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SEMAFO Inc.
SEMAFO Burkina Faso S.A.

MANA PROPERTY, BURKINA FASO NI 43-101 TECHNICAL REPORT DISCLOSING THE RESULTS OF THE SIOU UNDERGROUND PREFEASIBILITY STUDY

Effective Date of the Mineral Reserve Estimate, 31 December, 2017
Effective Date of this Technical Report, 31 December, 2017

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1.0 SUMMARY

1.1 INTRODUCTION

Micon International Limited (Micon) has been retained by SEMAFO Burkina Faso S.A. (SEMAFO BF), a wholly-owned subsidiary of SEMAFO Inc. (SEMAFO), to prepare a Technical Report under Canadian National Instrument 43-101 (NI 43-101) which discloses the results of the prefeasibility study (PFS) for the development of underground mineral reserves at the Mana gold project located in southwestern Burkina Faso, West Africa, and to disclose updated mineral resource and mineral reserve estimates.

The Mana mine was opened in March, 2008. Ore is mined using open pit methods from a number of deposits, Wona-Kona, Nyafé, Fofina and Siou. Exploration has identified the potential for underground mining at Siou.

The government of Burkina Faso has the right to hold a 10% free carried interest via a 10% equity interest in the local holding company. The local holding company is SEMAFO Burkina Faso SA which is 90% owned by SEMAFO. The mining licence for operations at Mana is held by SEMAFO Burkina Faso SA. Exploration permits are held by Mana Mineral SARL or Ressources Tangayen SARL.

1.1.1 Terms of Reference

This Technical Report has been prepared by Micon under the terms of its agreement with Mana Mineral SARL and SEMAFO BF. Data have been prepared by Mana Mineral SARL, SEMAFO BF, SEMAFO and its contractors. Micon has reviewed this work for completeness and to allow Micon Qualified Persons (QPs) to take responsibility for each section of this Technical Report.

The inclusion of underground resources at the Siou deposit requires the preparation of the present study to assess the technical and economic merits of including material mined by underground methods.

The processing flowsheet, project infrastructure and environmental and social issues, will remain largely unchanged from the present open pit operations.

The PFS is based on mineral resource and mineral reserve estimates with effective dates of 31 December, 2017. The reserve and resource estimates in this PFS have been prepared in accordance with NI 43-101. NI 43-101 is a rule developed by the Canadian Securities Administrators which establishes standards for all public disclosure an issuer makes of scientific and technical information concerning mineral projects.

1.2 PROPERTY DESCRIPTION AND LOCATION

The Mana gold deposits lie within the Mana Permit Group located in Burkina Faso, West Africa. The property lies approximately 200 km west of Ouagadougou, the capital of Burkina Faso. It is centred on UTM coordinates 465,000 mE and 1,326,000 mN (WGS84z31).

It is planned that the Mana operations will comprise mining the remainder of the Siou open pit reserves in 2018 and 2019. From 2020, the underground reserves at Siou will be mined at the full production rate of 700,000 t/y to contribute 40% of the mill feed at 2,000 t/d, equivalent to more than 50% of the ounces of gold produced. The remaining reserves will come from the Wona North pit expansion to maintain the balance of 5,000 t/d of mill feed.

SEMAFO holds 12 contiguous exploration permits collectively known as the Mana Permit Group, covering approximately 1,884.85 km^2.

There are no identified environmental or social issues on the Mana property that would materially impact SEMAFO’s ability to operate the mining and processing facilities.

1.2.1 Access, Infrastructure and Climate

The Mana operation is accessible by road from the capital city of Ouagadougou. The majority of the local workforce lives in nearby villages. SEMAFO established a camp about 0.5 km to the east of Mana mine for senior staff and expatriates, comprising living quarters, kitchen and recreational facilities.

The climate of Burkina Faso is semi-arid, with a rainy season from May to September, and a hot dry season from February to April.

Work can be carried out year-round.

1.2.2 History

Exploration work by Mana Mineral SARL on the Mana property started in October, 1997 and led to the initial discovery of the Nyafé, Filon 67 and Wona deposits. A formal feasibility study and environmental impact study were initiated in 2004. The mining permit for development of the Wona and Nyafé deposits was granted in February, 2007. Mill start-up took place on February 15, 2008. Capacity has been expanded in several phases and currently stands at 7,200 t/d in fresh ore and up to 8,000 t/d in blended ore.

1.3 GEOLOGICAL SETTING, MINERALIZATION AND DEPOSIT TYPE

The Mana district is located in the northern part of the Houndé greenstone belt. The lithostratigraphic succession is typical of greenstone belts and is characterized at the base by a major tholeiitic basaltic suite with some intercalations of argillic sedimentary rocks that are overlain by predominant pelagic and detrital sedimentary rocks (shale, sandstones, greywacke and volcanoclastics). The Mana district basalt unit has undergone submarine hydrothermal alteration with epidote, chlorite and local albite, and shows zones of strong silicification, some of which are anomalous in gold. Accessory minerals include rutile and disseminated pyrite. Free visible gold is encountered at the Wona-Kona and Siou deposits.

All deposits on the Mana Property are characterized as typical West African, shear-hosted orogenic gold deposits.

1.4 EXPLORATION

Stream sample geochemistry, airborne geophysics (helicopter-borne magnetic, Mag-Helitem) and surface mapping are used to identify areas for detailed investigation. Ground geophysics is also used to test extensions of known large scale structures. Sampling via auger or rotary air blast drilling follows on fixed grids in order to reach the saprolite below the lateritic cover.

Trenching and/or reverse circulation (RC) drilling is then used as a first pass to test the auger drilling anomalies. Generally, exploration sample quality is considered as being sufficient to indicate significant gold mineralization but not representative of the overall grade associated with the deposit. Following positive results, RC drilling and core drilling are used to extend the information at depth and to delineate the mineralized bodies.

1.5 DRILLING

Drilling at the Mana Property has been undertaken using a combination of air core (AC), RC and diamond drilling for a total of 13,955 holes over 1,374,587 m. In addition, 20 holes were precollared as RC and terminated as diamond drilling (5,603 m). Based on its observations, Micon concludes that there are no drilling/sampling/recovery factors that could materially impact the accuracy and reliability of the results of samples used to estimate mineral resources/reserves in this Technical Report.

1.6 SAMPLE PREPARATION, ANALYSES AND SECURITY

SEMAFO principally uses its mine site laboratory facilities at Mana (SMF BF) for RC and core drilling samples, as well as the ALS Laboratory (ALS-OU) in Ouagadougou. SEMAFO also retains the services of SGS Laboratory (SGS-OU) in Ouagadougou for assaying soil and auger drilling samples. SGS-OU and ALS-OU are commercial laboratories independent of SEMAFO. The SGS laboratory meets the requirements of ISO/IEC 17025. The ALS Ouagadougou laboratory does not have recognized accreditation, but it is part of the ALS Group of laboratories that operates under a global quality management system under ISO 9001:2008, and participates in international proficiency testing programs. The SEMAFO mine site laboratory does not have recognized accreditation but participates in international proficiency testing programs.

1.6.1 Quality Assurance and Quality Control

Quality assurance and quality control programs are in place to ensure the reliability and trustworthiness of exploration data. In order to monitor the reliability of assaying results delivered by the assaying laboratories, SEMAFO has developed an assaying protocol that consists of systematically inserting blank samples, certified reference materials, field duplicates and laboratory replicates. Additionally, re-assaying of a set number of sample pulps at a secondary umpire laboratory is performed on a quarterly basis as an additional test of the reliability of assaying results.

1.6.2 Bulk Density

Density measurements were performed on core samples from the Wona-Kona, Nyafé, Siou and Yama deposits and are derived from metallurgical studies for Fofina, Fobiri and Yaho. It is Micon's opinion that the equipment and the procedure used for measuring bulk density at Mana is appropriate for Mineral Resource estimation.

1.6.3 Conclusions

Sample collection and preparation, analytical techniques, security and QA/QC protocols implemented at Mana are consistent with standard industry best practices. In Micon's opinion, the sampling and assay data are adequate and reasonable for use in Mineral Resource estimation.

1.7 DATA VERIFICATION

Micon's data verification included visits to the SEMAFO head office in Montreal and to the Mana mine project in Burkina Faso, inspection of the facilities at the Mana mine laboratory where exploration samples are analyzed, analysis of monitoring reports on the performance of control samples, and validation of the resource database. Micon observed sampling and logging procedures and found them to be appropriate and conducted to industry standards, and to represent the mineralization of the Mana and Siou deposits. Micon is satisfied that the database used for the resource estimate in this Technical Report was generated in a credible manner and properly assembled and is therefore suitable for use in estimating the mineral resource. The genetic models adopted are appropriate.

1.8 MINERAL PROCESSING AND METALLURGICAL TESTING

1.8.1 Metallurgical Testwork Programs

External metallurgical testwork relating to the Mana operation has taken place in three phases relating to the development of feed from:

- The Wona-Kona and Nyafé deposits in 2002-2007.
- The Siou deposit in 2012.

- The South sector deposits, Fofina, Fobiri and Yaho in 2012-2013.

This work comprised comminution, leaching, gravity separation and acid base accounting tests.

Given the metallurgical processing experience gained by SEMAFO with the different types of mineralization in the area, there is no plan to undertake further testwork in support of underground development at Siou.

