPV with a 5% discount rate is \$533 million. Post-tax with the same 5% discount rate the NPV is \$418 million. The IRR is 17.7% pre-tax and 16.1% post-tax. Payback on the initial capital is expected to 4 years pre-tax and 4.2 years post-tax. The plant expansion in Years 6-8 is envisaged at this time to be covered by operating revenue and with the \$1,300/oz gold price is not expected to make the cashflow negative. Table 22-4 and Table 22-5 show the detailed results.

**Table 22-4: Discounted Cash Flow Results Summary**

| Gold Price Case        | NPV (\$M) |     |     | IRR % | Payback Period (Years) |
|------------------------|-----------|-----|-----|-------|------------------------|
|                        | 0%        | 5%  | 10% |       |                        |
| Pre-Tax Evaluation     |           |     |     |       |                        |
| Low Case – \$1,250/oz  | 1,149     | 442 | 145 | 15.7  | 4.4                    |
| Base Case – \$1,300/oz | 1,323     | 533 | 198 | 17.7  | 4.0                    |
| High Case – \$1,400/oz | 1,670     | 717 | 305 | 21.5  | 3.3                    |
| Spot Case – \$1,450/oz | 1,844     | 808 | 358 | 23.4  | 3.0                    |
| Post-Tax Evaluation    |           |     |     |       |                        |
| Low Case – \$1,250/oz  | 926       | 344 | 99  | 14.3  | 4.6                    |
| Base Case – \$1,300/oz | 1,062     | 418 | 142 | 16.1  | 4.2                    |
| High Case – \$1,400/oz | 1,335     | 564 | 229 | 19.5  | 3.6                    |
| Spot Case – \$1,450/oz | 1,472     | 637 | 272 | 21.1  | 3.3                    |

**Table 22-5: Discounted Cash Flow Detailed Results**

| Cost Category            | Unit    | Low Case | Base Case | High Case | Sensitivity Case |
|--------------------------|---------|----------|-----------|-----------|------------------|
| Gold Price               | (\$/oz) | 1,250    | 1,300     | 1,400     | 1,450            |
| <b>Operating Costs</b>   |         |          |           |           |                  |
| Open Pit Mining          | (M\$)   | 1,361.3  | 1,361.3   | 1,361.3   | 1,361.3          |
| Processing               | (M\$)   | 887.7    | 887.7     | 887.7     | 887.7            |
| G&A                      | (M\$)   | 228.6    | 228.6     | 228.6     | 228.6            |
| Subtotal Operating Costs | (M\$)   | 2,477.6  | 2,477.6   | 2,477.6   | 2,477.6          |
| <b>Capital Costs</b>     |         |          |           |           |                  |
| Open Pit Mining          | (M\$)   | 50.8     | 50.8      | 50.8      | 50.8             |
| Processing               | (M\$)   | 202.3    | 202.3     | 202.3     | 202.3            |
| Infrastructure           | (M\$)   | 94.8     | 94.8      | 94.8      | 94.8             |
| Environmental Costs      | (M\$)   | 10.0     | 10.0      | 10.0      | 10.0             |



| Cost Category              | Unit         | Low Case     | Base Case    | High Case    | Sensitivity Case |
|----------------------------|--------------|--------------|--------------|--------------|------------------|
| Owners Costs/Indirects     | (M\$)        | 146.5        | 146.5        | 146.5        | 146.5            |
| Contingency                | (M\$)        | 68.4         | 68.4         | 68.4         | 68.4             |
| Subtotal Capital Costs     | (M\$)        | 572.8        | 572.8        | 572.8        | 572.8            |
| Taxes                      | (M\$)        | 64.2         | 64.2         | 64.2         | 64.2             |
| <b>Total Capital Costs</b> | <b>(M\$)</b> | <b>637.0</b> | <b>637.0</b> | <b>637.0</b> | <b>637.0</b>     |
| Gold Revenue               | (M\$)        | 4,387.5      | 4,563.0      | 4,913.9      | 5,089.5          |
| Less Refining              | (M\$)        | 80.8         | 80.8         | 80.8         | 80.8             |
| Less Royalty               | (M\$)        | 43.1         | 44.8         | 48.3         | 50.1             |
| Net Gold Revenue           | (M\$)        | 4,263.6      | 4,437.3      | 4,784.8      | 4,958.6          |
| Pre-Tax Cash Flow          | (M\$)        | 1,148.9      | 1,322.7      | 1,670.2      | 1,843.9          |
| <b>Total Tax</b>           | <b>(M\$)</b> | <b>223.0</b> | <b>260.6</b> | <b>335.5</b> | <b>372.0</b>     |
| Post-Tax Cash Flow         | (M\$)        | 925.9        | 1,062.1      | 1,334.7      | 1,471.9          |
| Pre-Tax NPV at 5%          | (M\$)        | 442.0        | 533.0        | 717.0        | 808.0            |
| Pre-Tax IRR                | (%)          | 15.7         | 17.7         | 21.5         | 23.4             |
| Pre-Tax Payback Period     | Years        | 4.4          | 4.0          | 3.3          | 3.0              |
| Post-Tax NPV at 5%         | (M\$)        | 344.0        | 418.0        | 564.0        | 637.0            |
| Post-Tax IRR               | (%)          | 14.3         | 16.1         | 19.5         | 21.1             |
| Post-Tax Payback Period    | Years        | 4.6          | 4.2          | 3.6          | 3.3              |

## 22.6 Sensitivity Analysis

The project sensitivity to various inputs was examined on the base case (post-tax). The items that were varied were:

- Gold price
- Capital cost
- Operating cost.

The results of the sensitivity analysis are shown in Figure 22-2 and Figure 22-3 and in Table 22-6 and Table 22-7.



**Figure 22-2: NPV Sensitivity (Post-tax)**

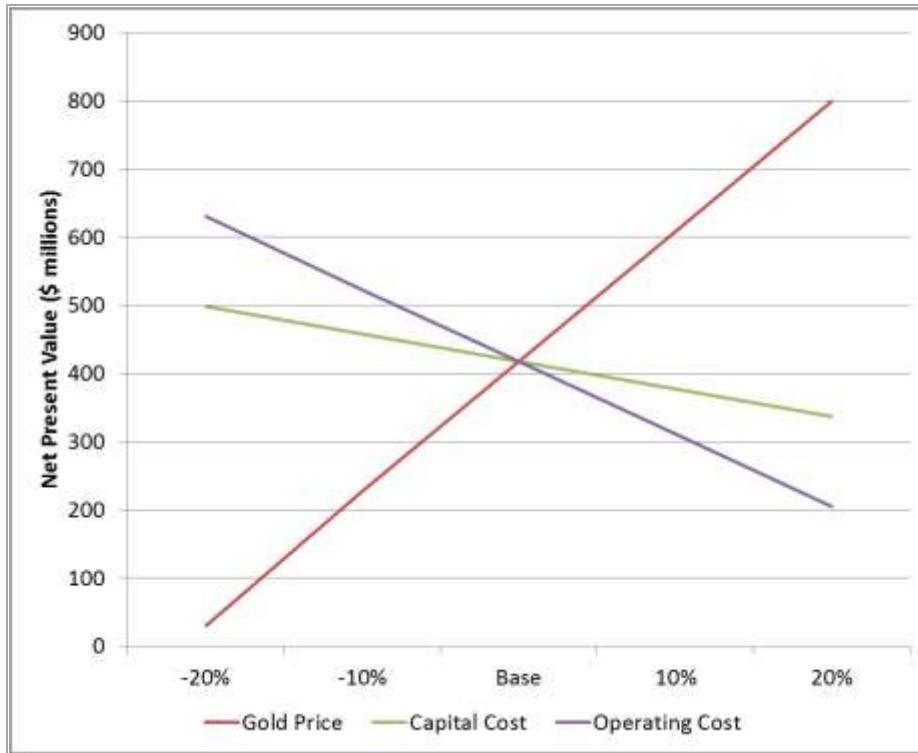
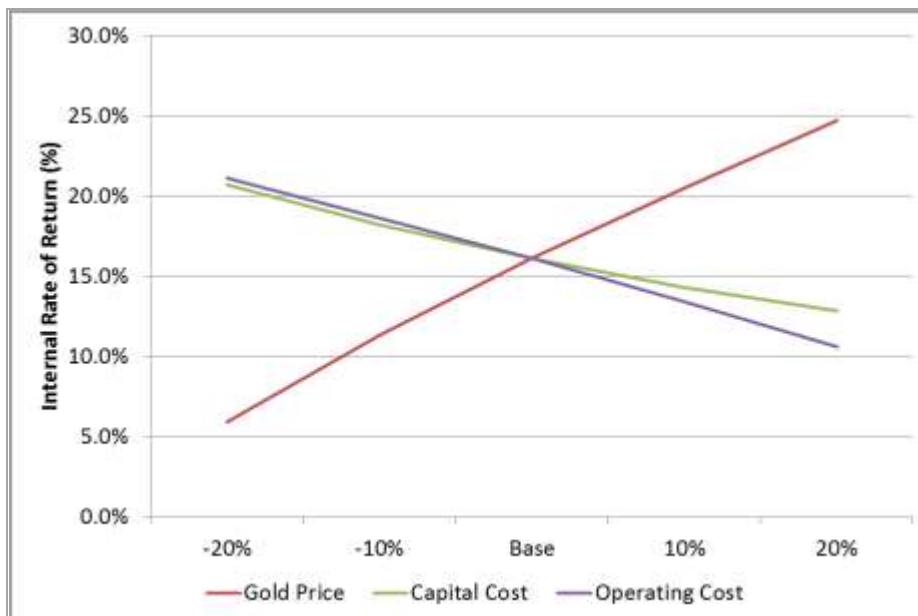


**Figure 22-3: IRR Sensitivity (Post-tax)**





The greatest sensitivity to the Project is gold price. The base case price of \$1,300/oz provides an NPV (5%) of \$418 million. If the gold price rises by 20% to \$1,560/oz, the NPV would rise to \$799 million. This equates to a 91% increase in NPV showing the impact of higher gold prices. The IRR rises to 24.7%. Conversely, a 20% reduction in gold price to \$1,040/oz results in a drop of the project NPV to \$30 million, still positive but a 93% decrease in NPV. The IRR with the 20% reduction in gold price is 5.9%.

Operating costs are the second most sensitive to the overall project economics but to a lesser degree than gold price. A 20% increase in the operating cost drops the NPV (5%) to \$205 million with an IRR of 10.6%. This is a 51% decrease in the project NPV. Conversely a 20% decrease in operating cost results in a 51% increase in project NPV.

Capital cost is the least sensitive parameter to the overall project economics. With a 20% increase in the capital cost, the NPV (5%) drops by 19% to \$337 million. The smaller impact is partially a result of the leasing of mine equipment so the sensitivity affects the operating cost more than the capital cost. If the capital costs are reduced by 20%, the NPV rises to \$498 million, a 19% improvement.

**Table 22-6: NPV Sensitivity (\$M) – Post-Tax**

| Sensitivity Item | -20 % | -10 % | Base | 10 % | 20 % |
|------------------|-------|-------|------|------|------|
| Gold Price       | 30    | 227   | 418  | 608  | 799  |
| Capital Cost     | 498   | 458   | 418  | 378  | 337  |
| Operating Cost   | 630   | 523   | 418  | 312  | 205  |

**Table 22-7: IRR % Sensitivity – Post-Tax**

| Sensitivity Item | -20 % | -10 % | Base | 10 % | 20 % |
|------------------|-------|-------|------|------|------|
| Gold Price       | 5.9   | 11.3  | 16.1 | 20.5 | 24.7 |
| Capital Cost     | 20.7  | 18.2  | 16.1 | 14.3 | 12.8 |
| Operating Cost   | 21.1  | 18.6  | 16.1 | 13.4 | 10.6 |

The impact of discount rate was also considered; a comparison to gold prices is shown in Table 22-8.



**Table 22-8: Sensitivity to Gold Price and Discount Rate**

|               | Gold Price (\$/oz) |       |       |       |       |       |       |       |       |       |
|---------------|--------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| NPV (\$M)     |                    | 1,100 | 1,150 | 1,200 | 1,250 | 1,300 | 1,350 | 1,400 | 1,450 | 1,500 |
| Discount Rate | 0.0%               | 516   | 653   | 789   | 926   | 1,062 | 1,198 | 1,335 | 1,472 | 1,610 |
|               | 2.5%               | 274   | 373   | 472   | 571   | 670   | 768   | 867   | 966   | 1,065 |
|               | <b>5.0%</b>        | 123   | 197   | 271   | 344   | 418   | 491   | 564   | 637   | 711   |
|               | 7.5%               | 27    | 84    | 141   | 197   | 253   | 308   | 364   | 420   | 476   |
|               | 10.0%              | -33   | 11    | 55    | 99    | 142   | 186   | 229   | 272   | 316   |
|               | 12.5%              | -72   | -37   | -2    | 33    | 68    | 102   | 137   | 171   | 206   |

## 22.7 Cash Costs

Various cash cost estimations are made to conform to Standard Reporting practices. Table 22-9 and Table 22-10 show the cash cost per ounce and cash cost per tonne milled.

**Table 22-9: Base Case Costs - \$/oz**

| Cost Category                                   | Year 1 to 6 | Year 7 to 21 | LOM <sup>(1)</sup> |
|-------------------------------------------------|-------------|--------------|--------------------|
| <b>Cash Cost</b>                                |             |              |                    |
| Open Pit Mining                                 | 383         | 373          | 388                |
| Processing                                      | 182         | 279          | 253                |
| G&A                                             | 69          | 63           | 65                 |
| <b>Total Operating Cost</b>                     | <b>634</b>  | <b>715</b>   | <b>706</b>         |
| Royalties                                       | 13          | 13           | 13                 |
| <b>Total Operating Cost including Royalties</b> | <b>647</b>  | <b>727</b>   | <b>719</b>         |
| Refining                                        | 23          | 23           | 23                 |
| <b>Total Cash Cost</b>                          | <b>670</b>  | <b>750</b>   | <b>742</b>         |
| <b>Capital Cost</b>                             |             |              |                    |
| Open Pit Mining                                 | 7           | 12           | 14                 |
| Processing                                      | 20          | 27           | 58                 |
| Infrastructure                                  | 12          | 3            | 27                 |
| Environmental Costs                             | 0           | 4            | 3                  |
| Owners Costs/Indirects                          | 36          | 17           | 42                 |
| Contingency                                     | 16          | 10           | 19                 |
| Tax (Importation)                               | 12          | 10           | 18                 |
| <b>Total Capital Cost</b>                       | <b>104</b>  | <b>83</b>    | <b>181</b>         |
| Taxes (Income with credits)                     | 32          | 90           | 74                 |
| <b>Total Mine Site Cost (inc. Tax)</b>          | <b>805</b>  | <b>923</b>   | <b>997</b>         |

**Note:** <sup>(1)</sup> LOM includes pre-production values



**Table 22-10: Base Case Costs - \$/t Mill Feed**

| Cost Category                                   | Year 1 to 6  | Year 7 to 21 | LOM <sup>(1)</sup> |
|-------------------------------------------------|--------------|--------------|--------------------|
| <b>Cash Cost</b>                                |              |              |                    |
| Open Pit Mining                                 | 19.27        | 11.42        | 13.25              |
| Processing                                      | 9.13         | 8.53         | 8.64               |
| G&A                                             | 3.49         | 1.93         | 2.22               |
| <b>Total Operating Cost</b>                     | <b>31.89</b> | <b>21.88</b> | <b>24.11</b>       |
| Royalties                                       | 0.64         | 0.39         | 0.44               |
| <b>Total Operating Cost including Royalties</b> | <b>32.53</b> | <b>22.27</b> | <b>24.55</b>       |
| Refining                                        | 1.16         | 0.71         | 0.79               |
| <b>Total Cash Cost</b>                          | <b>33.69</b> | <b>22.98</b> | <b>25.34</b>       |
| <b>Capital Cost</b>                             |              |              |                    |
| Open Pit Mining                                 | 0.37         | 0.37         | 0.49               |
| Processing                                      | 1.00         | 0.83         | 1.97               |
| Infrastructure                                  | 0.61         | 0.09         | 0.92               |
| Environmental Costs                             | 0.00         | 0.12         | 0.10               |
| Owners Costs/Indirects                          | 1.84         | 0.53         | 1.43               |
| Contingency                                     | 0.81         | 0.30         | 0.67               |
| Tax (Importation)                               | 0.60         | 0.45         | 0.62               |
| <b>Total Capital Cost</b>                       | <b>5.23</b>  | <b>2.69</b>  | <b>6.20</b>        |
| Taxes (Income with credits)                     | 1.60         | 2.75         | 2.54               |
| <b>Total Mine Site Cost (inc. Tax)</b>          | <b>40.51</b> | <b>28.42</b> | <b>34.07</b>       |

**Note:** <sup>(1)</sup> LOM includes pre-production values

## 22.8 Detailed Cash Flow

Table 22-11 shows the base case cash flow. This includes the mine schedule, gold recovery and payable calculations, operating costs, capital costs, revenue estimates, taxation calculations, and pre-tax and post-tax cash flows. For each of the cash flows the NPV and IRR have been determined.



**Table 22-11: Base Case Cash Flow**

|                                            | Unit          | Total<br>(t/d)     | Year -3     | Year -2      | Year -1           | Year 1            | Year 2            | Year 3            |
|--------------------------------------------|---------------|--------------------|-------------|--------------|-------------------|-------------------|-------------------|-------------------|
| <b>Mill Production</b>                     |               |                    |             |              |                   |                   |                   |                   |
| Mill Feed                                  | tonnes        | 102,760,773        |             |              | 378,000           | 3,000,000         | 3,000,000         | 3,000,000         |
| Gold Grade                                 | g/t           | 1.14               |             |              | 1.80              | 1.80              | 1.81              | 1.66              |
| Gold Recovered                             | ounces        | 3,513,498          |             |              | 20,851            | 164,877           | 164,761           | 150,172           |
| Gold Payable                               | ounces        | 3,509,985          |             |              | 20,830            | 164,712           | 164,597           | 150,022           |
| Average Recovery                           | %             | 92.3               |             |              | 95.4              | 94.7              | 94.4              | 93.7              |
| <b>Mine Production – Open Pit</b>          |               |                    |             |              |                   |                   |                   |                   |
| Feed to Mill                               | tonnes        | 74,128,319         |             |              | 312,270           | 3,000,000         | 3,000,000         | 3,000,000         |
| Feed to Stockpile                          | tonnes        | 28,632,450         |             |              | 1,158,243         | 2,893,766         | 2,704,142         | 3,229,647         |
| Stockpile to Mill                          | tonnes        | 28,632,454         |             |              | 65,730            | -                 | -                 | -                 |
| Waste                                      | tonnes        | 442,067,449        |             |              | 19,644,845        | 18,420,988        | 20,284,966        | 18,920,998        |
| <b>Total Material</b>                      | <b>tonnes</b> | <b>573,460,672</b> | <b>-</b>    | <b>-</b>     | <b>21,181,089</b> | <b>24,314,754</b> | <b>25,989,108</b> | <b>25,150,646</b> |
| Strip Ratio                                |               | 4.30               | -           | -            | 51.97             | 6.14              | 6.76              | 6.31              |
| <b>Operating Cost</b>                      |               |                    |             |              |                   |                   |                   |                   |
| Open Pit Mining                            | dollars       | 1,361,283,885      |             |              | 50,787,668        | 57,695,424        | 57,642,622        | 60,609,426        |
| Processing                                 | dollars       | 887,748,537        |             |              | 3,451,144         | 27,390,000        | 27,390,000        | 27,390,000        |
| G&A                                        | dollars       | 228,572,250        |             |              | 2,584,650         | 10,278,600        | 10,286,600        | 10,500,600        |
| Subtotal Operating                         | dollars       | 2,477,604,672      | 0           | 0            | 56,823,463        | 95,364,024        | 95,319,222        | 98,500,026        |
| <b>Capital Cost</b>                        |               |                    |             |              |                   |                   |                   |                   |
| Open Pit Mining                            | dollars       | 50,791,000         | 0           |              | 12,596,800        | 3,155,000         | 471,400           | 144,000           |
| Underground Mining                         | dollars       | 0                  | 0           | 0            | 0                 | 0                 | 0                 | 0                 |
| Processing                                 | dollars       | 202,275,423        | 0           | 57,215,900   | 57,215,900        | 0                 | 0                 | 200,273           |
| Infrastructure                             | dollars       | 94,822,501         | 21,730,138  | 35,921,267   | 18,352,970        | 6,395,714         | 0                 | 0                 |
| Environment Costs                          | dollars       | 10,000,000         | 0           | 0            | 0                 | 0                 | 0                 | 0                 |
| Owners Cost / Indirect                     | dollars       | 146,492,595        | 9,778,562   | 32,698,995   | 26,406,470        | 15,250,297        | 72,000            | 364,400           |
| Contingency                                | dollars       | 68,476,989         | 3,259,521   | 14,337,287   | 10,786,808        | 5,746,254         | 72,000            | 364,400           |
| Tax Importation (non-recoverable)          | dollars       | 41,831,207         | 2,335,231   | 9,326,203    | 8,491,383         | 2,312,809         | 50,675            | 66,087            |
| Tax Importation (Recoverable)              | dollars       | 22,337,510         | 951,071     | 3,798,289    | 3,458,292         | 1,507,476         | 33,029            | 43,075            |
| Subtotal Capital                           | dollars       | 637,027,225        | 38,054,524  | 153,297,942  | 137,308,623       | 34,367,550        | 699,104           | 1,182,235         |
| <b>Revenue(after refining + royalties)</b> |               |                    |             |              |                   |                   |                   |                   |
| Gold Revenue                               | dollars       | 4,562,980,226      | -           | -            | 27,078,993        | 214,125,221       | 213,975,643       | 195,028,509       |
| Less Refining Costs                        | dollars       | 80,810,461         | -           | -            | 479,569           | 3,792,161         | 3,789,512         | 3,453,958         |
| Less NSR Royalty                           | dollars       | 44,821,698         | -           | -            | 265,994           | 2,103,331         | 2,101,861         | 1,915,746         |
| Net Revenue after refining & royalty       | dollars       | 4,437,348,067      | -           | -            | 26,333,429        | 208,229,729       | 208,084,269       | 189,658,805       |
| <b>Pre-tax Cash Flow</b>                   |               |                    |             |              |                   |                   |                   |                   |
| Operating Cost                             | dollars       | 2,477,602,000      | 0           | 0            | 56,823,000        | 95,364,000        | 95,319,000        | 98,500,000        |
| Capital Cost                               | dollars       | 637,030,000        | 38,055,000  | 153,298,000  | 137,309,000       | 34,368,000        | 699,000           | 1,182,000         |
| Revenue                                    | dollars       | 4,437,347,000      | 0           | 0            | 26,333,000        | 208,230,000       | 208,084,000       | 189,659,000       |
| Pre-tax Cash Flow                          | dollars       | 1,322,715,000      | -38,055,000 | -153,298,000 | -167,799,000      | 78,498,000        | 112,066,000       | 89,977,000        |
| Pre-tax Cumulative                         | dollars       |                    | -38,055,000 | -191,353,000 | -359,152,000      | -280,654,000      | -168,588,000      | -78,611,000       |
| <b>Pre-tax NPV (millions) @</b>            |               |                    |             |              |                   |                   |                   |                   |
|                                            | 0%            | \$1,323            |             |              |                   |                   |                   |                   |
|                                            | 5%            | \$533              |             |              |                   |                   |                   |                   |
|                                            | 10%           | \$198              |             |              |                   |                   |                   |                   |
| <b>Payback Period</b>                      |               |                    |             |              |                   |                   |                   |                   |
| IRR                                        | years         | 4.0                |             |              |                   |                   |                   |                   |
|                                            | %             | 17.7               |             |              |                   |                   |                   |                   |
| <b>Post-tax Cash Flow</b>                  |               |                    |             |              |                   |                   |                   |                   |
| Pre-Tax Cash Flow                          | dollars       | 1,322,715,000      | -38,055,000 | -153,298,000 | -167,799,000      | 78,498,000        | 112,066,000       | 89,977,000        |
| Income Tax                                 | dollars       | -431,469,788       | 0           | 0            | 0                 | -16,049,920       | -15,303,191       | -14,046,987       |
| SUDAM Incentive                            | dollars       | 148,516,841        | 0           | 0            | 0                 | 8,851,059         | 8,439,260         | 7,746,500         |
| Tax Credits Compensation                   | dollars       | 22,337,510         | 0           | 0            | 0                 | 9,715,129         | 33,029            | 43,075            |
| Post-tax Cash Flow                         | dollars       | 1,062,099,563      | -38,055,000 | -153,298,000 | -167,799,000      | 81,014,267        | 105,235,098       | 83,719,588        |
| Post-tax Cumulative                        | dollars       |                    | -38,055,000 | -191,353,000 | -359,152,000      | -278,137,733      | -172,902,635      | -89,183,046       |
| <b>Post-tax NPV (millions) @</b>           |               |                    |             |              |                   |                   |                   |                   |
|                                            | 0%            | \$1,062            |             |              |                   |                   |                   |                   |
|                                            | 5%            | \$418              |             |              |                   |                   |                   |                   |
|                                            | 10%           | \$142              |             |              |                   |                   |                   |                   |
| <b>Payback Period</b>                      |               |                    |             |              |                   |                   |                   |                   |
| IRR                                        | years         | 4.2                |             |              |                   |                   |                   |                   |
|                                            | %             | 16.1               |             |              |                   |                   |                   |                   |