1.8.2 Tailings Characterization

Detoxification tests using tailings samples were carried out in 2010 by SGS South Africa. These tests indicated that the sodium metabisulfite/copper sulphite method achieved an average of 99.47% removal of weak acid dissociable cyanide, with 99.48% removal of total cyanide and 99.87% removal of free cyanide. A series of ABA tests using Wona-Kona tailings samples were completed by SGS South Africa in 2013. Of the 17 samples, none of them was characterized as acid producing. Five were classified as potentially acid producing, while the remaining 12 were non-acid producing.

1.9 MINERAL RESOURCE ESTIMATES

Resource block models have been created for each individual deposit. Three dimensional (3D) mineralized solids are first interpreted from drill hole data, limiting resources to the material inside those solids. All blocks interpolated below the surface topography or the mine surface survey as of December 31, 2017 make up the mineral inventory at that date. Blocks are classified relative to proximity to composites and corresponding precision/confidence level. Technical and economic factors are then applied to the blocks in the form of pit-optimization, optimized stope designs and cut-off grades to constrain the resources to those that present a reasonable prospect of economic extraction. Variographic analysis was undertaken.

Drill hole exploration data are stored and managed using the Geobank data management system from Micromine. Mineralized envelopes have been interpreted using Micromine software. Resources were modelled using Studio RM, NPV Scheduler and MSO (Mineable Shape Optimizer) software packages from Datamine.

The resulting mineral resource estimates for the deposits at Mana are presented in Table 1.1.

Table 1.1
Mana Estimated Resources, Exclusive of Reserves, as at 31 December, 2017

Deposits	Measured			Indicated			Total Resources		
	Tonnage	Grade (g/t Au)	Ounces	Tonnage	Grade (g/t Au)	Ounces	Tonnage	Grade (g/t Au)	Ounces
Wona-Kona	1,331,000	2.05	87,800	21,623,000	2.55	1,775,600	**22,954,000**	**2.52**	**1,863,400**
Nyafé	286,000	3.94	36,300	223,000	5.97	42,700	**509,000**	**4.83**	**79,000**
Fofina	293,000	4.25	40,000	253,000	4.45	36,100	**546,000**	**4.34**	**76,100**

Deposits	Measured			Indicated			Total Resources		
	Tonnage	Grade (g/t Au)	Ounces	Tonnage	Grade (g/t Au)	Ounces	Tonnage	Grade (g/t Au)	Ounces
Yaho	5,738,000	0.91	168,500	11,636,000	0.88	330,800	**17,374,000**	**0.89**	**499,300**
Filon 67	26,000	2.72	2,300	9,000	3.59	1,000	**35,000**	**2.93**	**3,300**
Fobiri	469,000	1.80	27,100	114,000	1.52	5,600	**583,000**	**1.74**	**32,700**
Siou Open Pit	67,000	0.63	1,400	56,000	0.65	1,200	**123,000**	**0.66**	**2,600**
Siou Underground	513,000	3.23	53,200	787,000	3.25	82,300	**1,300,000**	**3.24**	**135,500**
Yama	0		0	99,000	1.56	4,900	**99,000**	**1.54**	**4,900**
Total Mana	**8,723,000**	**1.49**	**416,600**	**34,800,000**	**2.04**	**2,280,200**	**43,523,000**	**1.93**	**2,696,800**

Deposits	Inferred		
	Tonnage	Grade (g/t Au)	Ounces
Wona-Kona	3,466,000	2.96	329,600
Nyafé	151,000	5.87	28,400
Fofina	67,000	4.20	9,100
Yaho	223,000	0.78	5,600
Filon 67	6,000	6.32	1,100
Fobiri	578,000	1.39	25,800
Maoula	2,628,000	1.62	137,100
Siou	2,093,000	3.86	259,900
Yama	58,000	1.33	2,500
Total Mana	**9,270,000**	**2.68**	**799,100**

Notes:

1. 2014 CIM Definition Standards were followed for mineral resources.
2. The mineral resource has been estimated using a gold price of USD1,400/oz.
3. High-grade assays have been capped.
4. The mineral resource was estimated using a block model. Three dimensional wireframes were generated using geological information. A combination of OK and ID^3 estimation methods were used to interpolate grades into blocks of varying dimensions depending on geology and spatial distribution of sampling.
5. Mineral resources that are not mineral reserves do not have demonstrated economic viability. There is currently insufficient exploration to define the inferred resources as indicated or measured resources.

Mineral resources were estimated by François Thibert M.Sc. Geo., Directeur, Groupe Estimation Ressources et Réserves, Afrique de l'Ouest, of SEMAFO under the supervision of Michel Crevier, P.Geo., MScA, Vice President, Exploration and Mine Geology and SEMAFO's QP. The estimates were reviewed by Charley Murahwi, M.Sc., P.Geo., FAusIMM, Senior Geologist with Micon who is the QP responsible for the estimate.

1.10 MINERAL RESERVE ESTIMATES

The Mana Mineral Reserves at the end of December, 2017, were estimated within open pits for the Wona-Kona, Nyafé and Fofina deposits, and within a combined open pit and underground mine for Siou. Estimates are based on a gold price of USD 1,200/oz (Table 1.2).

Table 1.2
Mana Estimated Mineral Reserves at 31 December, 2017

Deposits	Proven Reserves			Probable Reserves			Total Reserves			Stripping Ratio (Waste/Ore)
	Tonnage	Grade (g/t Au)	Ounces	Tonnage	Grade (g/t Au)	Ounces	Tonnage	Grade (g/t Au)	Ounces	
Wona-Kona	6,062,000	2.33	453,500	6,280,000	2.22	448,900	12,342,000	2.27	902,400	10.52
Nyafé	265,000	5.81	49,600	6,000	3.96	700	271,000	5.77	50,300	12.41
Fofina	33,000	4.66	4,900	3,000	3.94	300	36,000	4.49	5,200	2.95
Siou OP	1,400,000	3.78	170,200	179,000	1.92	11,000	1,579,000	3.57	181,200	17.76
Siou UG	1,047,000	5.10	171,600	1,988,000	5.38	344,200	3,035,000	5.29	515,800	-
Yama	-	-	-	651,000	1.75	36,600	651,000	1.75	36,600	12.62
Rompad	317,000	1.84	18,800	-	-	-	317,000	1.84	18,800	-
Total Mana	**9,124,000**	**2.96**	**868,600**	**9,107,000**	**2.88**	**841,700**	**18,231,000**	**2.92**	**1,710,300**	**11.40**

Notes:

1. All figures have been rounded to reflect the relative accuracy of the estimates
2. Metal price of USD 1,200 per ounce gold

Mineral reserves were estimated by François Thibert M.Sc. Geo., Directeur, Groupe Estimation Ressources et Réserves, Afrique de l'Ouest, of SEMAFO under the supervision of Michel Crevier, P.Geo., MScA, Vice President, Exploration and Mine Geology and SEMAFO's QP. The estimates were reviewed by Eur Ing Bruce Pilcher, CEng, FIMMM, FAusIMM(CP), Senior Mining Engineer with Micon who is the responsible QP for the estimate.

1.11 MINING METHODS

Two mining methods will be employed at the Mana operation. Open pit mining will continue to be used at Wona/Kona and part of the Siou ore zone, and at Fofina and Nyafé. Following identification of the ore at depth, underground mining will be employed in the southern part of the Siou deposit.

1.11.1 Open Pit Mining

Open pit mine production at Mana averages approximately 7,500 t/d of ore, mainly from the Wona and Siou pits, that can be blended with ore from the other open pit sources up to a maximum of 8,000 t/d for processing in the mill. The Kona pit has been mined out and backfilled.

Pit optimization was conducted using Datamine's NPV Scheduler software based on the Lerchs-Grossman algorithm. Considering the large volume of stripping material at the south of Siou Phase 4, (stripping ratio over 32), SEMAFO assessed the possibility of an underground mine below the open pit Phase 2.

Geotechnical pit slope designs were completed in 2016 and updated in 2017.

The total material to be moved over the eight-year life of all open pits is 184.8 Mt including 15.2 Mt of ore.

SEMAFO owns the majority of the open pit equipment fleet but it also uses contractors' services and rental equipment.

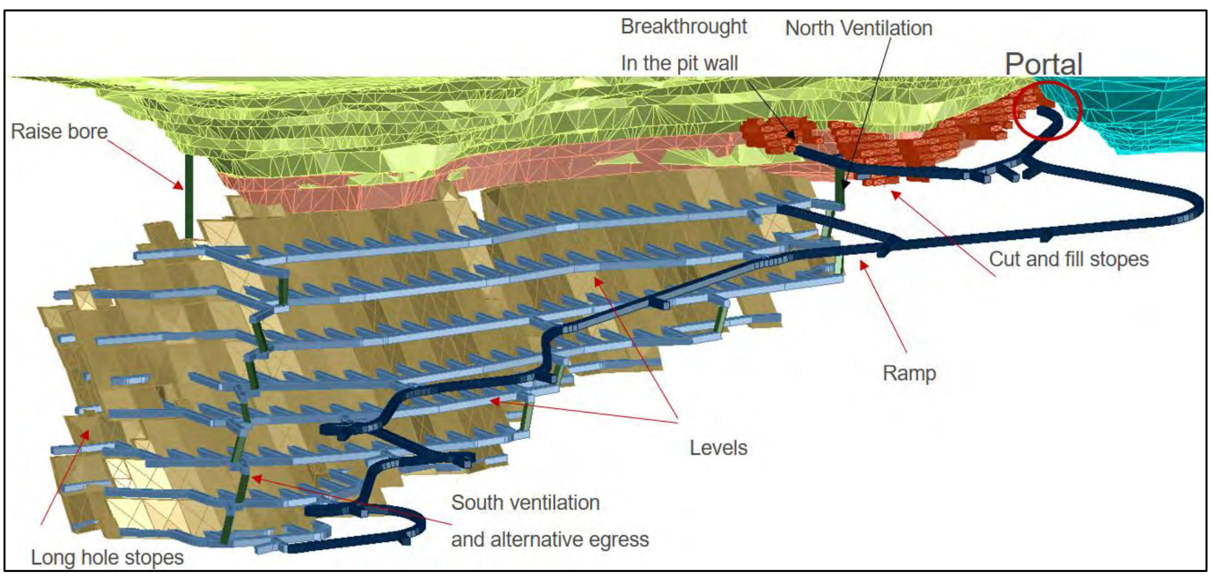
1.11.2 Underground Mining at Siou

Two underground mining methods will be used: long hole (longitudinal retreat and transversal) and cut and fill mining; these were selected because of the inclination of mineralized lenses and ore (stockwork) thickness. Long hole mining will be used when a stope can be mined economically above a dip of 50º degrees and by cut and fill below 50º. Most of the areas where the Siou orebody is located in the hanging wall will be mined cut and fill. Consolidated backfill and loose rock will be used to ensure safe ore recovery in long hole mining. For cut and fill mining, pivot ramps will be driven from the main access ramp.