**BELO SUN MINING CORP.**
**PRELIMINARY ECONOMIC ASSESSMENT, NI 43-101**
**VOLTA GRANDE PROJECT**
**PARÁ, BRAZIL**


|                                            | Unit    | Total<br>(t/d) | Year 4      | Year 5      | Year 6      | Year 7      | Year 8      | Year 9      |
|--------------------------------------------|---------|----------------|-------------|-------------|-------------|-------------|-------------|-------------|
| <b>Mill Production</b>                     |         |                |             |             |             |             |             |             |
| Mill Feed                                  | tonnes  | 102,760,773    | 3,000,000   | 3,000,000   | 3,000,000   | 3,000,000   | 4,500,000   | 6,000,000   |
| Gold grade                                 | g/t     | 1.14           | 1.56        | 1.58        | 1.57        | 1.45        | 0.92        | 0.93        |
| Gold Recovered                             | ounces  | 3,513,498      | 140,943     | 143,269     | 141,790     | 129,652     | 122,060     | 162,414     |
| Gold Payable                               | ounces  | 3,509,985      | 140,802     | 143,125     | 141,648     | 129,523     | 121,938     | 162,252     |
| Average Recovery                           | %       | 92.3           | 93.6        | 94.2        | 93.9        | 92.9        | 92.0        | 90.2        |
| <b>Mine Production – Open Pit</b>          |         |                |             |             |             |             |             |             |
| Feed to Mill                               | tonnes  | 74,128,319     | 2,633,564   | 2,900,191   | 3,000,000   | 3,000,000   | 2,697,659   | 4,333,284   |
| Feed to Stockpile                          | tonnes  | 28,632,450     | 3,179,121   | 2,700,257   | 2,108,312   | 1,498,326   | 563,329     | 830,149     |
| Stockpile to Mill                          | tonnes  | 28,632,454     | 366,436     | 99,809      | -           | -           | 1,802,341   | 1,666,716   |
| Waste                                      | tonnes  | 442,067,449    | 18,706,214  | 18,368,305  | 19,023,119  | 19,193,582  | 20,459,047  | 42,493,440  |
| Total Material                             | tonnes  | 573,460,672    | 24,885,336  | 24,068,563  | 24,131,431  | 23,691,909  | 25,522,376  | 49,323,588  |
| Strip Ratio                                |         | 4.30           | 6.24        | 6.12        | 6.34        | 6.40        | 4.55        | 7.08        |
| <b>Operating Cost</b>                      |         |                |             |             |             |             |             |             |
| Open Pit Mining                            | dollars | 1,361,283,885  | 62,932,776  | 55,982,685  | 51,991,120  | 52,682,661  | 56,387,209  | 102,743,777 |
| Processing                                 | dollars | 887,748,537    | 27,390,003  | 27,390,002  | 27,389,996  | 27,390,000  | 38,294,998  | 51,059,997  |
| G&A                                        | dollars | 228,572,250    | 10,524,600  | 10,584,600  | 10,611,600  | 10,452,600  | 11,574,600  | 13,230,600  |
| Subtotal Operating                         | dollars | 2,477,604,672  | 100,847,379 | 93,957,287  | 89,992,716  | 90,525,261  | 106,256,807 | 167,034,374 |
| <b>Capital Cost</b>                        |         |                |             |             |             |             |             |             |
| Open Pit Mining                            | dollars | 50,791,000     | 953,800     | 627,600     | 1,298,000   | 5,344,800   | 1,531,200   | 10,943,800  |
| Underground Mining                         | dollars | 0              | 0           | 0           | 0           | 0           | 0           | 0           |
| Processing                                 | dollars | 202,275,423    | 400,545     | 200,273     | 17,168,179  | 51,504,538  | 17,168,179  | 0           |
| Infrastructure                             | dollars | 94,822,501     | 0           | 0           | 4,582,356   | 7,840,057   | 0           | 0           |
| Environment Costs                          | dollars | 10,000,000     | 0           | 0           | 0           | 0           | 0           | 0           |
| Owners Cost / Indirect                     | dollars | 146,492,595    | 201,300     | 171,000     | 16,973,585  | 20,075,659  | 17,688,425  | 280,100     |
| Contingency                                | dollars | 68,476,989     | 201,300     | 171,000     | 8,013,550   | 7,609,871   | 10,103,097  | 280,100     |
| Tax Importation (non-recoverable)          | dollars | 41,831,207     | 145,071     | 93,149      | 3,732,248   | 7,904,733   | 3,393,331   | 1,046,681   |
| Tax Importation (Recoverable)              | dollars | 22,337,510     | 94,557      | 60,714      | 2,432,659   | 5,152,262   | 2,211,755   | 682,221     |
| Subtotal Capital                           | dollars | 637,027,225    | 1,996,573   | 1,323,737   | 54,200,577  | 105,431,919 | 52,095,987  | 13,232,901  |
| <b>Revenue(after refining + royalties)</b> |         |                |             |             |             |             |             |             |
| Gold Revenue                               | dollars | 4,562,980,226  | 183,042,455 | 186,063,064 | 184,142,588 | 168,379,252 | 158,519,956 | 210,927,291 |
| Less Refining Costs                        | dollars | 80,810,461     | 3,241,685   | 3,295,180   | 3,261,169   | 2,982,000   | 2,807,391   | 3,735,526   |
| Less NSR Royalty                           | dollars | 44,821,698     | 1,798,008   | 1,827,679   | 1,808,814   | 1,653,973   | 1,557,126   | 2,071,918   |
| Net Revenue after refining & royalty       | dollars | 4,437,348,067  | 178,002,762 | 180,940,205 | 179,072,606 | 163,743,280 | 154,155,439 | 205,119,848 |
| <b>Pre-Tax Cash Flow</b>                   |         |                |             |             |             |             |             |             |
| Operating Cost                             | dollars | 2,477,602,000  | 100,847,000 | 93,957,000  | 89,993,000  | 90,525,000  | 106,257,000 | 167,034,000 |
| Capital Cost                               | dollars | 637,030,000    | 1,997,000   | 1,324,000   | 54,201,000  | 105,432,000 | 52,096,000  | 13,233,000  |
| Revenue                                    | dollars | 4,437,347,000  | 178,003,000 | 180,940,000 | 179,073,000 | 163,743,000 | 154,155,000 | 205,120,000 |
| Pre-Tax Cash Flow                          | dollars | 1,322,715,000  | 75,159,000  | 85,659,000  | 34,879,000  | -32,214,000 | -4,198,000  | 24,853,000  |
| Pre-Tax Cumulative                         | dollars |                | -3,452,000  | 82,207,000  | 117,086,000 | 84,872,000  | 80,674,000  | 105,527,000 |
| <b>Pre-tax NPV (millions) @</b>            |         |                |             |             |             |             |             |             |
|                                            | 0%      | \$1,323        |             |             |             |             |             |             |
|                                            | 5%      | \$533          |             |             |             |             |             |             |
|                                            | 10%     | \$198          |             |             |             |             |             |             |
| <b>Payback Period</b>                      |         |                |             |             |             |             |             |             |
|                                            | years   | 4.0            |             |             |             |             |             |             |
| <b>IRR</b>                                 |         |                |             |             |             |             |             |             |
|                                            | %       | 17.7           |             |             |             |             |             |             |
| <b>Post-tax Cash Flow</b>                  |         |                |             |             |             |             |             |             |
| Pre-tax Cash Flow                          | dollars | 1,322,715,000  | 75,159,000  | 85,659,000  | 34,879,000  | -32,214,000 | -4,198,000  | 24,853,000  |
| Income Tax                                 | dollars | -431,469,788   | -9,663,550  | -13,953,376 | -22,637,502 | -15,059,518 | -1,256,584  | 0           |
| SUDAM Incentive                            | dollars | 148,516,841    | 5,329,163   | 7,694,876   | 12,483,916  | 8,304,881   | 692,969     | 0           |
| Tax Credits Compensation                   | dollars | 22,337,510     | 94,557      | 60,714      | 2,432,659   | 5,152,262   | 1,256,584   | 0           |
| Post-tax Cash Flow                         | dollars | 1,062,099,563  | 70,919,170  | 79,461,215  | 27,158,074  | -33,816,374 | -3,505,031  | 24,853,000  |
| Post-tax Cumulative                        | dollars |                | -18,263,876 | 61,197,339  | 88,355,412  | 54,539,038  | 51,034,007  | 75,887,007  |
| <b>Post-tax NPV (millions) @</b>           |         |                |             |             |             |             |             |             |
|                                            | 0%      | \$1,062        |             |             |             |             |             |             |
|                                            | 5%      | \$418          |             |             |             |             |             |             |
|                                            | 10%     | \$142          |             |             |             |             |             |             |
| <b>Payback Period</b>                      |         |                |             |             |             |             |             |             |
|                                            | years   | 4.2            |             |             |             |             |             |             |
| <b>IRR</b>                                 |         |                |             |             |             |             |             |             |
|                                            | %       | 16.1           |             |             |             |             |             |             |



|                                             | Unit          | Total<br>(t/d)     | Year 10           | Year 11           | Year 12           | Year 13           | Year 14           | Year 15           |
|---------------------------------------------|---------------|--------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| <b>Mill Production</b>                      |               |                    |                   |                   |                   |                   |                   |                   |
| Mill Feed                                   | tonnes        | 102,760,773        | 6,000,000         | 6,000,000         | 6,000,000         | 6,000,000         | 6,000,000         | 6,000,000         |
| Gold grade                                  | g/t           | 1.14               | 0.92              | 1.18              | 1.26              | 1.22              | 1.36              | 1.51              |
| Gold Recovered                              | ounces        | 3,513,498          | 160,840           | 208,728           | 226,491           | 220,270           | 247,621           | 276,856           |
| Gold Payable                                | ounces        | 3,509,985          | 160,679           | 208,519           | 226,265           | 220,050           | 247,373           | 276,579           |
| Average Recovery                            | %             | 92.3               | 90.3              | 92.1              | 93.0              | 93.6              | 94.3              | 94.9              |
| <b>Mine Production – Open Pit</b>           |               |                    |                   |                   |                   |                   |                   |                   |
| Feed to Mill                                | tonnes        | 74,128,319         | 4,748,292         | 6,000,000         | 6,000,000         | 6,000,000         | 6,000,000         | 6,000,000         |
| Feed to Stockpile                           | tonnes        | 28,632,450         | 1,048,808         | 974,751           | 959,761           | 1,059,067         | 880,559           | 1,225,604         |
| Stockpile to Mill                           | tonnes        | 28,632,454         | 1,251,708         | -                 | -                 | -                 | -                 | -                 |
| Waste                                       | tonnes        | 442,067,449        | 41,935,177        | 40,314,115        | 38,671,408        | 32,286,402        | 27,317,223        | 19,306,179        |
| <b>Total Material</b>                       | <b>tonnes</b> | <b>573,460,672</b> | <b>48,983,985</b> | <b>47,288,866</b> | <b>45,631,169</b> | <b>39,345,469</b> | <b>34,197,782</b> | <b>26,531,783</b> |
| Strip Ratio                                 |               | 4.30               | 6.99              | 6.72              | 6.45              | 5.38              | 4.55              | 3.22              |
| <b>Operating Cost</b>                       |               |                    |                   |                   |                   |                   |                   |                   |
| Open Pit Mining                             | dollars       | 1,361,283,885      | 105,897,803       | 108,223,696       | 108,767,846       | 102,482,832       | 87,592,222        | 74,197,954        |
| Processing                                  | dollars       | 887,748,537        | 51,059,997        | 51,060,000        | 51,060,000        | 51,060,004        | 51,059,998        | 51,060,000        |
| G&A                                         | dollars       | 228,572,250        | 12,866,600        | 12,926,600        | 12,762,600        | 12,697,600        | 12,562,600        | 11,811,600        |
| Subtotal Operating                          | dollars       | 2,477,604,672      | 169,824,401       | 172,210,296       | 172,590,446       | 166,240,436       | 151,214,820       | 137,069,554       |
| <b>Capital Cost</b>                         |               |                    |                   |                   |                   |                   |                   |                   |
| Open Pit Mining                             | dollars       | 50,791,000         | 830,200           | 1,428,400         | 7,605,200         | 677,200           | 2,037,200         | 966,400           |
| Underground Mining                          | dollars       | 0                  | 0                 | 0                 | 0                 | 0                 | 0                 | 0                 |
| Processing                                  | dollars       | 202,275,423        | 0                 | 200,273           | 200,273           | 200,273           | 200,273           | 0                 |
| Infrastructure                              | dollars       | 94,822,501         | 0                 | 0                 | 0                 | 0                 | 0                 | 0                 |
| Environment Costs                           | dollars       | 10,000,000         | 0                 | 0                 | 0                 | 0                 | 0                 | 0                 |
| Owners Cost / Indirect                      | dollars       | 146,492,595        | 749,200           | 3,239,600         | 451,200           | 1,018,600         | 473,200           | 28,000            |
| Contingency                                 | dollars       | 68,476,989         | 749,200           | 3,239,600         | 451,200           | 1,018,600         | 473,200           | 28,000            |
| Tax Importation (Non-recoverable)           | dollars       | 41,831,207         | 147,286           | 453,989           | 769,973           | 176,818           | 252,783           | 92,732            |
| Tax Importation (Recoverable)               | dollars       | 22,337,510         | 96,000            | 295,908           | 501,864           | 115,249           | 164,762           | 60,442            |
| Subtotal Capital                            | dollars       | 637,027,225        | 2,571,887         | 8,857,769         | 9,979,710         | 3,206,739         | 3,601,418         | 1,175,575         |
| <b>Revenue (after refining + royalties)</b> |               |                    |                   |                   |                   |                   |                   |                   |
| Gold Revenue                                | dollars       | 4,562,980,226      | 208,882,885       | 271,074,667       | 294,144,215       | 286,065,184       | 321,585,453       | 359,552,757       |
| Less Refining Costs                         | dollars       | 80,810,461         | 3,699,320         | 4,800,737         | 5,209,299         | 5,066,219         | 5,695,284         | 6,367,686         |
| Less NSR Royalty                            | dollars       | 44,821,698         | 2,051,836         | 2,662,739         | 2,889,349         | 2,809,990         | 3,158,902         | 3,531,851         |
| Net Revenue after Refining & Royalties      | dollars       | 4,437,348,067      | 203,131,730       | 263,611,191       | 286,045,567       | 278,188,975       | 312,731,267       | 349,653,221       |
| <b>Pre-Tax Cash Flow</b>                    |               |                    |                   |                   |                   |                   |                   |                   |
| Operating Cost                              | dollars       | 2,477,602,000      | 169,824,000       | 172,210,000       | 172,590,000       | 166,240,000       | 151,215,000       | 137,070,000       |
| Capital Cost                                | dollars       | 637,030,000        | 2,572,000         | 8,858,000         | 9,980,000         | 3,207,000         | 3,601,000         | 1,176,000         |
| Revenue                                     | dollars       | 4,437,347,000      | 203,132,000       | 263,611,000       | 286,046,000       | 278,189,000       | 312,731,000       | 349,653,000       |
| Pre-Tax Cash Flow                           | dollars       | 1,322,715,000      | 30,736,000        | 82,543,000        | 103,476,000       | 108,742,000       | 157,915,000       | 211,407,000       |
| Pre-Tax Cumulative                          | dollars       |                    | 136,263,000       | 218,806,000       | 322,282,000       | 431,024,000       | 588,939,000       | 800,346,000       |
| <b>Pre-tax NPV (millions) @</b>             |               |                    |                   |                   |                   |                   |                   |                   |
|                                             | 0%            | \$1,323            |                   |                   |                   |                   |                   |                   |
|                                             | 5%            | \$533              |                   |                   |                   |                   |                   |                   |
|                                             | 10%           | \$198              |                   |                   |                   |                   |                   |                   |
| <b>Payback Period</b>                       | years         | 4.0                |                   |                   |                   |                   |                   |                   |
| <b>IRR</b>                                  | %             | 17.7               |                   |                   |                   |                   |                   |                   |
| <b>Post-tax Cash Flow</b>                   |               |                    |                   |                   |                   |                   |                   |                   |
| Pre-Tax Cash Flow                           | dollars       | 1,322,715,000      | 30,736,000        | 82,543,000        | 103,476,000       | 108,742,000       | 157,915,000       | 211,407,000       |
| Income Tax                                  | dollars       | -431,469,788       | 0                 | -12,299,895       | -21,116,015       | -29,238,761       | -48,036,313       | -65,231,478       |
| SUDAM Incentive                             | dollars       | 148,516,841        | 0                 | 3,391,515         | 5,822,430         | 8,062,158         | 13,245,307        | 17,986,621        |
| Tax Credits Compensation                    | dollars       | 22,337,510         | 0                 | 2,029,299         | 501,864           | 115,249           | 164,762           | 60,442            |
| Post-Tax Cash Flow                          | dollars       | 1,062,099,563      | 30,736,000        | 75,663,920        | 88,684,280        | 87,680,646        | 123,288,756       | 164,222,585       |
| Post-tax Cumulative                         | dollars       |                    | 106,623,007       | 182,286,927       | 270,971,207       | 358,651,853       | 481,940,609       | 646,163,194       |
| <b>Post-tax NPV (millions) @</b>            |               |                    |                   |                   |                   |                   |                   |                   |
|                                             | 0%            | \$1,062            |                   |                   |                   |                   |                   |                   |
|                                             | 5%            | \$418              |                   |                   |                   |                   |                   |                   |
|                                             | 10%           | \$142              |                   |                   |                   |                   |                   |                   |
| <b>Payback Period</b>                       | years         | 4.2                |                   |                   |                   |                   |                   |                   |
| <b>IRR</b>                                  | %             | 16.1               |                   |                   |                   |                   |                   |                   |



|                                             | Unit          | Total<br>(t/d)     | Year 16           | Year 17           | Year 18           | Year 19           | Year 20          | Year 21          |
|---------------------------------------------|---------------|--------------------|-------------------|-------------------|-------------------|-------------------|------------------|------------------|
| <b>Mill Production</b>                      |               |                    |                   |                   |                   |                   |                  |                  |
| Mill Feed                                   | tonnes        | 102,760,773        | 6,000,000         | 6,000,000         | 6,000,000         | 6,000,000         | 6,000,000        | 4,882,773        |
| Gold grade                                  | g/t           | 1.14               | 1.41              | 1.02              | 0.77              | 0.65              | 0.48             | 0.45             |
| Gold Recovered                              | ounces        | 3,513,498          | 257,713           | 180,238           | 137,201           | 112,887           | 78,768           | 65,095           |
| Gold Payable                                | ounces        | 3,509,985          | 257,456           | 180,058           | 137,064           | 112,774           | 78,689           | 65,030           |
| Average Recovery                            | %             | 92.3               | 95.0              | 91.6              | 92.5              | 90.7              | 84.2             | 92.3             |
| <b>Mine Production – Open Pit</b>           |               |                    |                   |                   |                   |                   |                  |                  |
| Feed to Mill                                | tonnes        | 74,128,319         | 6,000,000         | 3,230,197         | 1,411,495         | 861,367           | -                | -                |
| Feed to Stockpile                           | tonnes        | 28,632,450         | 804,891           | 410,012           | 235,939           | 167,766           | -                | -                |
| Stockpile to Mill                           | tonnes        | 28,632,454         | -                 | 2,769,803         | 4,588,505         | 5,138,633         | 6,000,000        | 4,882,773        |
| Waste                                       | tonnes        | 442,067,449        | 10,568,396        | 5,441,124         | 6,866,560         | 3,845,359         | -                | -                |
| <b>Total Material</b>                       | <b>tonnes</b> | <b>573,460,672</b> | <b>17,373,287</b> | <b>11,851,136</b> | <b>13,102,499</b> | <b>10,013,125</b> | <b>6,000,000</b> | <b>4,882,773</b> |
| Strip Ratio                                 |               | 4.30               | 1.76              | 0.91              | 1.14              | 0.64              | -                | -                |
| <b>Operating Cost</b>                       |               |                    |                   |                   |                   |                   |                  |                  |
| Open Pit Mining                             | dollars       | 1,361,283,885      | 55,823,340        | 37,035,486        | 34,132,231        | 21,131,185        | 9,034,686        | 7,509,234        |
| Processing                                  | dollars       | 887,748,537        | 51,060,000        | 51,060,000        | 51,060,000        | 51,060,000        | 51,060,000       | 41,552,398       |
| G&A                                         | dollars       | 228,572,250        | 9,977,600         | 9,371,600         | 9,489,600         | 8,646,600         | 7,428,600        | 7,401,600        |
| Subtotal Operating                          | dollars       | 2,477,604,672      | 116,860,940       | 97,467,086        | 94,681,831        | 80,837,785        | 67,523,286       | 56,463,232       |
| <b>Capital Cost</b>                         |               |                    |                   |                   |                   |                   |                  |                  |
| Open Pit Mining                             | dollars       | 50,791,000         | 36,000            | 0                 | 0                 | 144,000           | 0                | 0                |
| Underground Mining                          | dollars       | 0                  | 0                 | 0                 | 0                 | 0                 | 0                | 0                |
| Processing                                  | dollars       | 202,275,423        | 200,273           | 0                 | 200,273           | 0                 | 0                | 0                |
| Infrastructure                              | dollars       | 94,822,501         | 0                 | 0                 | 0                 | 0                 | 0                | 0                |
| Environment Costs                           | dollars       | 10,000,000         | 0                 | 0                 | 0                 | 3,000,000         | 4,000,000        | 3,000,000        |
| Owners Cost / Indirect                      | dollars       | 146,492,595        | 0                 | 0                 | 72,000            | 150,000           | 200,000          | 150,000          |
| Contingency                                 | dollars       | 68,476,989         | 0                 | 0                 | 72,000            | 450,000           | 600,000          | 450,000          |
| Tax Importation (non-recoverable)           | dollars       | 41,831,207         | 22,034            | 0                 | 25,391            | 307,181           | 391,669          | 293,752          |
| Tax Importation (Recoverable)               | dollars       | 22,337,510         | 14,361            | 0                 | 16,550            | 200,219           | 255,288          | 191,466          |
| Subtotal Capital                            | dollars       | 637,027,225        | 272,668           | 0                 | 386,213           | 4,251,399         | 5,446,957        | 4,085,218        |
| <b>Revenue (after refining + royalties)</b> |               |                    |                   |                   |                   |                   |                  |                  |
| Gold Revenue                                | dollars       | 4,562,980,226      | 334,692,458       | 234,075,017       | 178,183,251       | 146,606,707       | 102,296,246      | 84,538,415       |
| Less Refining Costs                         | dollars       | 80,810,461         | 5,927,409         | 4,145,473         | 3,155,629         | 2,596,407         | 1,811,668        | 1,497,177        |
| Less NSR Royalty                            | dollars       | 44,821,698         | 3,287,650         | 2,299,295         | 1,750,276         | 1,440,103         | 1,004,846        | 830,412          |
| Net Revenue after Refining & Royalties      | dollars       | 4,437,348,067      | 325,477,398       | 227,630,248       | 173,277,347       | 142,570,196       | 99,479,731       | 82,210,826       |
| <b>Pre-Tax Cash Flow</b>                    |               |                    |                   |                   |                   |                   |                  |                  |
| Operating Cost                              | dollars       | 2,477,602,000      | 116,861,000       | 97,467,000        | 94,682,000        | 80,838,000        | 67,523,000       | 56,463,000       |
| Capital Cost                                | dollars       | 637,030,000        | 273,000           | 0                 | 386,000           | 4,251,000         | 5,447,000        | 4,085,000        |
| Revenue                                     | dollars       | 4,437,347,000      | 325,477,000       | 227,630,000       | 173,277,000       | 142,570,000       | 99,480,000       | 82,211,000       |
| Pre-Tax Cash Flow                           | dollars       | 1,322,715,000      | 208,343,000       | 130,163,000       | 78,209,000        | 57,481,000        | 26,510,000       | 21,663,000       |
| Pre-Tax Cumulative                          | dollars       |                    | 1,008,689,000     | 1,138,852,000     | 1,217,061,000     | 1,274,542,000     | 1,301,052,000    | 1,322,715,000    |
| <b>Pre-tax NPV (millions) @</b>             |               |                    |                   |                   |                   |                   |                  |                  |
|                                             | 0%            | \$1,323            |                   |                   |                   |                   |                  |                  |
|                                             | 5%            | \$533              |                   |                   |                   |                   |                  |                  |
|                                             | 10%           | \$198              |                   |                   |                   |                   |                  |                  |
| <b>Payback Period</b>                       | years         | 4.0                |                   |                   |                   |                   |                  |                  |
| <b>IRR</b>                                  | %             | 17.7               |                   |                   |                   |                   |                  |                  |
| <b>Post-tax Cash Flow</b>                   |               |                    |                   |                   |                   |                   |                  |                  |
| Pre-Tax Cash Flow                           | dollars       | 1,322,715,000      | 208,343,000       | 130,163,000       | 78,209,000        | 57,481,000        | 26,510,000       | 21,663,000       |
| Income Tax                                  | dollars       | -431,469,788       | -63,919,354       | -38,464,320       | -21,684,952       | -16,697,824       | -5,990,910       | -819,339         |
| SUDAM Incentive                             | dollars       | 148,516,841        | 17,624,822        | 10,605,970        | 5,979,307         | 4,604,179         | 1,651,905        | -                |
| Tax Credits Compensation                    | dollars       | 22,337,510         | 14,361            | 0                 | 16,550            | 200,219           | 255,288          | 191,466          |
| Post-Tax Cash Flow                          | dollars       | 1,062,099,563      | 162,062,829       | 102,304,651       | 62,519,904        | 45,587,574        | 22,426,284       | 21,035,127       |
| Post-tax Cumulative                         | dollars       |                    | 808,226,024       | 910,530,675       | 973,050,578       | 1,018,638,152     | 1,041,064,436    | 1,062,099,563    |
| <b>Post-tax NPV (millions) @</b>            |               |                    |                   |                   |                   |                   |                  |                  |
|                                             | 0%            | \$1,062            |                   |                   |                   |                   |                  |                  |
|                                             | 5%            | \$418              |                   |                   |                   |                   |                  |                  |
|                                             | 10%           | \$142              |                   |                   |                   |                   |                  |                  |
| <b>Payback Period</b>                       | years         | 4.2                |                   |                   |                   |                   |                  |                  |
| <b>IRR</b>                                  | %             | 16.1               |                   |                   |                   |                   |                  |                  |



## **23 ADJACENT PROPERTIES**

There are no adjacent properties to the Project that are considered relevant to this report.



## **24 OTHER RELEVANT DATA AND INFORMATION**

AGP is not aware of any other relevant data or information that has not been previously stated in the report that affects the continued exploration or development activity at the Volta Grande property.



## **25 INTERPRETATION AND CONCLUSIONS**

### **25.1 Geology**

The Project is located on the Xingu River, north of the Carajás mineral province, approximately 60 km southeast of the City of Altamira.

The Project comprises 18 contiguous exploration permits, four mining concession applications, and 23 exploration applications, covering a total area of 178,559 ha. It is located in the municipality of Senador José Porfírio in the northern region of Pará State in northern Brazil.

Belo Sun holds 100% interest in the Project through its wholly owned subsidiary Verena. The Project comprises 18 exploration permits, covering an area of 99,168 ha; four mining concession application, covering an area of 2,356 ha, 14 exploration applications for exploration in mineral rights covering an area of 44,374 ha; and nine exploration applications for exploration in mineral rights in public tender, covering an area of 32,660 ha; five of the exploration applications in public tender are in a priority regime.

The Project area is situated along the northern boundary of the Carajás-Iricoumé Block of the Eastern Amazonian Craton. The Project area is located in the western portion of the west-northwest–trending Três Palmeiras Greenstone Belt, which is surrounded by the Xingu Complex of the Brazilian Shield in central Pará State. Rocks of the Xingu Complex are predominantly Archean basement granitic gneisses originating from tonalite, trondjemite, and granodiorite. In places, they may be migmatitic. The Xingu Complex is subdivided into groups, including the Igarapé Salobo, Igarapé Pojuca, Igarapé Bahia, Grão Pará, Buritirama, and Rio Fresco. All rocks in the area exhibit strong foliation, with a number of mylonitic zones and a steeply dipping attitude to the south. Other structures in the area include northeast, north-northeast, north-northwest, and east-trending faults.

The Project contains two target areas named the North and South blocks. The North Block contains two large mineralized areas: the Ouro Verde area in the northwestern part of the North Block, and the Grota Seca area, which contains the Grota Seca West, Grota Seca, and Grota Seca East areas along the southern part of the North Block. The South Block comprises three target areas: Pequi in the northern part, Grande in the southern part, and Itatá in the southeastern part. The North and South blocks include the old and new *garimpeiros* workings.



There are two types of gold mineralization at Volta Grande: primary gold in intrusive rock and secondary gold in saprolitic rock. Both types of gold mineralization occur within a major shear zone. In general, the gold mineralization in fresh rock occurs in zones of intense hydrothermal replacement and is associated with up to approximately 5% sulphides (pyrite and/or arsenopyrite) at Grotta Seca and Ouro Verde. Sulphide content in the South Block can be higher and is associated with regional north-striking cross faults.

Verena and Belo Sun drilled a combined total of 667 core boreholes (approximately 168,136 m) and 59 RC boreholes (11,225 m) at Ouro Verde and Grotta Seca in the North Block of the Volta Grande gold project.

Exploration work by Belo Sun is professionally managed and uses procedures consistent with generally accepted industry best practices. After their review, SRK is of the opinion that the exploration data collected by Belo Sun are sufficiently reliable to interpret with confidence the boundaries of the gold mineralization for Project's Ouro Verde, Grotta Seca, and South Block deposits.

The mineral resource model supporting the PEA was prepared by Belo Sun and was audited by SRK. It represents the eighth mineral resource evaluation prepared for the Project in accordance with the Canadian Securities Administrators' NI 43-101.

The mineral resource model considers 313 core boreholes (85,159 m) for the Ouro Verde deposit, 474 core boreholes and 59 reverse circulation boreholes (126,832 m) for the Grotta Seca deposit, and 95 core boreholes (21,318 m) for the South Block deposit. The drilling data were acquired by TVX (1996 to 1998), Verena (2006-2008), and Belo Sun (since 2010).

SRK also considers that the procedures used by Belo Sun for the evaluation and classification of mineral resources are in accordance with generally accepted CIM Estimation of Mineral Resource and Mineral Reserve Best Practices and Definition Standards for Mineral Resources and Mineral Reserves Guidelines.

Belo Sun has defined eight geological zones (including saprolite zones) in the Grotta Seca, and nine zones in the Ouro Verde deposits, and three in the South Block. Belo Sun has estimated gold grades for each of these deposits in a block model informed by composited gold assays, capped where appropriate, using an ordinary kriging estimator. Average specific gravity values of 2.75 and 1.36 were used to convert fresh rock and saprolite volumes into tonnage.