Golder was retained to undertake the geotechnical and hydrogeological analysis of the underground project at Siou, including stope dimension, ground support and pillar dimension. The rock is classified as Good to Very Good for the four geological units present at Siou. Under a steady state condition and at the end of the excavation, a total water inflow of about 700 m^3/d is estimated for the underground mine.

The mine design and planning were based on the Siou geological model results. The production rate will be 2,000 t/d using a contract miner. Figure 1.1 shows an isometric view of the mine design.

Figure 1.1
Siou Isometric View of Underground Mine Design



SEMAFO, 2017.

SEMAFO envisages underground production at Siou reaching capacity in the second quarter of 2020. Detailed engineering will take place through the first half of 2018. It is expected that the mining contractor will be mobilized in the third quarter of 2018, with portal preparation and underground development initiated immediately.

1.12 RECOVERY METHODS

Gold from the Mana deposit is recovered by a state of the art metallurgical plant which was constructed in 2008. Between 2008 and 2017, the Mana plant processed a total of 22,790,647 t of ore coming from the Wona, Kona, Nyafé, Siou and Fofina pits at an average grade of 2.8 g/t Au and an overall recovery of 90.8% which produced 1,863,186 oz of gold. The operational results correlate very well with the laboratory tests performed over the years for different ore types and for all mineralization types including oxides and sulphides.

The Mana flowsheet comprises a standard SABC comminution circuit, carbon-in-leach (CIL) circuit, Zadra elution circuit, gold electrowinning and tailings disposal. Slurry tails from the CIL circuit are pumped to the tailings storage facility and supernatent water is recycled back to the mill. There will be no changes in processing as a result of the change of mining method from open pit to underground mining. Projected annual production is summarized in Table 1.3.

Table 1.3
Summary of Projected Mine Annual Production

	2018[1]	2019	2020	2021	2022	2023	2024	2025	Total
Total tonnes	2,157,685	2,209,475	2,299,626	2,386,935	2,387,312	2,403,177	2,462,907	1,605,831	17,912,948
g/t Au	2.74	3.04	3.25	3.16	3.13	3.12	2.78	1.97	2.94
Recovery	86.5%	88.8%	88.4%	88.0%	88.6%	88.6%	75.1%	81.1%	86.1%
Ounces	164,403	191,790	212,441	213,258	212,608	213,868	165,205	82,371	1,455,945

[1] Production numbers for 2018 excludes processing of rompad material.

1.13 PROJECT INFRASTRUCTURE

Facilities at the Mana site include the open pit mines, waste rock dumps, process plant, tailings storage facility, water storage/supply dam, five water runoff basins, sediment ponds, storage areas, buildings, power plant, bulk fuel storage, accommodation camps and main access road. Different areas are fenced to provide security and prevent animal access.

1.13.1 Power Supply

Due to the remote location of the Mana site, power is provided by a diesel-fuelled generation station located adjacent to the process plant.

An onsite bulk fuel storage facility is located close to the power plant and provides diesel for power generation, mine trucks, light vehicles and users at the process plant.

1.13.2 Sewage, Waste Water and Solid Waste Management

Domestic wastewater and sewage from the site facilities are collected and sent to a wastewater treatment plant. The water discharged is rigorously monitored and remains in compliance with the discharge standards of Burkina Faso. The industrial wastewater from the Wona and Siou garages and the hydrocarbon depot are treated in self-contained structures with settling separators before being discharged to the environment. All discharge is closely monitored through a sampling and analysis program.

All waste is sorted at source and placed in different coloured containers. Material such as food waste uncontaminated packaging, green waste, ordinary industrial waste, is collected in green bins and sent to the landfill site within the tailings storage facility.

1.13.3 Accommodation

The accommodation camp is located about 1 km to the east of the process plant and provides accommodation for 135 employees including expatriates, national senior and technical staff.

1.13.4 Mine and Plant Facilities

Site buildings consist of administration offices, workshops, warehouses, laboratory and reagent storage sheds which are constructed of structural steel framing and metal cladding on concrete slabs. Offices and amenity buildings are concrete block or brick construction.

The explosive site is a separately fenced area with 24-h security guard and equipped with surveillance cameras.

The Siou mining operation is located approximately 16 km east of the processing plant. Certain infrastructure items are located in the Siou sector to minimize transportation and maintenance costs, and to ensure security for mining high grade ore.

1.13.5 Water Supply

Operational water demand is met from tailings storage facility decant, pit dewatering (including precipitation in the pit area), surface runoff and site groundwater which is collected in raw water dams and ponds around the site. The total plant water demand is between 3.6 and 3.9 Mm^3/y. The surface water collection network consists of five collection basins located north and south of the treatment plant with a nominal holding capacity of 601,000 m^3.

Potable water for the Mana site is supplied from underground wells (Dangouna village, Somana, Wona and accommodation camps).

1.13.6 Tailings Storage Facility

A tailings storage facility (TSF) with a storage capacity of 41 Mm^3 of tailings generated by the ore processing operations is required for the life of the project at a rate of 2.7 Mt/y. Tailings are discharged to the facility via a 5 km pipeline. The supernatant water is recycled to the plant and there is no effluent out of the tailings pond. Ten control wells around the TSF monitor groundwater quality and fluctuations in the water table.

The facility is contained by four peripheral laterite embankment dams and has an area of approximately 130 ha and is divided into two cells, east and west, separated by a median dam. The tailings are deposited alternately in the cells in order to accelerate consolidation and evaporation.

1.14 MARKET STUDIES AND CONTRACTS

No market studies have been undertaken for this prefeasibility study. The commercial product is gold doré.

SEMAFO has contracts in place for sale of gold from its producing mine, Mana, in Burkina Faso. These contracts are with well recognized international refineries and sales are made based on spot gold prices.

1.15 ENVIRONMENTAL STUDIES, PERMITTING AND SOCIAL OR COMMUNITY IMPACT

There are no identified environmental or social issues on the Mana property that would materially impact SEMAFO's ability to operate the mining and processing facilities.

Environmental and social impact assessments, environmental and social management plans and resettlement action plans define the terms of the environmental management of the Mana mining and processing operations, as well as the compensation for people affected by the developments all in accordance with the regulations.

Environmental control, implementation of management and facility response plans, and the monitoring of extraction and treatment operations are the responsibility of the Environmental Manager. Water quality, air quality, noise and vibration, acid generating potential, waste materials, and tailings pond are subject to rigorous monitoring in accordance with the regulatory requirements of Burkina Faso and industry best practice. Due to the high impact of the rainy season, special attention is given to monitoring the overall management of water, including the tailings pond. There is no effluent discharge to the environment.

The Community Relations Department and the SEMAFO Foundation are responsible for implementing social commitments and SEMAFO's social responsibilities.

An amendment to the existing operating permit is required for the development of the Siou underground mine. The application for an amendment to the operating permit requires a feasibility study that must first be accepted by the relevant agency together with an ESIA which must include a resettlement action plan (RAP) that has been accepted by all stakeholders.

1.15.1 Acid Rock Drainage

Regular analyses carried out over the period 2009-2012 on samples from the Wona and Nyafé pits demonstrate that the types of materials contained in the existing waste rock can be considered as non-acid generating.

1.15.2 Waste Rock Storage

Waste rock is transported to one of the five storage areas located near the open pits with total capacity of 29.3 Mt. These structures are built up in layers and the slopes leveled to an average of about 20° and are surrounded by perimeter diversion ditches. Each waste rock storage area is progressively rehabilitated and revegetated.

1.15.3 Closure, Decommissioning and Reclamation

The mine rehabilitation and closure plan outline the recommended remediation options, including the stages and costs of implementation. By decree, the government has set up a fund to be used for the restoration of mining sites. The account of SEMAFO in this fund stood at USD 7,255,733, as of December 31, 2017 on an annual rehabilitation budget of USD 0.01/t of material mined (ore and waste rock).

The main objectives of the closure and rehabilitation plan are restoration of ecosystems and recovery of land use.

1.16 CAPITAL AND OPERATING COSTS

Capital and operating costs for all mining operations in Mana, including the Wona-Kona pit, the Siou pit and the Siou underground project are expressed in United States dollars.