The audited Mineral Resources Statement prepared by SRK is reported at two cutoff grades reflecting two potential extraction scenarios. Open pit mineral resources are



reported at a cutoff grade of 0.50 g/t Au within a conceptual pit shell while underground mineral resources include all material above a cutoff grade of 2.00 g/t Au outside the conceptual pit envelopes.

SRK draws the following conclusions:

- An improved understanding of mineralization controls through structural geology studies can be instrumental in providing a better geological model to predict the form and shape of the gold mineralization and to improve the confidence in the mineral resources.
- Mineral resources can be upgraded in GS pending delineation drilling in the Galo trend area following structural investigations.
- Mineral resources can be expanded in the South Block deposit area by exploration drilling to extend known mineralization along strike and down dip in all three target areas.

## **25.2 Open Pit Mining**

The PEA for the Project is based on developing two open pits: Ouro Verde and Grota Seca. South Block was not considered in this PEA study.

The PEA utilizes only Measured and Indicated resources from Grota Seca and Ouro Verde for calculation of the economics. Some Inferred material has been incorporated as dilution and upgraded in category if a minor percentage occurs in the block. There is no certainty that the assumptions used in the PEA will be realized. Inferred mineral resources are considered too speculative geologically to have economic considerations applied to them that would enable them to be categorized as reserves. Mineral resources that are not mineral reserves do not have demonstrated economic viability.

The open pits will provide a combined 102.8 Mt of feed to the mill for processing over a 21-year mine life. LOM average grade is 1.14 g/t. Mining starts in Year -1 with a small quarry within the ultimate Ouro Verde pit. The object is to provide rock fill for road widening and the tailings dam. Feed material is available for milling in the last three months of Year -1. This is used in the commission of the mill. A total of 378,000 tonnes of feed at a grade of 1.80 g/t is used in the commissioning. The mill feed is maintained at 3 Mt/a for seven years at a grade of 1.63 g/t. Lower-grade material is stockpiled near the crusher for use later in the mine life, and assist during times when the pits may not be accessible due to high rainfall during the rainy season.

In Year 8 there is a planned plant expansion to 6 Mt/a. This requires feed of 4.5 Mt that year with an average grade of 0.92 g/t. The lower grade is a result of using a low-grade



stockpile while additional pit development is occurring. From Year 9 onwards, the mine will provide the mill with 6 Mt/a until the end of the mine in Year 21. The average feed grade during this time is estimated at 1.02 g/t. The lower grade is partly the result of reclaiming the low-grade stockpile material in the last five years, which had a grade of 0.52 g/t.

The pits have been phased to reduce initial stripping and provide higher grades in the early years of mine life. All the pit designs are based on a \$1,020 gold price for definition of the ultimate shell. The lower gold price than what was used in the economic analysis or resource statement was an effort to maximize the NPV of the Project. The additional phases to the ultimate pit limit showed increasing strip ratio that were better suited to mining in higher metal price environments. Internal phasing from the ultimate pits were then designed.

Ouro Verde is designed as a three-phase pit with logical expansions outwards from the starter pit. A quarry is designed as part of the third and final phase in an area where there is a rock outcrop. This outcrop has minimal saprolite and easy access to rock fill for construction. It was decided to advance a portion of Ouro Verde's Phase 3 to take advantage of this material.

Grota Seca is designed as a six-phase pit. The phases in were developed based on highest initial value, and also access development. Grota Seca is in terrain that is more undulating than Ouro Verde, so access considerations were of greater importance.

The mine equipment selection is staged to match the plant production. During the 3 Mt/a phase of milling, the mine equipment is based on DTH hammer drills with bits of 200 mm diameter. Five front-end loaders (14.5 m<sup>3</sup>) are used to load the saprolite and rock feed into fifteen haul trucks of 90-tonne capacity. One of the loaders will be stationed at the crusher to feed material from the mine trucks. The trucks are to be outfitted with suspended dump bodies to reduce carry-back of the saprolite material, and also reduced abrasion of the rock on truck box bodies. Support equipment will include two large backhoes in the pit to assist in grade control by separating feed from waste material. Support equipment in the form of track dozers, graders, and water trucks are part of the fleet.

A separate fleet of RC drills will handle grade control. They are responsible for drilling the entire pit areas on a grid and sending samples to the assay laboratory. The assay information will be used by the engineering and geology departments to update geological models and make the determination between feed material (high and low grade) and waste. There will be one drill in each pit with the sole task of determining the material grades up to 18 months in advance of mining.



Expansion of mill to 6 Mt/a in Year 8, with full production in Year 9, corresponds with the timing for major equipment replacement in the mine. The mine equipment fleet will continue to use the DTH drills (200 mm diameter bits), but loading and hauling units will increase in size and type. The loaders will be increased to 18 m<sup>3</sup> in capacity, but only two will be needed. Two hydraulic shovels will be added to the fleet, and they will have 22 m<sup>3</sup> buckets. Truck capacity increases to 136 tonnes, but will still use the suspended dump bodies. Support equipment type and sizing will remain the same as the earlier requirements. One front-end loader with a capacity of 14.5 m<sup>3</sup> will still be used at the crusher to tram stockpile material to the crusher as needed, and provide backup if necessary.

The LOM operating cost is estimated to be \$2.37/t material mined. This includes the grade control program at \$0.09/t mined and equipment leasing at \$0.34/t mined.

The mill feed and waste rock in the Project is expected to be NAG. Waste material will be stored in two waste rock management facilities (WMFs), as well as used for the tailings dams and the base of the low-grade stockpile. WMFs are sized to accommodate the 442 Mt of waste material. Concurrent re-sloping and reclamation of the WMF will minimize final reclamation requirements.

Geotechnical parameters will need to be continually revisited in the mining areas particularly in Grotta Seca. With the amount of shearing that has occurred the possibility exists of finding a previously unrecorded shear or fault. Operational monitoring of the slopes will be standard practice to ensure safety of the operations, and minimize disruption to the mining process.

Condemnation drilling has already occurred in the tailings-management and waste rock management areas.

## **25.3 Metallurgy and Process**

Metallurgical testwork programs on samples from the Project were carried out at SGS Chile in 2012 and again in 2013. The objectives of the testwork included flowsheet confirmation and the provision of feasibility-level design data. The following conclusions regarding the Volta Grande composites can be drawn from the metallurgical testwork completed to date:

- grindability testing of a composite samples revealed a moderate BBWi of 15.4 kWh/t and a BRWi of 16.0 kWh/t
- the composite samples were found to have above average abrasiveness, with Abrasion Index values as high as 0.496



- JK Drop Weight Axb values were low, averaging 27.8, indicating that the ore is highly resistant to fracture at coarse particle size
- optimum gold extraction by cyanidation was realized at a primary grind size P<sub>80</sub> of 75 µm
- whole ore cyanidation was found to result in gold extractions ranging from 84% to 97%, with head grade being the strongest determinant of overall extraction
- centrifugal gravity concentration was found to be capable of recovering 40% to 50% of the contained gold to concentrate at the target grind size P<sub>80</sub> of 75 µm
- cyanide consumption for the leach tests on the cyclone overflow were found to be low to moderate, and are estimated at 0.35 kg/t
- cyanide destruction tests using the INCO SO<sub>2</sub>-air process indicated that the pulp can be reduced below 1 ppm WAD-CN by this method
- at a Phase 1 feed grade of 1.66 g/t Au the estimated plant gold recovery is 94 1%.

Based on results of the testwork program, the composite samples from the Ouro Verde and Grota Seca deposits were found to be amenable to gold recovery by a conventional flow sheet consisting of the following unit operations: primary crushing, SAG milling, closed circuit ball milling with gravity concentration, intensive leach of the gravity concentrate, CIL of the cyclone overflow, elution, electrowinning, and sludge refining to doré.

## **25.4 Infrastructure and Site Layout**

The infrastructure and site layout plans take into consideration Belo Sun's commitments for environmental stewardship. Unit cost estimates from vendors were applied to the layout quantities to determine civil costs associated with the project. Subsequent study will need to update these quantities for detail costing in the future.

The site infrastructure for the Project includes main access road to site, camp facilities, laydown areas, offices, shops and warehouses, site roads to the tailings dam and pits, tailings management facility, raw-water storage, explosive storage, and settling ponds.

The process plant is located to the south of the Ouro Verde pit and west of the TMF. The facilities are on a levelled pad cut into the slope to optimize cut-and-fill quantities. Shop facilities for the mine will be located on a terrace to the east of the plant and the camp on the southeast side.

Power for the Project will be brought to the main substation south of the process plant for distribution around the site as required. Power will be provided to the Project under



a BOOT agreement with the local utility for the transmission line and the main substation to reduce up front capital costs.

The TMF for the Project is designed to contain the tailings solids generated by the milling process over the 21-year mine life. This is estimated to be 85.6 Mm<sup>3</sup> of tailings with a 1.2 t/m<sup>3</sup> density of solids. The starter dam is constructed initially of compacted soil. Subsequent lifts will comprise compacted saprolite on the upstream face, and rock fill from the mine on the downstream face. The main dam will be 64 m high when complete. A seepage pond below the dam will collect any seepage for return to the TMF.

Tailings will be pumped to the TMF via a pipeline. Water will be reclaimed from the TMF and returned to the plant via a dedicated reclaim water barge with pumps and a pipeline. Both the tailings and water-reclaim line will follow the access road from the process plant to the TMF.

Site drainage will be collected in a series of settling ponds throughout the Project. Two large ponds are located on the west and east sides of the process plant. These are to be used as the source of raw water for the plant process. Mine water collection is pumped to settling ponds near the pits. Water from these ponds is to be used for dust control on the roads, with the excess sent to the TMF or to the easternmost settling pond. Surface mine drainage will be diverted away from the mining to ensure contact with active mining areas does not occur. If contact does occur, it will be directed to these collection ponds.

Site roads are to be established with local borrow material including waste rock from the mine. This material is to be sourced from a rock quarry near the plant site and smaller borrow pits along the roads to minimize haulage distances. A road is needed early in the Project development sequence to provide construction access the TMF main dam. This road will be widened with material from the open pit when mining commences. The mine roads to the crusher and Grota Seca are to be widened with material from pre-stripping of the Ouro Verde pit.

## **25.5 Economic Analysis**

The Project has pre-tax NPV with a 5% discount rate of \$533 million using a base price for gold of \$1,300/oz. Post-tax NPV with the same 5% discount rate and \$1,300 gold price was \$418 million. IRR are respectively 17.7% pre-tax and 16.1% post-tax. Payback on the Project capital is expected to be 4 years pre-tax and 4.2 years post-tax.

The PEA largely utilizes only Measured and Indicated resources from Grota Seca and Ouro Verde for calculation of the economics. Some Inferred material has been incorporated as dilution and upgraded in category if a minor percentage occurs in the



block. There is no certainty that the assumptions utilized in the PEA will be realized. Inferred mineral resources are presently considered too speculative geologically to have economic considerations applied to them that would enable them to be categorized as reserves. Mineral resources that are not mineral reserves and do not have demonstrated economic viability.

The analysis was completed using 4Q 2013 values with no escalation assumed. The exchange rate is based on 2.35 Brazilian Real to 1 US dollar (BRL: US\$ = 2.35:1)

A review of recent studies and market consensus on gold pricing showed a range from \$1,250/oz to above \$1,300/oz. For design purposes, a gold price of \$1,020/oz was considered reasonable, based on pit geometry and strip ratio. The base case for the economic analysis was set at \$1,300/oz.

Mill feed for the project totals 102.8 Mt with a life of mine feed grade of 1.14 g/t. The mine provides feed for the mill starting in the pre-production period to allow for commissioning of the mill. Starting in Year 1 mill production is maintained at 3 Mt/a for seven years at an average grade of 1.63 g/t. In Year 6, development of an expansion in the plant capacity is initiated taking approximately 18 months to complete. Ramp up of that capacity occurs in Year 8 with 4.5 Mt of feed processed at an average diluted grade of 0.92 g/t. A production rate of 6 Mt/a is maintained from Year 9 to the end of the mine life in Year 21 with an average grade of 1.02 g/t. The lower grade is partly the result of the reclaim of low-grade stockpile material in the last five years at an average grade of 0.52 g/t.

Tax planning for the Project was developed by L&M, Belo Sun's Brazilian tax advisors, taking into consideration the existing tax laws applied to capital costs, operating costs, sales of gold, and profits. AGP has reviewed this and take responsibility for that work.

The greatest sensitivity to the Project is gold price. The base case price of \$1,300/oz provides an NPV (5%) of \$418 million. If the gold price rises by 20% to \$1,560/oz, the NPV would rise to \$799 million. This equates to a 91% increase in NPV showing the impact of higher gold prices. The IRR rises to 24.7%. Conversely, a 20% reduction in gold price to \$1,040/oz results in a drop of the Project NPV to \$30 million, still positive but a 93% decrease in NPV. The IRR with the 20% reduction in gold price is 5.9%.

Operating costs are the second most sensitive to the overall Project economics, but to a lesser degree than gold price. A 20% increase in the operating cost drops the NPV (5%) to \$205 million with an IRR of 10.6%. This is a 51% decrease in the Project NPV. Conversely, a 20% decrease in operating cost results in a 51% increase in Project NPV.