1.16.1 Mana Open Pits

Sustaining capital expenditures for the eight-year life-of-mine (LOM) period amount to USD 46.3 million. These amounts take into consideration tailings lift, major component rebuild, electrical and mechanical tools, liners and various small sustaining capital needs

Stripping costs are included in the cash operating cost per tonne and in the total mining operation expenses. The unit operating costs shown in Table 1.4 are representative of the historical cost incurred operationally. The following assumptions were used to forecast open pit operating costs:

- Price of fuel: USD 0.98/L.
- Exchange rate: USD1.07: €1.00.

Table 1.4
Open Pit Operating Costs

Description	Unit	Wona-Kona	Fofina	Siou/Nyafé/Yama
Waste Mining				
Oxides (saprolite)	USD/t	1.00	1.41	1.33
Transitional (saprock)	USD/t	2.37	2.24	2.37
Sulphides (bedrock)	USD/t	2.57	2.39	2.57
Ore Mining				
Oxides (saprolite)	USD/t	2.00	3.76	5.07
Transitional (saprock)	USD/t	3.17	4.41	6.01
Sulphides (bedrock)	USD/t	3.23	4.77	6.31
Processing				
Oxides (saprolite)	USD/t	12.81	12.48	13.56
Transitional (saprock)	USD/t	15.91	15.67	16.20
Sulphides (bedrock)	USD/t	17.17	17.12	17.11
G&A				
Oxides (saprolite)	USD/t	2.65	2.65	2.65
Transitional (saprock)	USD/t	3.33	3.36	3.36
Sulphides (bedrock)	USD/t	3.56	3.60	3.60

1.16.2 Siou Underground Project Capital Cost Estimate

The capital cost estimate includes all the direct and indirect costs and appropriate project estimating contingencies required to bring the Siou underground project into production, as defined by this prefeasibility study. The estimated pre-production capital cost is USD 51.7 million and the sustaining development capital is USD 16.5 million, as shown in Table 1.5.

Table 1.5
Siou Underground Project Overall Capital Cost Estimate
(Million USD)

Main Area	Pre-production	Sustaining	Total
Underground Mine	26.5	10.8	37.3
Maintenance and Infrastructure	13.2	2.9	16.1
Technical Services	2.9	0.5	3.4
Administration	1.5	0.2	1.7
Contingency (15%)	6.6	2.2	8.8
Subtotal	50.7	16.5	67.2
Operation Readiness Plan	1.0		1.0
Total	**51.7**	**16.5**	**68.2**

The project initial capital costs are based on a pre-production period from Q3 2018 through Q4 2019. Pre-production represents the period prior to the processing of the first production ore from the underground mine. The largest portion of the capital cost estimate is attributed to development costs, which have been based on contractor quotations. The capital costs include a contingency of 15%. Mining capital includes mine access development, pre-production mining costs, contractor mobilization and other mine infrastructure that is comprised of surface facilities and portal collar construction. The development capital has been estimated based on the metreage of development, and the contractor's proposed unit cost of development for each of the different development profiles. Ventilation raise development was quoted to be completed using production drill and raise bore equipment rates.

The project sustaining development capital costs and operating costs are for the period from 2020 to 2024.

1.16.3 Siou Underground Project Mine Operating Costs

Operating cost estimates for the project are based primarily on contract mining. Average unit costs are shown in Table 1.6 based on annual tonnes milled.

Table 1.6
Mining Operating Cost per Tonne

Item	Units	Y -1	Y 1	Y 2	Y 3	Y 4	Y 5	Total
Mill Production	kt	65	654	704	704	705	204	3,036
Underground Mine	USD/t		62.02	48.77	48.35	38.15	41.51	47.54
Maintenance and Infrastructure	USD/t		17.92	17.97	18.64	17.04	11.45	17.07
Technical Services	USD/t		3.14	3.15	3.41	3.35	3.34	3.20
Administration	USD/t		1.43	1.43	1.55	1.53	1.53	1.45

Life of mine average operating cost for mining in respect of the underground project is forecast to be approximately USD 70/t milled.

1.16.4 Siou Underground Project Processing and General and Administration Costs

The operating costs for processing and G&A were provided by SEMAFO BF. The LOM average costs in respect of the underground project are USD 17.11/t and USD 3.60/t, respectively, and are representative of the historical cost incurred.

1.17 ECONOMIC ANALYSIS

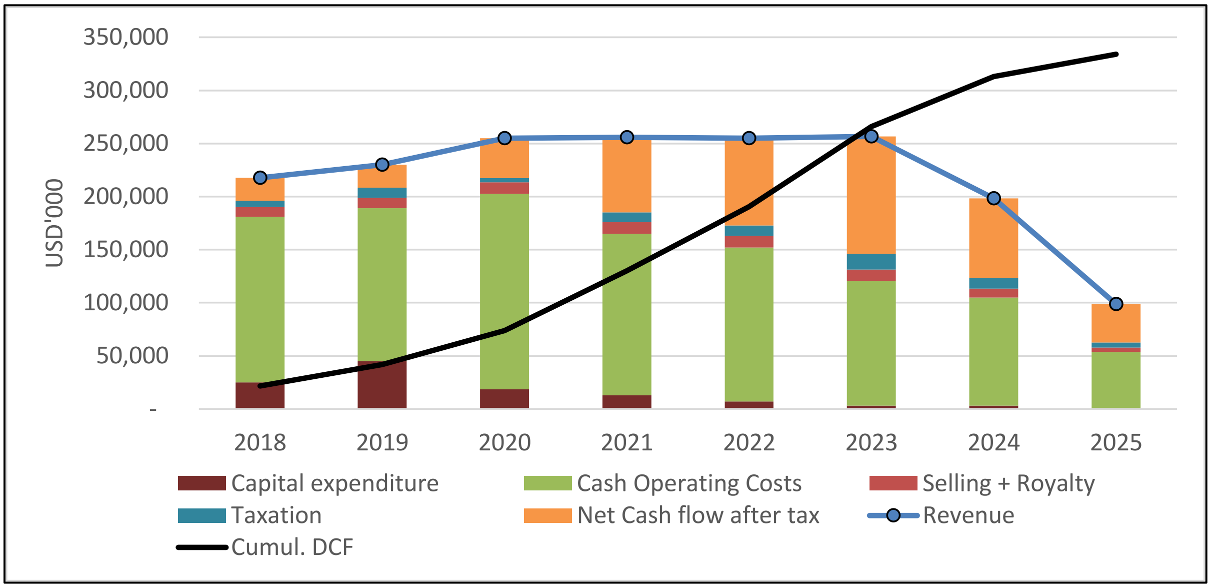
Micon has prepared its economic analysis of the Siou underground project on the basis of a discounted cash flow model, from which net present value (NPV) and other measures of project viability can be determined. for the potential viability of an open pit and underground mining operation with an on-site mill and processing plant producing doré bullion for sale to a precious metals refinery.

All metal price forecast, capital and operating cost estimates and cash flow projections are expressed in United States dollar terms. Inputs to the cash flow model for the project have been prepared using constant, first quarter 2018 money terms.

The base case cash flow projection assumes a static gold price in real terms of USD 1,200/oz. Corporate income tax in Burkina Faso is charged at 17.5% after depreciation and amortization allowances calculated on a unit of production basis. A state royalty of 4.0%

sales has been provided for. Base case LOM annual cash flows are presented graphically in Figure 1.2.

Figure 1.2
Life of Mine Annual Cash Flow Forecast



1.17.1 Discounted Cash Flow Evaluation

At an annual discount rate of 8.0%, the discounted cash flow evaluates to an NPV of USD 334 million.

Owing to the absence of negative annual cash flows in the forecast period, no internal rate of return (IRR) or payback period can be determined.

1.17.2 Conclusion

Micon concludes that this study demonstrates the viability of the project within the range of accuracy expected of a prefeasibility study for the estimated capital and operating costs, production forecast, and price assumptions.

1.18 RECOMMENDATIONS

This prefeasibility study demonstrates that the transition from an open pit to an underground operation for the Siou deposit is economically viable and it is recommended that SEMAFO advances the project to development.

A budget of USD 1.25 million has been allocated, of which USD 0.25 million will be used for drilling four holes in an area of probable reserves in order to improve the confidence category to proven reserves. The sum of USD 1.00 million will be expended on preparation of an operational readiness plan for underground development.

Continued exploration is warranted in order to expand the mineral resources at Siou along strike and at depth. Once development of the haulage decline is sufficiently advanced, drilling can be conducted to test for potential extensions of the mineral deposit down-dip and to the north and south of the current known resource.

In order to advance the Siou underground project beyond the prefeasibility study stage, it is recommended that more detailed work proceeds on areas such as underground facilities (fans and pumps), water supply for mining operations, detailed mine planning, ground control management plan and grade control programs. The operational readiness program includes preparation of a mining plan to be filed with the authorities in Burkina Faso in support of an amendment to the mining permit to allow underground development.

It is recommended that the project financial model is updated in order to provide a detailed monthly schedule and budget for the period of underground mine development and to regularly monitor the impact of actual data on the underground development project.

Micon has reviewed the budget for the work described above and recommends that SEMAFO proceeds with development of an underground mining operation at Siou.

2.0 INTRODUCTION

Micon International Limited (Micon) has been retained by SEMAFO Burkina Faso S.A. (SEMAFO BF), a wholly-owned subsidiary of SEMAFO Inc. (SEMAFO), to prepare a Technical Report under Canadian National Instrument 43-101 (NI 43-101) which discloses the results of the prefeasibility study (PFS) for the development of underground mineral reserves at the Mana gold project located in southwestern Burkina Faso, West Africa, and to disclose updated mineral resource and mineral reserve estimates.

The Mana mine was opened in March, 2008. Ore is mined using open pit methods from a number of deposits, Wona-Kona, Nyafé, Fofina and Siou. Exploration has identified the potential for underground mining at Siou.

The government of Burkina Faso has the right to hold a 10% free carried interest via a 10% equity interest in the local holding company. The local holding company is SEMAFO Burkina Faso SA (SEMAFO Burkina Faso) which is 90% owned by SEMAFO.

The mining licence for operations at Mana is held by SEMAFO Burkina Faso. Exploration permits are held by Mana Mineral SARL or Ressources Tangayen SARL (Ressources Tangayen), a related company.

2.1 TERMS OF REFERENCE

2.1.1 Prefeasibility Study

This Technical Report has been prepared by Micon under the terms of its agreement with SEMAFO BF. Data have been prepared by Mana Mineral SARL, SEMAFO and its contractors. Micon has reviewed this work for completeness and to allow Micon Qualified Persons (QPs) to take responsibility for each section of this Technical Report.

The inclusion of underground resources at the Siou deposit requires the preparation of the present study to assess the technical and economic merits of including material mined by underground methods.

The processing flowsheet, project infrastructure and environmental and social issues, will remain largely unchanged from the present open pit operations.

The PFS is based on mineral resource and mineral reserve estimates with effective dates of 31 December, 2017. The reserve and resource estimates in this PFS have been prepared in accordance with NI 43-101. NI 43-101 is a rule developed by the Canadian Securities Administrators which establishes standards for all public disclosure an issuer makes of scientific and technical information concerning mineral projects.

The PFS demonstrates the economic viability of the underground development of the Siou deposit. The PFS has an effective date of 15 February, 2018.

2.1.2 Previous Technical Reports

Technical Reports prepared on the Mana property since 2009 are:

- Advanced Technical Report, Mana Property, Burkina Faso, Reserve and Resource Update as at June 30, 2013, prepared by SEMAFO (SEMAFO, 2013).
- Met-Chem Canada Inc., Technical Report, Feasibility Study of the Wona Deep Project and Updated Mana Resources and Reserves, 31 March, 2011.
- Met-Chem Canada Inc., Technical Report, Pre-feasibility Study of the Wona Deep Project and Updated Mana Open Pit Reserves, 12 August, 2010.
- SEMAFO Inc., 2013a, Technical Report, Advanced Technical Report, Mana Property, Burkina Faso. Reserve and Resource Update as of December 31, 2012, dated March 22, 2013.
- SEMAFO Inc., 2013b, Advanced Technical Report, Mana Property, Burkina Faso, Reserve and Resource Update as at June 30, 2013, prepared by SEMAFO Inc.
- SGS Geostat Ltd., 2009, Technical Report on the Resources and Reserves of the Mana gold deposits, Burkina-Faso, as of Dec. 31, 2008, dated 25 March, 2009.
- SGS Geostat Ltd., Technical Report on the Resources and Reserves of the Mana gold deposits, Burkina Faso, as of Dec. 31, 2009, dated 28 February, 2010.
- SGS Canada Inc., Advanced Technical Report, Mana Property, Burkina Faso, Reserve and Resource Update as of December 31, 2011, prepared by SGS Canada Inc., effective date 11 July, 2012.

The feasibility study for the Mana property was prepared by Breton, Banville International Inc. (BBA) and Micon, dated July, 2005.

Mineral resource and mineral reserve estimates for the Mana property have been updated annually by SEMAFO and disclosed in Technical Reports between 2005 and 2013 (SEMAFO, 2005, 2006, 2007 and 2008, 2013a, 2013b).

2.1.3 Relationship with SEMAFO

Micon does not have, and has not previously had, any material interest in SEMAFO BF or SEMAFO, or any related entities. The relationship between Micon and SEMAFO BF is solely a professional association between the client and the independent consultant. This report is prepared in return for fees based upon agreed commercial rates and the payment of these fees is in no way contingent on the results of this report.

The conclusions and recommendations in this report reflect the authors' best independent judgment in light of the information available to them at the time of writing. The authors and Micon reserve the right, but will not be obliged, to revise this report and conclusions if additional information becomes known to them subsequent to the date of this report. Use of this report acknowledges acceptance of the foregoing conditions.

This report is intended to be used by SEMAFO BF subject to the terms and conditions of its agreement with Micon. Micon permits SEMAFO to file this report as a Technical Report with the Canadian Securities Administrators pursuant to provincial securities legislation. Except for the purposes legislated under provincial securities laws, any other use of this report, by any third party, is at that party's sole risk.

The requirements of electronic document filing on SEDAR necessitate the submission of this report as an unlocked, editable pdf (portable document format) file. Micon accepts no responsibility for any changes made to the file after it leaves its control.

2.2 QUALIFIED PERSONS, SITE VISITS, AND AREAS OF RESPONSIBILITY

The primary authors of this report and Qualified Persons are:

- Richard Gowans, P.Eng., President and Principal Metallurgist.
- Christopher Jacobs, CEng, MIMMM, Vice President.
- Charley Murahwi, M.Sc., P.Geo., Senior Geologist.
- EurIng, Bruce Pilcher, CEng, FIMMM, FAusIMM(CP), Senior Mining Engineer.
- Jane Spooner, P.Geo., Vice President

Micon's site visit to the Mana property was conducted on 26 to 29 July, 2017 by Messrs. Gowans, Murahwi and Pilcher. They were accompanied by Richard Roy, P.Geo., Exploration Manager with SEMAFO. Discussions were held with Mana site personnel.

2.3 UNITS AND ABBREVIATIONS

All currency amounts are stated in United States dollars ($ or USD). Quantities are generally stated in metric units, the standard Canadian, and international practice, including metric tons (tonnes, t) and kilograms (kg) for weight, kilometres (km) or metres (m) for distance, hectares (ha) for area. Wherever applicable, Imperial units have been converted to Système International d'Unités (SI) units for reporting consistency. Metal grades may be expressed as a percentage (%), grams per metric tonne (g/t), parts per million (ppm) or parts per billion (ppb). A list of abbreviations is provided in Table 2.1.

Table 2.1
List of Abbreviations

Abbreviation	Term
A	Ampere(s)
AA	Atomic absorption
AAS	Atomic absorption spectrometry
ABA	Acid base accounting

Abbreviation	Term
AC	Air core
A/cm^2	Amperes per square centimetre
AMD	Acid mine drainage
ARD	Acid rock drainage
bcm	Bank cubic metre(s)
BLEG	Bulk leach extractable gold
BQ	Drill core tube size interior diameter 36.5 mm
CIL	Carbon in leach
CIM	Canadian Institute of Mining, Metallurgy and Petroleum
cm	Centimetre(s)
cm^2	Square centimetres
CN	Sodium cyanide
CV	Coefficient of variation
CRM	Certified reference material
DO	Dissolved oxygen
DTM	Digital Terrain Model
d/w	Days per week
EM	Electromagnetic
ESIA	Environmental and Social Impact Assessment
ft^3	Cubic feet
g	Gram(s)
Ga	Giga-annum, billion years old
g/cm^3	Grams per cubic centimetre
g/L	Grams per litre
G&A	General and administration
g/t	Grams per tonne
g/t Au	Grams per tonne of gold
GPS	Global positioning system
GRG	Gravity recoverable gold
h	Hour(s)
ha	Hectare(s)
HCl	Hydrochloric acid
h/y	Hours per year
HDPE	High density polyethylene
HFO	Heavy fuel oil
HP	Horse power
Hz	Hertz
ID	Identification
ID^3	Inverse distance cubed
in	Inch(es)
IRR	Internal rate of return
kg	Kilogram(s)
kg/h	Kilograms per hour
km	Kilometre(s)
km/h	Kilometres per hour
kPa	Kilopascal(s)
kt	Thousand tonnes
kV	Kilovolt(s)
kWh	Kilowatt hour(s)
LG	Lerchs-Grossman
L/s	Litres per second

Abbreviation	Term
m	Metre(s)
Ma	Million years old.
m^3	Cubic metre(s)
m^3/h	Cubic metres per hour
m^3/m	Cubic metres per month
m^3/t	Cubic metres per tonne
m^3/y	Cubic metres per year
M	Million(s)
Ma	Million years
mg/L	Milligrams per litre
mL	Millilitre(s)
Mm^3	Million cubic metres
Mm^3/y	Million cubic metres per year
Mbcm	Million bank cubic metres
mg/kg	Milligrams per kilogram
mg/L	Milligrams per litre
mm	Millimetre(s)
mol/L	Moles per litre
Moz	Million ounces
Mt	Million tonnes
Mt/y	Million tonnes per year
MVA	Megavolt ampere(s)
MW	Megawatt(s)
NQ	Drill core tube size interior diameter 47.6 mm
NPV	Net present value
NPV_8	Net present value at a discount rate of 8% per year
NSR	Net smelter return
OK	Ordinary kriging
OP	Open pit
oz	Ounces (troy ounces)
oz/y	Ounces per year
P_{80}	80% passing size
PLS	Pregnant leach solution
ppb	Parts per billion
ppm	Parts per million
PQ	Drill core diameter 85 mm
QA/QC	Quality assurance/quality control
QQ	Quartile-quartile
QP	Qualified Person
PVC	Polyvinyl chloride
RAB	Rotary air blast
RC	Reverse circulation
ROM	Run of mine
RQD	Rock quality designation
S	Sulphur
SABC	Semi-autogenous and ball mill crushing
SAG	Semi-autogenous grinding
SD	Standard deviation
SEM	Scanning electron microprobe
SG	Specific gravity
SMBS	Sodium metabisulphite

Abbreviation	Term
t	Tonne(s)
t/d	Tonnes per day
t/h	Tonnes per hour
t/m^3	Tonnes per cubic metre
TSF	Tailings storage facility
UG	Underground
UPS	Uninterruptible power supply
UTM	Universal Transverse Mercator
V	Volt(s)
v/v	Volume for volume
WACC	Weighted average cost of capital
WAD	Weak acid dissociable
VVVF	Variable voltage/variable frequency
w/v	Weight for volume
w/w	Weight for weight
wt/h	Wet tonnes per hour
wt%	Weight percent
y	Year(s)
Y	Operating year
yd^3	Cubic yard(s)
XRD	X-ray diffraction
XRF	X-ray fluorescence
º	Degree(s)
ºC	Degrees Centigrade
%	Percent
%/y	Percent per year
µm	Micron(s)
€	Euros
USD	United States dollars
CAD	Canadian dollars
3D	Three dimensional

3.0 RELIANCE ON OTHER EXPERTS

Micon has reviewed and analyzed data provided by SEMAFO BF and its parent company, and has drawn its own conclusions therefrom, augmented by its direct field examination. Micon has not carried out any independent exploration work, drilled any holes or carried out a program of sampling and assaying on the property. Micon has not taken any samples to independently verify the mineralization at the Mana property.