## 25.6 Risks and Opportunities

### 25.6.1 Project Risks

| Risk                                                                                          | Explanation                                                                                                                                                                      | Potential Impact                                                                                                                                                                                        | Possible Risk Mitigation                                                                                                                                                                                                                                                                                                                             |
|-----------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>General</b>                                                                                |                                                                                                                                                                                  |                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                      |
| <ul style="list-style-type: none"> <li>Unauthorized access to/from site</li> </ul>            |                                                                                                                                                                                  | <ul style="list-style-type: none"> <li>Numerous impacts possible</li> </ul>                                                                                                                             | <ul style="list-style-type: none"> <li>Establish security fencing and security to the project area</li> </ul>                                                                                                                                                                                                                                        |
| <ul style="list-style-type: none"> <li>Legal challenges</li> </ul>                            | <ul style="list-style-type: none"> <li>NGO interference, influence from lawyers, public prosecutors, public defenders</li> </ul>                                                 | <ul style="list-style-type: none"> <li>Increased costs and delays</li> </ul>                                                                                                                            | <ul style="list-style-type: none"> <li>Continued involvement with the community, and regulatory bodies</li> </ul>                                                                                                                                                                                                                                    |
| <ul style="list-style-type: none"> <li>Untimely approval of permits</li> </ul>                | <ul style="list-style-type: none"> <li>Different Federal, State and local laws affecting permits</li> <li>Legal challenges to permits</li> <li>Permitting process</li> </ul>     | <ul style="list-style-type: none"> <li>Increased costs and delays</li> </ul>                                                                                                                            | <ul style="list-style-type: none"> <li>Maintain close contact with regulatory agencies and issuing bodies</li> </ul>                                                                                                                                                                                                                                 |
| <b>Geology</b>                                                                                |                                                                                                                                                                                  |                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                      |
| <ul style="list-style-type: none"> <li>High grade mineralization with visible gold</li> </ul> | <ul style="list-style-type: none"> <li>High-grade gold deposits displaying core intervals with visible gold are difficult to accurately sample with diamond drilling.</li> </ul> | <ul style="list-style-type: none"> <li>Diamond drill hole grade are highly variable. High-grade areas in the resource model may be lower grade than anticipated.</li> </ul>                             | <ul style="list-style-type: none"> <li>Risk is mitigated via capping level however the Project is still sensitive to the capping level used.</li> <li>Tighter drill spacing in an drill program is required</li> <li>As part of early mine development, perform test mining to better understand the impact and assess grade distribution</li> </ul> |
| <ul style="list-style-type: none"> <li>Degree of feed/waste selectivity</li> </ul>            | <ul style="list-style-type: none"> <li>Contacts for the feed/waste contact are variable in some areas</li> </ul>                                                                 | <ul style="list-style-type: none"> <li>Reliance on a comprehensive grade control program will be needed to achieve the resource model grade and to minimize dilution</li> </ul>                         | <ul style="list-style-type: none"> <li>Develop and analyze selectivity scenarios for those areas to allow future mining to incorporate flexibility in mine operations</li> </ul>                                                                                                                                                                     |
| <ul style="list-style-type: none"> <li>Domain definition</li> </ul>                           | <ul style="list-style-type: none"> <li>Definition of high grade and low grade require further definition along with structural controls</li> </ul>                               | <ul style="list-style-type: none"> <li>Redistribution of the high grade and low grade may result from further analysis. Structural controls will lead to better understanding of the deposit</li> </ul> | <ul style="list-style-type: none"> <li>Re-examination of the drill core with the intent to classify all mineralized intercepts into domain categories.</li> <li>Developing a 3D model of the improved domains and re-interpolating the resource model.</li> </ul>                                                                                    |
| <b>Mining</b>                                                                                 |                                                                                                                                                                                  |                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                      |
| <ul style="list-style-type: none"> <li>Mining costs</li> </ul>                                | <ul style="list-style-type: none"> <li>Study mining costs developed from first principles</li> </ul>                                                                             | <ul style="list-style-type: none"> <li>Potential changes in cost estimates</li> </ul>                                                                                                                   | <ul style="list-style-type: none"> <li>Reconfirm R&amp;M costs for equipment vendors</li> <li>Examine costs from other operations with high silica content for GET estimate</li> <li>Look at suspended dump bodies to reduce material carryback and abrasion</li> </ul>                                                                              |
| <ul style="list-style-type: none"> <li>Mill feed contact definition</li> </ul>                | <ul style="list-style-type: none"> <li>Definition of the waste contact for feed/waste separation impacts on the dilution and may be difficult to delineate</li> </ul>            | <ul style="list-style-type: none"> <li>Dilution increases will result in lower feed grades to the mill and lower revenue</li> </ul>                                                                     | <ul style="list-style-type: none"> <li>Detailed grade control program as outlined in the study</li> <li>Increased geologic support for visual clues</li> </ul>                                                                                                                                                                                       |
| <ul style="list-style-type: none"> <li>Weather related delays</li> </ul>                      | <ul style="list-style-type: none"> <li>Torrential rainfall will be diverted to the pit as an overflow but may reduce access to high grade material</li> </ul>                    | <ul style="list-style-type: none"> <li>Reduced high-grade feed to the mill will result in fewer ounces produced</li> </ul>                                                                              | <ul style="list-style-type: none"> <li>Early establishment of pit dewatering program</li> <li>Maintain a high grade stockpile near the crusher with several weeks capacity during the wet</li> </ul>                                                                                                                                                 |



| Risk                                                                                                                                                  | Explanation                                                                                                                                                                                                        | Potential Impact                                                                                                                                                                                                                      | Possible Risk Mitigation                                                                                                                                                                                                                                                                                                                  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                       |                                                                                                                                                                                                                    |                                                                                                                                                                                                                                       | <ul style="list-style-type: none"> <li>season</li> <li>• Extra expenditure on pumps and piping should they be required</li> <li>• Short term mine planning to advance high grade areas in the dry season</li> <li>• Phasing of the open pit to allow extra storage surge capacity in the pit bottom during the wet season</li> </ul>      |
| <ul style="list-style-type: none"> <li>• Wall stability</li> </ul>                                                                                    | <ul style="list-style-type: none"> <li>• Shear zones with mineralization may have undiscovered faults that may affect wall stability</li> </ul>                                                                    | <ul style="list-style-type: none"> <li>• Wall stability could be impacted, resulting in loss of feed material or access to this feed</li> <li>• Increased waste stripping to support the areas or clean up after a failure</li> </ul> | <ul style="list-style-type: none"> <li>• Constant geotechnical field mapping to highlight structure as encountered</li> <li>• Additional core drilling in potential high risk areas</li> <li>• Stockpile management strategies to minimize impact on mill feed delivery</li> <li>• Controlled drilling and blasting near walls</li> </ul> |
| <b>Metallurgy and Processing</b>                                                                                                                      |                                                                                                                                                                                                                    |                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                           |
| <ul style="list-style-type: none"> <li>• Gold recoveries not achieved</li> </ul>                                                                      | <ul style="list-style-type: none"> <li>• If gold recovery in any aspect of the circuit does not match current projections, gold may be lost to tailings</li> </ul>                                                 | <ul style="list-style-type: none"> <li>• Increased gold loss and corresponding decrease in revenue</li> </ul>                                                                                                                         | <ul style="list-style-type: none"> <li>• State of the art monitoring/assaying</li> <li>• Improvements in design that may provide flexibility to recover additional gold</li> <li>• Steady feed grades to the mill</li> </ul>                                                                                                              |
| <ul style="list-style-type: none"> <li>• Feed harder than expected</li> </ul>                                                                         | <ul style="list-style-type: none"> <li>• Insufficient milling capacity</li> </ul>                                                                                                                                  | <ul style="list-style-type: none"> <li>• Lower recovery at coarser grind</li> </ul>                                                                                                                                                   | <ul style="list-style-type: none"> <li>• Variability hardness testing</li> <li>• Communication with mine to assist in providing the mill with more homogeneous feed</li> </ul>                                                                                                                                                            |
| <ul style="list-style-type: none"> <li>• Poor solids settling in pre-leach thickener</li> </ul>                                                       | <ul style="list-style-type: none"> <li>• Solids in thickener overflow/high flocculant addition</li> </ul>                                                                                                          | <ul style="list-style-type: none"> <li>• Increased operating costs</li> </ul>                                                                                                                                                         | <ul style="list-style-type: none"> <li>• Dynamic settling testwork to ensure correct thickener sizing and flocculant selection</li> </ul>                                                                                                                                                                                                 |
| <ul style="list-style-type: none"> <li>• High reagent consumptions in cyanide destruction circuit</li> </ul>                                          | <ul style="list-style-type: none"> <li>• Excessive dosages required to achieve discharge limits</li> </ul>                                                                                                         | <ul style="list-style-type: none"> <li>• Increased operating costs</li> </ul>                                                                                                                                                         | <ul style="list-style-type: none"> <li>• Bench testwork to develop reagent scheme</li> </ul>                                                                                                                                                                                                                                              |
| <b>Infrastructure</b>                                                                                                                                 |                                                                                                                                                                                                                    |                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                           |
| <ul style="list-style-type: none"> <li>• Foundations for TMF and water storage are poorer than expected</li> </ul>                                    | <ul style="list-style-type: none"> <li>• The TMF or water storage facility foundations conditions may not be as designed requiring further drilling, engineering, and proper materials for construction</li> </ul> | <ul style="list-style-type: none"> <li>• Increased earthworks cost due to stabilization</li> <li>• Delay in having the facility ready to capture a rainy season of water for process water</li> </ul>                                 | <ul style="list-style-type: none"> <li>• Complete detailed geotechnical testwork on the required location</li> <li>• Prepare alternate water-storage locations for raw-water storage to capture the maximum amount of rainfall prior to starting production</li> </ul>                                                                    |
| <ul style="list-style-type: none"> <li>• Roads may require more cut-and-fill than estimated</li> </ul>                                                | <ul style="list-style-type: none"> <li>• Insufficient fill material will be available for the extra work and more cutting will be needed</li> </ul>                                                                | <ul style="list-style-type: none"> <li>• Increased costs for cutting and filling operations</li> </ul>                                                                                                                                | <ul style="list-style-type: none"> <li>• Make the temporary plant crusher available earlier to produce aggregate for roads.</li> <li>• Be prepared to cut more of the terrain road.</li> </ul>                                                                                                                                            |
| <ul style="list-style-type: none"> <li>• Delay in supply of electrical power to the Project as a result of a third party being responsible</li> </ul> | <ul style="list-style-type: none"> <li>• Delays to site power will mean staying on temporary power for longer</li> </ul>                                                                                           | <ul style="list-style-type: none"> <li>• Increased costs for running on temporary diesel powered gensets</li> </ul>                                                                                                                   | <ul style="list-style-type: none"> <li>• Commence utility scope for power as soon as practically possible.</li> <li>• Work closely with the utility to minimize delays.</li> </ul>                                                                                                                                                        |
| <ul style="list-style-type: none"> <li>• Dewatering activities may produce more water than the settling ponds can</li> </ul>                          | <ul style="list-style-type: none"> <li>• Water may need to be treated if sufficient capacity is not available for storage in the TMF</li> </ul>                                                                    | <ul style="list-style-type: none"> <li>• Potential discharge of water to environment</li> </ul>                                                                                                                                       | <ul style="list-style-type: none"> <li>• Complete extensive hydrogeological survey in dewatering areas to fully</li> </ul>                                                                                                                                                                                                                |



| Risk                                                                                                                         | Explanation                                                                                                                           | Potential Impact                                                                                                    | Possible Risk Mitigation                                                                                                                                                                                                                                                                                                            |
|------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| handle                                                                                                                       |                                                                                                                                       |                                                                                                                     | <ul style="list-style-type: none"> <li>understand potential of issue</li> <li>Make allowance for additional settling ponds and water treatment</li> <li>Phase the pit during the wet season so that additional short term storage capacity is available in the pit</li> <li>Use the pit as emergency storage if required</li> </ul> |
| <ul style="list-style-type: none"> <li>Camp buildings that are constructed from flat packed units are not durable</li> </ul> | <ul style="list-style-type: none"> <li>The camp facilities may deteriorate in the tropical conditions sooner than expected</li> </ul> | <ul style="list-style-type: none"> <li>Poorer living conditions for employees</li> <li>Loss of morale</li> </ul>    | <ul style="list-style-type: none"> <li>Commit more funds to permanent facilities if durability becomes a concern</li> </ul>                                                                                                                                                                                                         |
| <ul style="list-style-type: none"> <li>Tailings line blockages will stop plant production</li> </ul>                         | <ul style="list-style-type: none"> <li>Process plant will not be able to operate until the line is unblocked</li> </ul>               | <ul style="list-style-type: none"> <li>Lost plant production due to downtime</li> </ul>                             | <ul style="list-style-type: none"> <li>Investigate the possibility of installing a second parallel tailings line</li> <li>Make allowance for catchment ponds into which tailings can be drained temporarily along the route of the pipeline</li> </ul>                                                                              |
| <b>Economic Analysis</b>                                                                                                     |                                                                                                                                       |                                                                                                                     |                                                                                                                                                                                                                                                                                                                                     |
| <ul style="list-style-type: none"> <li>Gold price</li> </ul>                                                                 | <ul style="list-style-type: none"> <li>If the gold price drops the Project economics are reduced</li> </ul>                           | <ul style="list-style-type: none"> <li>Reduced revenue</li> <li>Longer payback period on Project capital</li> </ul> | <ul style="list-style-type: none"> <li>Hedging of a portion of production</li> <li>Focus on reducing OPEX/CAPEX to minimize impact of lower gold pricing</li> <li>Mine higher grades during periods of low gold prices</li> </ul>                                                                                                   |
| <ul style="list-style-type: none"> <li>Reduction in gold grade</li> </ul>                                                    | <ul style="list-style-type: none"> <li>If the mill feed grade drops due to dilution or re-estimation</li> </ul>                       | <ul style="list-style-type: none"> <li>Reduction in feed ounces for a given time</li> </ul>                         | <ul style="list-style-type: none"> <li>Detailed examination of dilution in the mining method</li> <li>Additional drilling for confirmation of grade</li> <li>Bulk sample for greater confidence</li> </ul>                                                                                                                          |

## 25.6.2 Project Opportunities

| Opportunity                                                                                    | Explanation                                                                                                                                                                     | Potential Benefit                                                                                                                                                           |
|------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>General</b>                                                                                 |                                                                                                                                                                                 |                                                                                                                                                                             |
| <ul style="list-style-type: none"> <li>Timely identification of long lead items</li> </ul>     | <ul style="list-style-type: none"> <li>With proper identification, long lead items can be ordered in advance</li> </ul>                                                         | <ul style="list-style-type: none"> <li>Prevention of schedule delays associated with the project construction</li> </ul>                                                    |
| <ul style="list-style-type: none"> <li>Include South Block</li> </ul>                          | <ul style="list-style-type: none"> <li>Potential for addition of higher grade feed from a separate area such as South Block</li> </ul>                                          | <ul style="list-style-type: none"> <li>Potential to increase gold produced and revenue generated</li> </ul>                                                                 |
| <ul style="list-style-type: none"> <li>Cumulative effects from infrastructure works</li> </ul> | <ul style="list-style-type: none"> <li>Power line, road, river, communications, ferry crossing, local community</li> </ul>                                                      | <ul style="list-style-type: none"> <li>Improvement of socio-economic activities</li> </ul>                                                                                  |
| <b>Geology</b>                                                                                 |                                                                                                                                                                                 |                                                                                                                                                                             |
| <ul style="list-style-type: none"> <li>High grade mineralization with visible gold</li> </ul>  | <ul style="list-style-type: none"> <li>High grade gold deposits displaying core intervals with visible gold are difficult to accurately sample with diamond drilling</li> </ul> | <ul style="list-style-type: none"> <li>Diamond drill hole grades are highly variable. Low-grade areas in the resource model may be higher grade than anticipated</li> </ul> |
| <ul style="list-style-type: none"> <li>Degree of feed/waste selectivity</li> </ul>             | <ul style="list-style-type: none"> <li>Detailed knowledge and experience with the zones may improve feed/waste selectivity</li> </ul>                                           | <ul style="list-style-type: none"> <li>Potential to reduce feed grade dilution to the mill resulting in higher received grades</li> </ul>                                   |
| <ul style="list-style-type: none"> <li>Domain definition</li> </ul>                            | <ul style="list-style-type: none"> <li>Improving domain definition could affect the capping level and variography</li> </ul>                                                    | <ul style="list-style-type: none"> <li>Potential to improve selectivity of the mine plan reducing mining cost</li> </ul>                                                    |



| Opportunity                                                                                                   | Explanation                                                                                                                                                                                                                                                                                                                 | Potential Benefit                                                                                                                                                                                                                                                                                                                                                   |
|---------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Mining</b>                                                                                                 |                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                     |
| <ul style="list-style-type: none"> <li>Mining costs</li> </ul>                                                | <ul style="list-style-type: none"> <li>Mining cost estimate is conservative</li> </ul>                                                                                                                                                                                                                                      | <ul style="list-style-type: none"> <li>Reduced haulage times could result in lower operating costs</li> <li>Suspended dump bodies may carry more material for reduced unit costs</li> </ul>                                                                                                                                                                         |
| <ul style="list-style-type: none"> <li>Mill feed contact definition</li> </ul>                                | <ul style="list-style-type: none"> <li>Detailed RC grade control program easily identifies the feed zones</li> </ul>                                                                                                                                                                                                        | <ul style="list-style-type: none"> <li>Reduced dilution</li> <li>Increased feed grade</li> </ul>                                                                                                                                                                                                                                                                    |
| <ul style="list-style-type: none"> <li>Weather impacts</li> </ul>                                             | <ul style="list-style-type: none"> <li>With proper planning, weather-related delays would be reduced by short term planning initiatives</li> </ul>                                                                                                                                                                          | <ul style="list-style-type: none"> <li>More productive time from mine equipment, resulting in more material movement</li> <li>Have stockpile near crusher during the wet season</li> <li>Construct durable haul roads that can be used in the wet season</li> <li>Ensure adequate water storage capacity on site to control discharge to the environment</li> </ul> |
| <b>Metallurgy and Processing</b>                                                                              |                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                     |
| <ul style="list-style-type: none"> <li>Gravity circuit recovery is higher than expected</li> </ul>            | <ul style="list-style-type: none"> <li>More gold reporting to the intensive leach circuit</li> </ul>                                                                                                                                                                                                                        | <ul style="list-style-type: none"> <li>Increased recovery</li> <li>Reduced cyanide consumption</li> </ul>                                                                                                                                                                                                                                                           |
| <ul style="list-style-type: none"> <li>Recovery is not strongly dependent on grind size</li> </ul>            | <ul style="list-style-type: none"> <li>Mill feed rate can be increased if needed</li> </ul>                                                                                                                                                                                                                                 | <ul style="list-style-type: none"> <li>Higher throughput/production at a slightly lower recovery</li> </ul>                                                                                                                                                                                                                                                         |
| <b>Infrastructure</b>                                                                                         |                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                     |
| <ul style="list-style-type: none"> <li>Foundation conditions are better than anticipated</li> </ul>           | <ul style="list-style-type: none"> <li>Foundations for the tailings, water and plant are better than currently estimated</li> </ul>                                                                                                                                                                                         | <ul style="list-style-type: none"> <li>Reduction in initial capital costs</li> </ul>                                                                                                                                                                                                                                                                                |
| <ul style="list-style-type: none"> <li>Finding a used and refurbished camp for construction period</li> </ul> | <ul style="list-style-type: none"> <li>A used or refurbished camp may be available</li> </ul>                                                                                                                                                                                                                               | <ul style="list-style-type: none"> <li>Savings in upfront capital cost</li> </ul>                                                                                                                                                                                                                                                                                   |
| <ul style="list-style-type: none"> <li>Source used crushing equipment for Phase 1 circuit</li> </ul>          | <ul style="list-style-type: none"> <li>Used equipment may provide a cost-effective solution to the Phase 1 crushing</li> </ul>                                                                                                                                                                                              | <ul style="list-style-type: none"> <li>Reduction in initial capital costs</li> <li>May have more capacity with less cost rather than a mobile crushing unit</li> </ul>                                                                                                                                                                                              |
| <b>Economic Analysis</b>                                                                                      |                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                     |
| <ul style="list-style-type: none"> <li>Inferred upgrades to Indicated</li> </ul>                              | <ul style="list-style-type: none"> <li>The PEA is currently based on material classified as Measured and Indicated. Inferred material exists but is not considered other than as dilution. If the Inferred material upgrades with additional drilling it can be used for further studies or as feed to the mill.</li> </ul> | <ul style="list-style-type: none"> <li>Reduction in strip ratio</li> <li>Potential for more tonnage extending the mine life including higher grade inferred material</li> <li>Potential to increase plant capacity in Phase 2 if sufficient Inferred material is upgraded.</li> </ul>                                                                               |
| <ul style="list-style-type: none"> <li>Increase in feed grade</li> </ul>                                      | <ul style="list-style-type: none"> <li>Feed grade rises due to improvement in mining method with use of RC drilling program</li> <li>Feed grade rises due to re-estimation of gold grade in high grade and low grade domains</li> </ul>                                                                                     | <ul style="list-style-type: none"> <li>Increased revenue</li> </ul>                                                                                                                                                                                                                                                                                                 |
| <ul style="list-style-type: none"> <li>Tax and Investment Incentives</li> </ul>                               | <ul style="list-style-type: none"> <li>The PEA was developed with simplified tax calculations that may not have considered certain tax benefits</li> </ul>                                                                                                                                                                  | <ul style="list-style-type: none"> <li>reduced taxation</li> <li>increased net revenue</li> </ul>                                                                                                                                                                                                                                                                   |



## **26 RECOMMENDATIONS**

### **26.1 Introduction**

Based on the results of the PEA study, AGP recommends that Belo Sun continue with additional studies leading to a project execution decision. The recommendations, and associated budgets, are described in the sections below. The cost of a potential feasibility study should be required for financing.

South Block, while not a component of the PEA study, represents an opportunity for Belo Sun should further exploration be considered. At that time, its inclusion in the overall project could be assessed.

### **26.2 Geology**

SRK recommends a work program that includes structural geology investigations, infill and delineation drilling, and geology and mineral resource modelling. The aim of the structural geology investigations is to study the controls on the distribution of the higher-grade gold mineralization, particularly along the Galo trend with the objective of understanding the distribution of the auriferous quartz vein field. Infill and step out drilling is recommended to improving the delineation of the gold mineralization in the Galo trend and the South Block with the aim to improve resource classification. Geology and mineral resource modelling efforts should focus on improving the delineation of the low grade domains defined at Ouro Verde and Grota Seca. The proposed work program comprises four components:

- structural geology investigations to study the controls on the distribution of the higher grade gold mineralization throughout the deposits and particularly along the Galo trend
- infill drilling to improve the delineation of the higher grade gold mineralization along the Galo trend and in the South Block
- infill and step-out drilling to improve the confidence in the continuity of the gold mineralization in the South Block
- geology and mineral resource modelling focussing on the low grade domains in Ouro Verde and Grota Seca areas.



### **26.2.1**     *Structural Geology Investigation*

SRK is of the opinion that structural geology investigations are required to study the distribution of the gold mineralization throughout the Volta Grande gold deposits and particularly the higher-grade mineralization in the Galo trend. A better understanding on the controls on the distribution of the higher grade auriferous veins is required to improve the confidence in the lateral continuity of the gold mineralization that exists throughout the Volta Grande gold deposit, and in particular, along the Galo trend where the vein field appears to exhibit a different trend. Previous studies have shown that the confidence in the geological continuity of the higher-grade veins remains poor.

SRK believes that structural geology investigations on archive core can help elucidate the controls on the distribution of the auriferous veins and improve the confidence in their orientation and continuity. In turn, the results of the study would assist with the design of an appropriate infill drilling program targeting those areas. The proposed work program includes field investigations and subsequent geological modelling.

### **26.2.2**     *Infill and Step-out Drilling*

SRK considers that additional drilling is warranted to:

- infill areas along the Galo trend to improve the confidence in the mineralization model
- infill gaps in the drilling data within the South Block with the potential to improve resource classification.

The higher-grade gold mineralization found along the Galo trend has proven to be difficult to model because of its discontinuous appearance partly due to the orientation of the drilling and the understanding of the structural controls. SRK recommends that an additional 10,000 m of core drilling is justified to improve the confidence in the continuity of the gold mineralization in the Galo trend in light of the findings of the structural geology investigations.

The South Block currently represents a relatively small portion of the Volta Grande mineral resources. SRK believes that additional drilling has the potential to extend the areas of gold mineralization with positive impact on the mineral resources in this the South Block. SRK considers that approximately 15,000 m of step-out and infill core drilling should target the South Block area. South Block is not currently planned to be mined within the PEA study.



### 26.2.3 Geology and Mineral Resource Modelling

Upon completion of the structural geology investigations, SRK recommends that the geological model for the low-grade domains at Ouro Verde and Grota Seca deposits should be revised. The current model is based on extruded polygons, resulting in an interpretation that does not honour borehole information. The geology model for these domains should be revised in a similar fashion to the medium and high-grade domains, taking into account strict modelling guidelines and ensuring that borehole information is honoured. Once completed, the mineral resource model should be updated to take into account the new interpretation.

The cost of the recommended work program for Ouro Verde and Grota Seca is estimated at approximately \$2.5 million as detailed in Table 26-1. Additional work to expand on the South Block Resource is estimated at \$3.6 million and is shown in Table 26-2 and is of a lower priority based on the PEA.

**Table 26-1: Estimated Costs for Recommended Exploration Program (Ouro Verde and Grota Seca)**

| Description                                | Unit   | Cost Per Unit (\$) | Quantity | Cost (\$)        |
|--------------------------------------------|--------|--------------------|----------|------------------|
| Field structural investigation             |        |                    |          | 40,000           |
| Structural data interpretation             |        |                    |          | 20,000           |
| Resource delineation drilling – Galo trend | m      | 200                | 10,000   | 2,000,000        |
| Assays                                     | Sample | 20                 | 10,000   | 200,000          |
| Low grade domain modelling                 |        |                    |          | 20,000           |
| Updated Mineral Resource Model             |        |                    |          | 30,000           |
| Subtotal                                   |        |                    |          | 2,310,000        |
| Contingency at 10%                         |        |                    |          | 231,000          |
| <b>Total</b>                               |        |                    |          | <b>2,541,000</b> |

**Table 26-2: Estimate Costs for South Block Recommended Exploration Program**

| Description                               | Unit   | Cost Per Unit (\$) | Quantity | Cost (\$)        |
|-------------------------------------------|--------|--------------------|----------|------------------|
| Resource expansion drilling – South Block | m      | 200                | 15,000   | 3,000,000        |
| Assays                                    | Sample | 20                 | 15,000   | 300,000          |
| Subtotal                                  |        |                    |          | 3,300,000        |
| Contingency at 10%                        |        |                    |          | 330,000          |
| <b>Total</b>                              |        |                    |          | <b>3,630,000</b> |



## **26.3 Open Pit Mining**

Significant work has been completed to date on the open pit designs and costing for the Project and specifically the Ouro Verde and Grota Seca pits. This work demonstrates the potential for economic development of the Project. There are still some areas that require further definition prior to operation and can be handled as separate studies or part of a feasibility study.

### **26.3.1 Ore Control Procedures (\$75,000 budget estimate)**

The PEA went into detail with specific methods of ore control but this area represents a significant benefit to the overall mine operation if dilution is reduced. Additional study is required to evaluate exact equipment for use in the grade control program and methodologies to be employed in mine operations. There are specific experts in the field that other operations in Brazil have contacted and it would benefit the project to consider them as part of the future study.

### **26.3.2 Wall Slopes (\$600,000 budget estimate)**

A closer examination of the wall slopes in Grota Seca is warranted. The pit phases in Grota Seca are designed to final wall from the very beginning. This limits the learning curve normally associated with a longer-term pit. Precise drilling and design of the wall would ensure that operational delays associated with potential wall failures could be avoided or mitigated easily.

Ouro Verde with its concentric phase development is less prone to this and allows time to learn from operational experience.

### **26.3.3 Ground Engaging Tools (\$30,000 budget estimate)**

The high silica content of the mine rock is expected to be abrasive on parts in contact with it. This includes truck bodies, dozer tracks and undercarriages, and ground engaging tools such as bits, hammers, drill steel, blades, and shovel/loader teeth. This cost could increase dramatically and/or affect availability of equipment if sufficient supplies are not on hand. Further study of this should be undertaken with the vendors to accurately estimate consumption of these parts.

### **26.3.4 Suspended Truck Bodies (\$30,000 budget estimate)**

The use of suspended truck bodies is considered in the PEA study. The purpose of this was to reduce carry-back and abrasion in the standard boxes. In some applications,



these bodies have been designed to carry more payloads while not exceeding the gross vehicle weight recommendations of the manufacturer. The opportunity for increased payload for the same haulage configuration has the potential to reduce operating costs. This potential should be examined further and incorporated in later studies or mine operation.