While exercising all reasonable diligence in checking, confirming and testing it, Micon has relied upon SEMAFO BF and its parent company's presentation of the data relating to the Mana property, in preparing this report.

3.1 MINERAL TENURE AND SURFACE RIGHTS

Micon and has not reviewed any of the documents or agreements under which SEMAFO Burkina Faso, Mana Mineral SARL and Ressources Tangayen SARL hold title to the Mana property and offers no opinion as to the validity of the mineral titles claimed. A description of the properties, and ownership thereof, is provided in Section 4.2 for general information purposes only.

3.2 ENVIRONMENTAL LIABILITIES AND SOCIAL AND COMMUNITY IMPACTS

The existing environmental conditions, liabilities and remediation are described as required by NI 43-101 regulations.

3.3 TAXATION AND ROYALTIES

Micon has relied on information regarding taxation and royalties provided by SEMAFO BF and its parent company.

3.4 OTHER INFORMATION

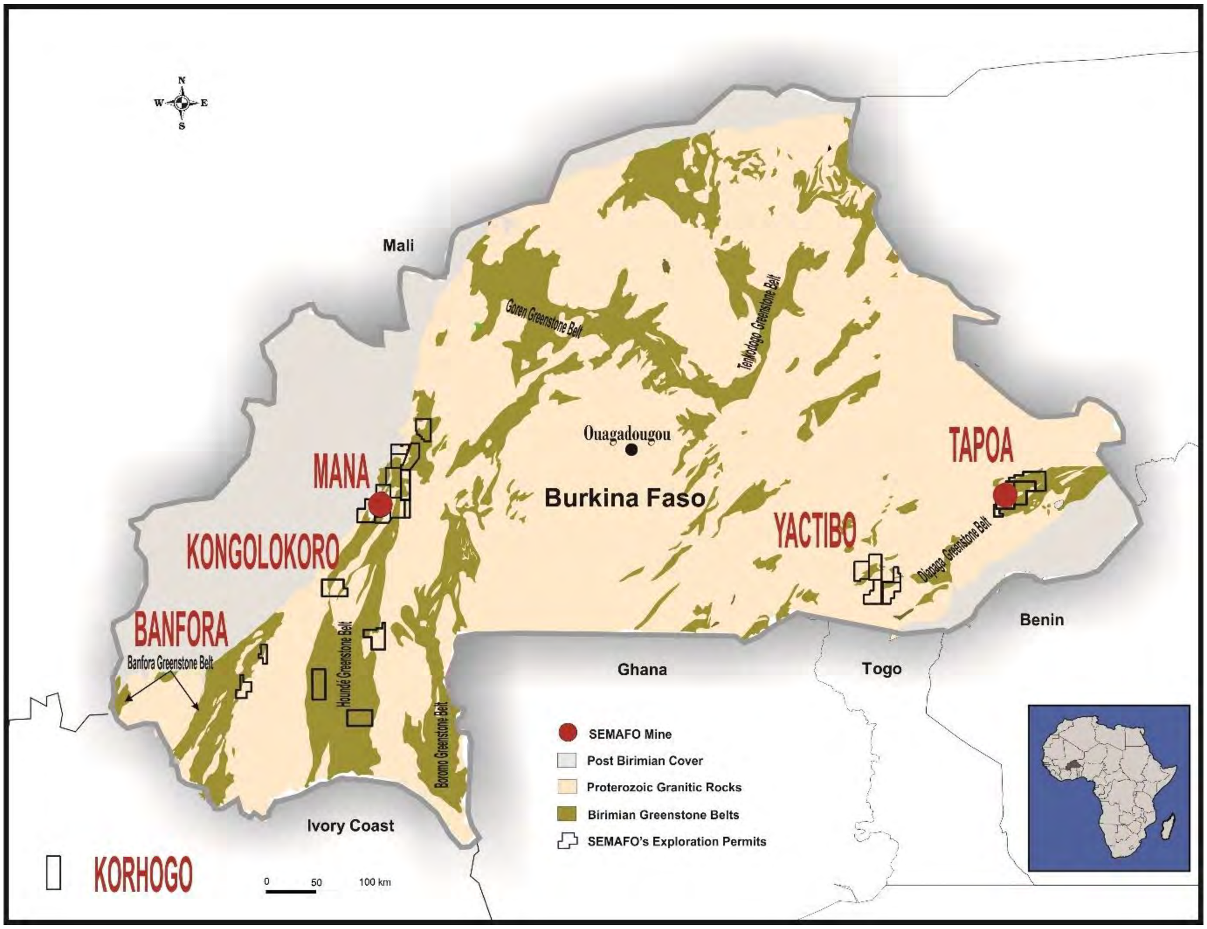
Micon is pleased to acknowledge the helpful cooperation of SEMAFO BF and its parent company which made any and all data requested available and responded openly and helpfully to all questions, queries and requests for material.

4.0 PROPERTY DESCRIPTION AND LOCATION

4.1 PROPERTY DESCRIPTION AND LOCATION

The Mana gold deposits lie within the Mana Permit Group located in Burkina Faso, West Africa. The property lies approximately 200 km west of Ouagadougou, the capital of Burkina Faso, as shown in Figure 4.1. It is centred on UTM coordinates 465,000mE and 1,326,000mN (WGS84z31).

Figure 4.1
Mana Permit Group General Location Map



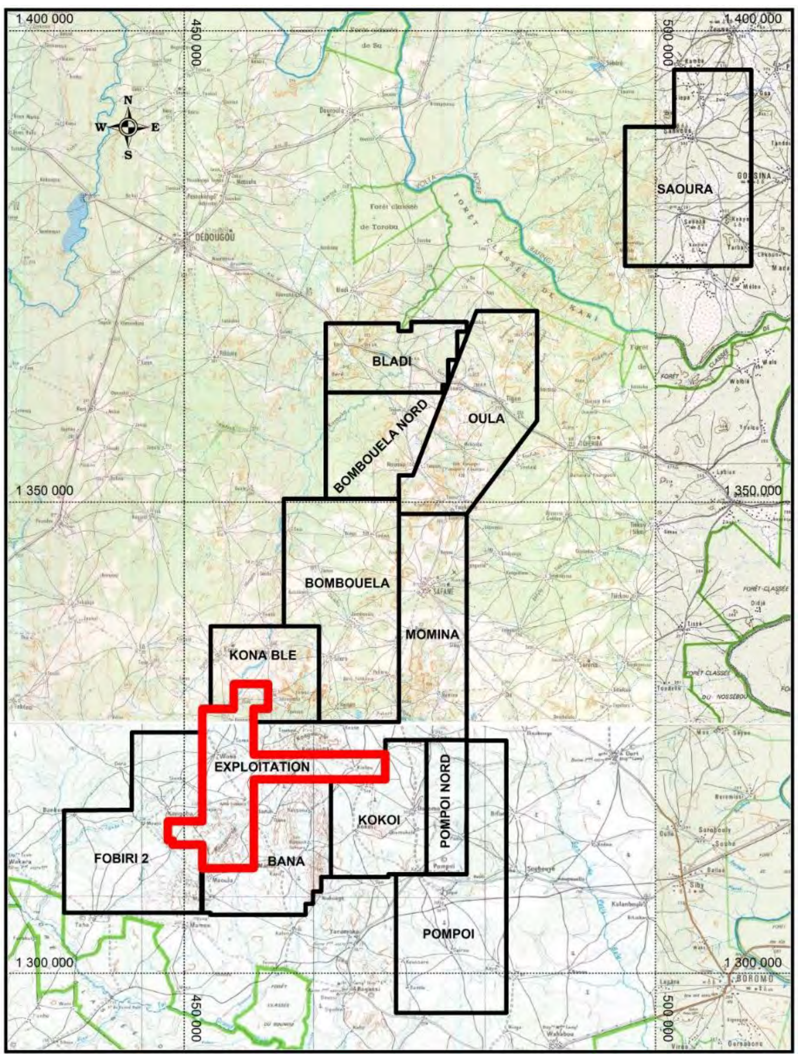
SEMAFO, 2017.