## **26.4 Metallurgy**

To complement the results presented here, additional metallurgical characterization of the Ouro Verde and Grota Seca deposits is recommended, as follows:

- bench-scale, continuous detox testing by the INCO SO<sub>2</sub>-air process to develop more accurate estimates for parameters such as residence time and reagent consumption
- detailed final tailings characterization including multi-element scan by ICP, and ABA
- complete a CIP versus CIL trade-off study to determine the most economic leaching circuit based on latest modelling.

## **26.5 Infrastructure**

Advanced study has been completed with respect to the tailings designs, plant, and shops. With the concept of a mobile crusher, further design work is required to verify that costs are sufficiently accurate for budgeting purposes.

As well, the use of temporary structures during construction to manage the peak of labour force should be considered. The camp facilities cost is significant and opportunities to sensibly save money while not affecting morale of the work force should be investigated.

Not insignificant costs have been allocated to the preparation of the waste management facilities and seepage / raw water ponds. Timing the construction of these with mining activities may help in lowering the initial cost of the project. A review of these items in detail is recommended.

Further geotechnical investigation may be required in order to properly design equipment and building foundations.



## 26.6 Environmental

Belo Sun has advanced their environmental program well beyond what is normally associated with a PEA study. The progression towards and receipt of some licences is indicative of this. The program in place and the path forward as outlined should be continued to obtain all necessary permits and licences.

## 26.7 Recommendations and Estimated Budget

Table 26-3 shows a summary of recommendations per discipline and the total costs.

These costs would be in addition to the completion of a feasibility study if it was required for financing purposes.

**Table 26-3: Summary of Recommendations and Total Costs**

|                   | Recommended Budget<br>(\$) |
|-------------------|----------------------------|
| Geology           | 6,105,000                  |
| <b>Mining</b>     | 735,000                    |
| Metallurgy        | 70,000                     |
| Infrastructure    | 300,000                    |
| Environmental     | 300,000                    |
| Feasibility Study | 1,000,000                  |
| <b>Total</b>      | <b>8,510,000</b>           |



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**BELO SUN MINING CORP.**

PRELIMINARY ECONOMIC ASSESSMENT, NI 43-101

VOLTA GRANDE PROJECT

PARÁ, BRAZIL



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SRK 2013: Couture, J.F., Leuangthong, O., and Weiershäuser, L., 2013: Mineral Resource Technical Report for the Volta Grande Gold Project, Pará, Brazil, Prepared for Belo Sun Mining Corp., SRK Consulting (Canada) Inc., 31 January 2013.



## **28 CERTIFICATE OF AUTHORS**

### **28.1 Lars Weiershäuser, P.Geol.**

I, Lars Weiershäuser, Ph.D., P.Geol., of Toronto, Ontario, as a QP of this technical report titled "Preliminary Economic Assessment, NI 43-101 Volta Grande Project, Pará, Brazil" with an effective date of 31 March 2014 (the "Technical Report") do hereby certify the following statements:

- I am a Senior Consultant (Geology) with SRK Consulting (Canada) Inc., with a business address at Suite 1300, 151 Yonge Street, Toronto, Ontario.
- I have graduated from the South Dakota School of Mines and Technology in Rapid City, South Dakota, USA with a MSc in Geology in 2000. I obtained a PhD in Geology from the University of Toronto in Toronto in 2005. I am a member in good standing of the Association of Professional Geoscientists of Ontario, Registration #1504.
- I have practiced my profession in the mining industry continuously since 2000.
- I have read the definition of "qualified person" set out in National Instrument 43-101 (NI 43-101 or the Instrument) 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 purpose of NI 43-101.
- My relevant experience includes the preparation of Technical Reports on base and precious metal deposits over the last seven years.
- I have conducted a site visit of the property.
- I am responsible for Sections 1.1, 1.10.1, 4 to 12, 25.1, 26.2.1, and 26.2.2 of this Technical Report.
- I am independent of the issuer as defined by Section 1.5 of the Instrument.
- I have read NI 43-101 and the Technical Report has been prepared in compliance with NI 43-101 and Form 43-101F1.
- As of the effective date of the Technical Report, to my knowledge, information, and belief, the Technical Report contains all scientific and technical information that is required to be disclosed to make the Technical Report not misleading.

Signed and dated this 31<sup>st</sup> day of March 2014, at Toronto, Ontario.

*"Original Document Signed and Sealed"*

Lars Weiershäuser, P.Geol.



## **28.2 Oy Leuangthong, PhD., P.Eng.**

I, Oy Leuangthong, PhD., P.Eng., of Aurora, Ontario as a QP of this technical report titled “Preliminary Economic Assessment, NI 43-101 Volta Grande Project, Pará, Brazil” with an effective date of 31 March 2014 (the “Technical Report”) do hereby certify the following statements:

- I am a Principal Consultant (Geostatistics) with SRK Consulting (Canada) Inc., with a business address at Suite 1300, 151 Yonge Street, Toronto Ontario, M5C 2W7.
- I am a graduate of the University of Toronto in 1998, B.A.Sc.(Honours) in Civil Engineering. I am a graduate of the University of Alberta in 2003 with a PhD in Mining Engineering.
- I am a member in good standing of the Professional Engineers of Ontario, Registration #90563867.
- I have practiced my profession in the mining industry continuously since 2003.
- I have read the definition of “qualified person” set out in National Instrument 43-101 (NI 43-101 or the Instrument) 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 purpose of NI 43-101.
- My relevant experience includes research in resource modelling and geostatistics, teaching activities in mine planning, resource estimation and advanced Geostatistics, and since 2010 geostatistical support and modelling for exploration projects in the Americas, Australia, and West Africa.
- I have not conducted a site visit of the property.
- I am responsible for Sections 1.2, 14, and 26.2.3 of this Technical Report.
- I am independent of the issuer as defined by Section 1.5 of the Instrument.
- I have read NI 43-101 and the Technical Report has been prepared in compliance with NI 43-101 and Form 43-101F1.
- As of the effective date of the Technical Report, to my knowledge, information, and belief, the Technical Report contains all scientific and technical information that is required to be disclosed to make the Technical Report not misleading.

Signed and dated this 31st day of March 2013, at Toronto, Ontario.

*“Original Document Signed and Sealed”*

Oy Leuangthong, PhD. P.Eng.



### **28.3 Jean-Francois Couture, PhD., P.Geo.**

I, Jean-Francois Couture, PhD, P.Geo., of Toronto, Ontario, as a QP of this technical report titled "Preliminary Economic Assessment, NI 43-101 Volta Grande Project, Pará, Brazil" with an effective date of 31 March 2014 (the "Technical Report") do hereby certify the following statements:

- I am a Corporate Consultant (Geology) with SRK Consulting (Canada) Inc., with a business address at Suite 1300, 151 Yonge Street, Toronto, Ontario, M5C 2W7.
- I am a graduate of the Université Laval in Québec City in 1982 and I obtained a BSc in Geology. I am a graduate of the Université du Québec à Chicoutimi in 1986 and 1994 and obtained a MScA in Earth Sciences and a PhD in Mineral Resources, respectively.
- I am a member in good standing of the Association of Professional Geoscientists of Ontario, APGO #0197 and l'Ordre des Géologues du Québec (OGQ #1106).
- I have practiced my profession in the mining industry since 1982.
- I have read the definition of "qualified person" set out in National Instrument 43-101 (NI 43-101 or the Instrument) 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 purpose of NI 43-101.
- My relevant experience includes the design and execution of exploration programs for base and precious metal deposits, the research of base and precious metals deposits, and the completion of several independent technical reports on base and precious metals exploration and mining projects worldwide.
- I have not conducted a site visit of the property.
- I am a co-author of this report and responsible for Sections 1.1, 1.2, 1.10.1, 4 to 14, and 26.2 of this Technical Report.
- I am independent of the issuer as defined by Section 1.5 of the Instrument.
- I have read NI 43-101 and the Technical Report has been prepared in compliance with NI 43-101 and Form 43-101F1.
- As of the effective date of the Technical Report, to my knowledge, information, and belief, the Technical Report contains all scientific and technical information that is required to be disclosed to make the Technical Report not misleading.

Signed and dated this 31<sup>st</sup> day of March 2013, at Toronto, Ontario.

*"Original Document Signed and Sealed"*

Jean-Francois Couture, PhD, P.Geo.



## **28.4 Gordon Zurowski, P.Eng.**

I, Gordon Zurowski, P.Eng., of Stouffville, Ontario, as a QP of this technical report titled “Preliminary Economic Assessment, NI 43-101 Volta Grande Project, Pará, Brazil” with an effective date of 31 March 2014 (the “Technical Report”) do hereby certify the following statements:

- I am a Principal Mining Engineer with AGP Mining Consultants Inc., with a business address at 92 Caplan Avenue, Suite 610, Barrie, Ontario, L4N 0Z7.
- I am a graduate of the University of Saskatchewan, B.Sc. Geological Engineering, 1989.
- I am a member in good standing of the Association of Professional Geoscientists of Ontario, Registration #100077750.
- I have practiced my profession in the mining industry continuously since graduation.
- I have read the definition of “qualified person” set out in National Instrument 43-101 (NI 43-101 or the Instrument) 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 purpose of NI 43-101.
- My relevant experience includes the design and evaluation of open pit mines for over 20 years.
- I conducted a site visit of the property Oct 21-23, 2012.
- I am responsible for Sections 1.3, 1.4, 1.7 to 1.9, 1.10.2, 1.10.5 to 1.10.6, 2, 3, 15, 16, 19, 20, 21.1.1, 21.1.2, 21.1.6 to 21.1.9, 21.2.1, 21.2.2, 21.2.4 to 21.2.7, 22 to 24, 25.2, 25.5, 25.6 (General, Geology, Mining, Economic Analysis) 26.1, 26.3, 26.6 and 26.7 (Geology, Mining, Environmental and Feasibility study) of the Technical Report.
- I am independent of the issuer as defined by Section 1.5 of the Instrument.
- I have read NI 43-101 and the Technical Report has been prepared in compliance with NI 43-101 and Form 43-101F1.
- As of the effective date of the Technical Report, to my knowledge, information, and belief, the Technical Report contains all scientific and technical information that is required to be disclosed to make the Technical Report not misleading.

Signed and dated this 31<sup>st</sup> day of March 2014, at Stouffville, Ontario.

*“Original Document Signed and Sealed”*

Gordon Zurowski, P.Eng.



## **28.5 Lyn Jones, P.Eng.**

I, Lyn Jones of Peterborough, Ontario, as a QP of this technical report titled “Preliminary Economic Assessment, NI 43-101 Volta Grande Project, Pará, Brazil” with an effective date of 31 March 2014 (the “Technical Report”), do hereby certify that and make the following statements:

- I am a Senior Metallurgical Associate with AGP Mining Consultants Inc. with a business address at 92 Caplan Avenue, Suite 246, Barrie, Ontario, L4N 0Z7.
- I am a graduate of the University of British Columbia, Metals and Materials Engineering, 1998.
- I am a member in good standing of the Association of Professional Engineers of Ontario, Registration No. 100067095.
- I have practiced my profession continuously since graduation.
- I have read the definition of “qualified person” set out in National Instrument 43-101 (NI 43-101 or the Instrument) 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 purpose of NI 43-101.
- My relevant experience with respect to metallurgy and process design includes 14 years of work experience in plant operations, metallurgical testing, flowsheet development, and process engineering.
- I completed a site visit July 18 – 20 2013 of the property.
- I am responsible for Sections 1.5, 1.10.3, 13, 17, 21.1.3, 21.1.4, 21.2.3, 25.3, 25.6 (metallurgy and processing portions) 26.4 and 26.7 (metallurgy portion) of the Technical Report.
- I am independent of the issuer as defined by Section 1.5 of the Instrument.
- I have read NI 43-101 and the Technical Report has been prepared in compliance with NI 43-101 and Form 43-101F1.
- As of the effective date of the Technical Report, to my knowledge, information, and belief, the Technical Report contains all scientific and technical information that is required to be disclosed to make the Technical Report not misleading.

Signed and dated this 31<sup>st</sup> day of March 2014, at Peterborough, Ontario.

*“Original Document Signed and Sealed”*

Lyn Jones, P.Eng.



## **28.6 Justin Taylor, P.Eng.**

I, Justin Taylor, P.Eng., of 84 Furrow Lane, Etobicoke, ON, M8Z 0A3, Canada, do hereby certify that as one of the authors of this updated technical report titled “Preliminary Economic Assessment, NI 43-101 Volta Grande Project, Pará, Brazil” with an effective date of 31 March 2014 (the “Technical Report”), I hereby make the following statements:

- I am an Associate Project Manager with AGP Mining Consultants Inc. with a business address at 92 Caplan Ave., Ste. #610, Barrie, Ontario, Canada, L4N 0Z7.
- I graduated from the University of Pretoria South Africa with Bachelor of Engineering degree in Mechanical Engineering 1999; Maintenance Engineering (Hons)2002; Diploma Business Management 2003.
- I am a member in good standing of the Association of Professional Engineers of Ontario, Registration No. 100067095.
- I am a registered member in good standing of the Engineering Council of South Africa.
- I have practiced my profession continuously since graduation.
- I have read the definition of “qualified person” set out in National Instrument 43-101 (NI 43-101 or the Instrument) 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 purpose of NI 43-101.
- I have worked as a mechanical engineer involved with minerals processing, materials handling in the mining and minerals industry for 15 years since my graduation from university.
- I have not visited the property.
- I am responsible for the content of Sections 1.6, 1.10.4, 18, 21.1.5, 25.4, 25.6 (Infrastructure portions) and 26.5 of this technical report.
- I am independent of the issuer as defined by Section 1.5 of the Instrument.
- I have read NI 43-101 and the Technical Report has been prepared in compliance with NI 43-101 and Form 43-101F1.
- As of the effective date of the Technical Report, to my knowledge, information, and belief, the Technical Report contains all scientific and technical information that is required to be disclosed to make the Technical Report not misleading.

Signed and dated this 31<sup>st</sup> day of March 2014, in Toronto, Ontario.

*“Original Document Signed and Sealed”*

Justin Taylor, P.Eng.