It is planned that the Mana operations will comprise mining the remainder of the Siou open pit reserves (at the North end of the pit) in 2018 and 2019. From 2020, the underground reserves at Siou will be mined at the full production rate of 700,000 t/y to contribute 40% of the mill feed at 2,000 t/d, equivalent to more than 50% of the ounces of gold produced. The balance of the total 5,000 t/d of mill feed will come from the Wona North extension. The overall tonnage mined from the open pits will gradually decrease from 37 Mt/y in 2018 as the underground portion of the Siou operation reaches the full production rate.

4.1.1 Mineral Tenure

The Mining Act of Burkina Faso (Number 036-2015/CNT of 26 June, 2015) provides the legal framework for exploration and mining activities within the country. Exploration permits, up to 250 km^2 in area, are granted for an initial period of three years, and may be renewed twice for periods of three years. At the second renewal, the permit area must be reduced by 25%, although an exemption from this requirement may be applied for at the time of the second renewal. Exploration activities are required to be reported annually to the Director General of Mines and Geology, along with the provisional program of work and budget expenses for the subsequent year. SEMAFO holds 12 contiguous exploration permits collectively known as the Mana Permit Group, covering approximately 1,884.85 km^2, excluding the Wona-Nyafé Exploitation Permit, as shown in Figure 4.2.

Figure 4.2
Mana Permit Group



Wona-Nyafé exploitation permit outlined in red.
SEMAFO, 2017.

Table 4.1 shows details of exploration permits in the Mana Permit Group.

Table 4.1
Mana Permit Group Exploration Permits

Permit Name	Grant Date	First Renewal Date (Decree No.)	Second Renewal Date (Decree No.)	Final Permit Expiry Date	Ownership	Area (km^2)
Fobiri 2[1]	2009-01-05	2012-10-24 (12-245)	2015-06-05 (162)	2018-01-05	Mana Mineral SARL	212.34
Kokoi[2]					Ressources Tangayen SARL	130.2
Momina[2]					Ressources Tangayen SARL	229.0
Bara[2]					Ressources Tangayen SARL	124.15
Kona Blé	2011-01-18	2017-04-03 (17-007)	Awaiting Decree	2020-01-18	Mana Mineral SARL	76.03
Bombouela 2	2013-05-06	2016-08-29 (16-149)	-	2022-05-06	Mana Mineral SARL	250
Bombouela Nord	2010-12-30	2013-12-3 (14-025)	Awaiting Decree	2019-12-30	Mana Mineral SARL	87.02
Oula[3]	2003-10-27	2007-05-14 (07-061)	2010-09-13 (10-149)	2012-10-27	Mana Mineral SARL	194.11
Saoura	2010-04-15	2013-04-15 (13-099)	2016-08-23 (16-142)	2019-04-15	Mana Mineral SARL	247.48
Pompoi Nord	2014-02-17	2017-04-14 (17-019)	-	2023-02-17	Ressources Tangayen SARL	60.82
Pompoi	2010-12-27	2013-12-27 (14-012)	Awaiting Decree	2019-12-27	Société CASSEZ	174.2
Bladi	2012-11-20	2016-03-11 (16-035)	-	2021-11-20	Ressources Tangayen SARL	99.5

[1] Awaiting Exceptional Renewal approval.
[2] New permits replacing Mana Est, Mana Ouest and Bara. Same land coverage. Held by Ressources Tangayen SARL rather than Mana Mineral SARL. Payment submitted and received but awaiting Ministerial Decree.
[3] Awaiting government decision on status. New permits filed. Decision remains pending.

Goldrush Resources Ltd. (Goldrush) signed an option agreement with Société CASSEZ on the Pompoi permit in June, 2011. Although the terms of the agreement were fulfilled, and the permit essentially owned by Goldrush, the official transfer was never completed. SEMAFO, via Ressources Tangayen SARL (Tangayen, a subsidiary of SEMAFO Inc.), optioned the permit from Goldrush and the terms (apart from payment of the net smelter return royalty) have also been fulfilled. SEMAFO is in the process of transferring the permit to Tangayen. Minor exploration completed by Goldrush includes a soil sampling program on the south part of the permit and 131 m (five holes) of air core drilling to test two soil sample anomalies.

Exploitation (Mining) Permits, which are required for mining to commence, are granted for a term of 20 years (with unlimited five-year renewals) and the government carries the right to hold a 10% free carried interest (via a 10% equity interest in the local holding company). The application for an Exploitation Permit requires an Environmental and Social Impact Assessment (ESIA) and an environmental monitoring and management plan. The current Mining Act includes a sliding scale royalty payable to the government which is dependent on the gold price (3% up to USD 1,000/oz, 4% up to USD 1,300/oz and 5% over USD 1,300/oz).

The government of Burkina Faso is currently updating its renewal process. These changes have caused considerable delays in obtaining final certificates of renewals (see Table 4.1).

4.1.2 Wona-Nyafé Exploitation Permit

The first Wona-Nyafé exploitation permit, No. 2007-144, was obtained in 2007 to cover the Wona-Kona and Nyafé deposits. Following the discoveries of the Fofina and Siou Deposits, a revised permit, No. 2014-223, was obtained to include these deposits. This permit covers a total area of 148.84 km^2 and is held by SEMAFO Burkina Faso SA (90% subsidiary of SEMAFO Inc.). Permit No. 2014-223 is valid for 20 years, until 2027, starting from the initial permit decree. A revised area is currently under request.

4.2 Environmental, Permitting and Other Issues

There are no identified environmental or social issues on the Mana property that would materially impact SEMAFO's ability to operate the mining and processing facilities.

Environmental and social impact assessments (ESIA), environmental and social management plans (ESMP) and resettlement action plans (RAP) define the terms of the environmental management of the Mana mining and processing operations, as well as the compensation for people affected by the developments. The terms of compensation for the people affected by development include the relocation of populations and the amount of financial compensation in accordance with the regulations in place.

Environmental control, implementation of ESMPs and facility response plans (FRP) and the monitoring of extraction and treatment operations are the responsibility of the Environmental Manager for all operations at Mana. A team of technicians and environment operators under his supervision carries out regular environmental controls. Water quality (groundwater, surface water, drinking water, waste water), air quality, noise and vibration, acid generating potential, waste materials, tailings pond are subject to rigorous monitoring in accordance with the regulatory requirements of Burkina Faso and industry best practice. Due to the high impact of the rainy season, special attention is given to monitoring the overall management of the mine's water, including the tailings pond. All water from the tailings pond is recycled to the mill for ore processing. There is no effluent discharge to the environment.

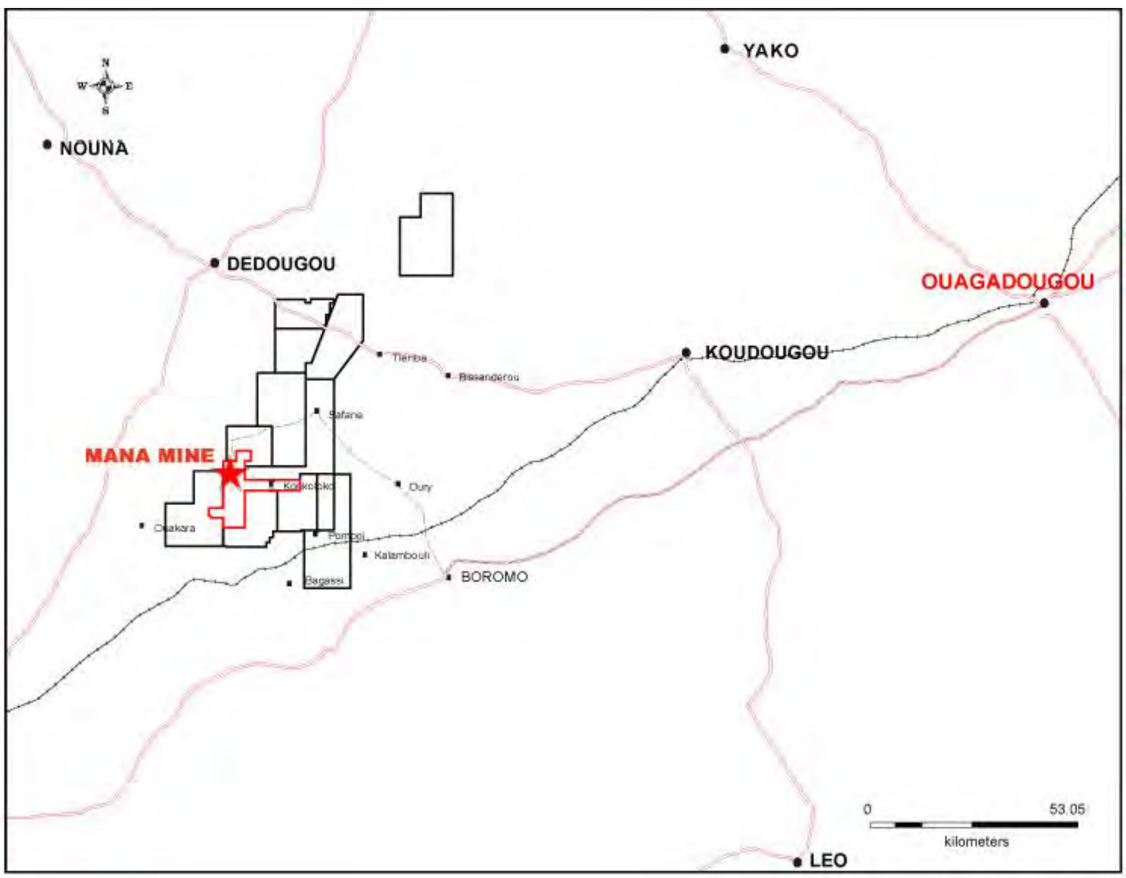
Community development has always been an important part of SEMAFO's business strategy, and the company remains very active in this regard. The Community Relations Department and the SEMAFO Foundation are responsible for implementing social commitments and SEMAFO's social responsibilities. Several initiatives and programs ensure the continued support of the surrounding communities, not only for ongoing operations but also for any future expansion.

5.0 ACCESSIBILITY, CLIMATE, LOCAL RESOURCES, INFRASTRUCTURE AND PHYSIOGRAPHY

5.1 ACCESS AND INFRASTRUCTURE

The Mana deposits and mine are accessible by road from the capital city of Ouagadougou which is serviced by regular air flights to Europe and other African countries. The first 250 km of the 300-km distance is on the main paved roads between Ouagadougou and Dédougou (N1 and N14). The remaining 50 km southwards from Dédougou is via a well-maintained gravel road. See Figure 5.1.

Figure 5.1
Mana Property Access Routes



SEMAFO, 2017.

Numerous tracks allow for access to most places throughout the Mana area. During the peak of the wet season, heavy rains may temporarily restrict vehicle movement in the immediate area of the deposits.

A number of small towns and settlements surround the Mana property, including Ouona, Fobiri, Kana and Madou. The provincial capital of Balé Province is Boromo and the departmental centre is Bagassi with a population of approximately 3,000. The provincial capital of Mouhoun is Dédougou.

SEMAFO holds sufficient ground within the Mana area to meet the requirements of all mining and ancillary operations. Power is currently generated from diesel generators. The mine site operates year-round. Operational water demand is met from tailings storage facility decant, pit dewatering (including precipitation in the pit area), surface runoff and site groundwater which is collected in raw water dams and ponds around the site. A 58-km pipeline from the Mouhoun River became operational in 2012 and provides a backup supply.

5.2 LOCAL RESOURCES

The Mana mine began operations in 2008. The majority of the local workforce lives in the nearby villages of Bana, Wona, Somona, Yona, Fofina and Bissa in the Province of Balé to the south and those of Kona and Dangouna in the Province of Mouhoun to the north. A small portion of the workforce is composed of expatriates who work on 35 days in/28 days out rotation. SEMAFO established a camp about 0.5 km to the east of Mana mine for senior staff and expatriates, comprising living quarters, kitchen and recreational facilities. The camp can accommodate up to 135 personnel.

Health services are provided at the national teaching hospitals, located in Ouagadougou and Bobo Dioulasso, and at regional and district hospitals.

5.3 PHYSIOGRAPHY

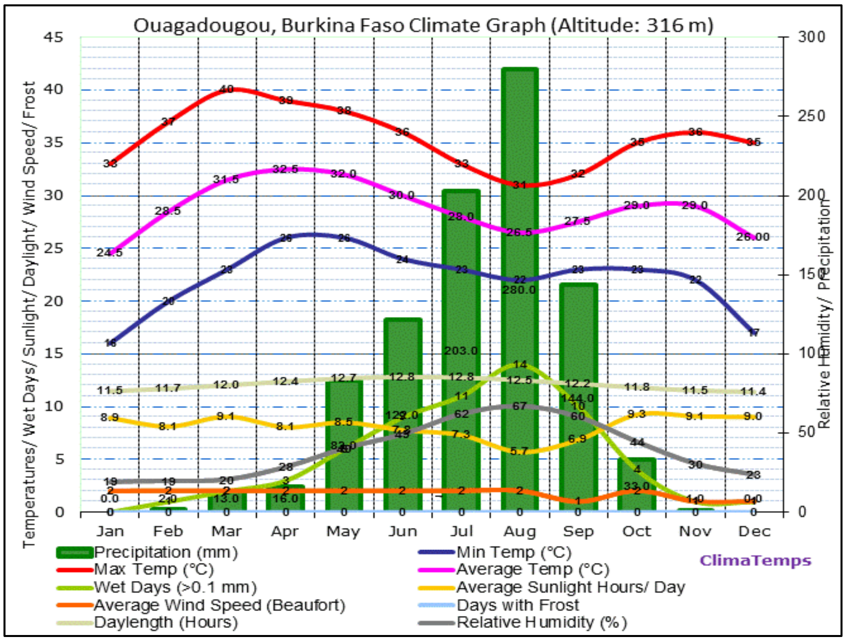
Most of the area lies at elevations of about 350 m with local highs of 450 m on several "lateritic" hills that dot the landscape. Those hills are mostly found to the southeast of the Fobiri 2 permit, the south of the Wona-Nyafé mining permit (with the Nyafé and F67 deposits) and most of the Mana West (or Bana) permit. The north part of the mining permit, where with the Wona-Kona deposit and milling facilities are located, is on relatively flat topography.

Vegetation in the region is a mosaic of cultivated land and tropical acacia savannah.

5.4 CLIMATE

The climate of Burkina Faso is semi-arid, with a rainy season from May to September, and a hot dry season from February to April. Climate data for Ouagadougou are summarized in Figure 5.2. Average temperatures range between 16°C overnight in the cool season to over 40°C during the day in the hot season. Average annual rainfall is approximately 900 mm, although large inter-year variability is common (see Figure 5.2). During October to April, the climate is heavily influenced by the dry, dust-laden northwest trade wind known as Harmattan, which blows down from the Sahara Desert and dust storms from the north are frequent in February and March. Work can be carried out year-round.

Figure 5.2
Climate Data for Ouagadougou



www.climatemps.com (accessed 12 Jan 2016).

Monthly rainfall historic data have been obtained from Customweather for the Boromo weather station located approximately 50 km southeast of Mana. The data cover the years 2005 to 2015. Average monthly rainfall data from this station are given in Table 5.1. August is on average the wettest month of the year with an average rainfall of 257.7 mm, while December, January and February are the driest months with average rainfall of less than 3 mm.

Table 5.1
Average Monthly Rainfall for Boromo, Burkina Faso

Month	Average Monthly Rainfall (mm)
January	2.3
February	1.8
March	5.2
April	29.5
May	47.3
June	89.8
July	182.9
August	257.7
September	172.7
October	48.0
November	6.0
December	0.1
Annual Total	**843.3**

www.customweather.com

6.0 HISTORY

All but one of the permits forming the Mana Property were obtained by Mana Mineral SARL, a subsidiary of SEMAFO, directly from the government of Burkina Faso. No previous work was carried out in the area apart from minor artisanal mining. Exploration work by Mana Mineral SARL on the Mana property started in October, 1997 and led to the initial discovery of the Nyafé, Filon 67 and Wona deposits. The latter was renamed Wona-Kona following the discovery of the Kona deposit in 2010. A formal feasibility study and environmental impact study were initiated in 2004. The results of the feasibility study were made public in August, 2005 while the environmental impact study was completed in 2006. A public hearing on environmental impact began in 2006. The Ministry of Environment of Burkina Faso approved the project and the mining permit for development of the Wona and Nyafé deposits was granted in February, 2007.

Mill start-up took place on February 15, 2008 and the first doré bar was poured on March 31, 2008. Initial capacity was 2,000 t/d based on ball mill capacity. A few months later, the capacity was increased to 4,000 t/d. In 2010, a semi-autogenous grinding (SAG) mill was added to increase mill throughput to 6,000 t/d. Two additional carbon in leach tanks (CIL) were added in 2010 to optimize gold recovery. In February, 2011, a fourth phase of plant expansion to attain up to 7,200 t/d in fresh ore and up to 8,000 t/d in blended ore was launched.

The principal changes to the processing plant include the installation of a new pebble crusher into the grinding circuit, addition of two new generation units to the power plant, addition of an additional CIL tank, upgrade of the elution circuit and upgrading all services in the mill. The commissioning of the latest expansion (Phase 4) was completed in July, 2012 and current plant capacity exceeds nameplate capacity.

Further exploration between 2010 and 2016 led to the discovery and delineation of five different mineralized zones, of which two, Siou and Fofina, have since contributed significantly to gold production. More recently, drilling has principally focused on evaluating the underground potential of the Siou deposit.

The total ore production at Mana to date is close to 2.0 Moz gold from 20.08 Mt of ore at a grade of 2.95 g/t Au (See Table 6.1).

Table 6.1
Summary of Ore Production on the Mana Property from 2008 to 31 December, 2017

Deposit	Tonnes	Grade (g/t Au)	Ounces
Wona-Kona	13,500,000	2.30	990,000
Nyafé-Filon 67	960,000	6.25	193,000
Siou	3,830,000	4.00	496,000
Fofina	2,790,000	3.50	314,000
Total	**21,080,000**	**2.95**	**1,993,000**

Minor exploration was completed by Goldrush on the Pompoi permit, prior to the acquisition by SEMAFO, including a soil sampling program on the south part of the permit and 131 m (five holes) of air core drilling to test two soil sample anomalies. Goldrush reported the following in 2013:

> "Soil samples taken over about 30% of the Pompoi permit provided a number of anomalies which were inadequately tested with rotary air blast drilling because of extensive laterite and a high water table. Gold mineralization in the vicinity of the highest soil value of 983 ppb was confirmed in quartz veined granite saprolite (the main host rock of the 55 Zone) adjacent to the Roxgold [Roxgold Inc.] permit boundary by an intersection of 0.47 g/t Au over 2.0 metres which may represent deposit peripheral mineralization, and which is open in all directions." (Goldrush, 2013).

There are no historical mineral resource or reserve estimates on the property prepared prior to SEMAFO gaining the Mana permits.

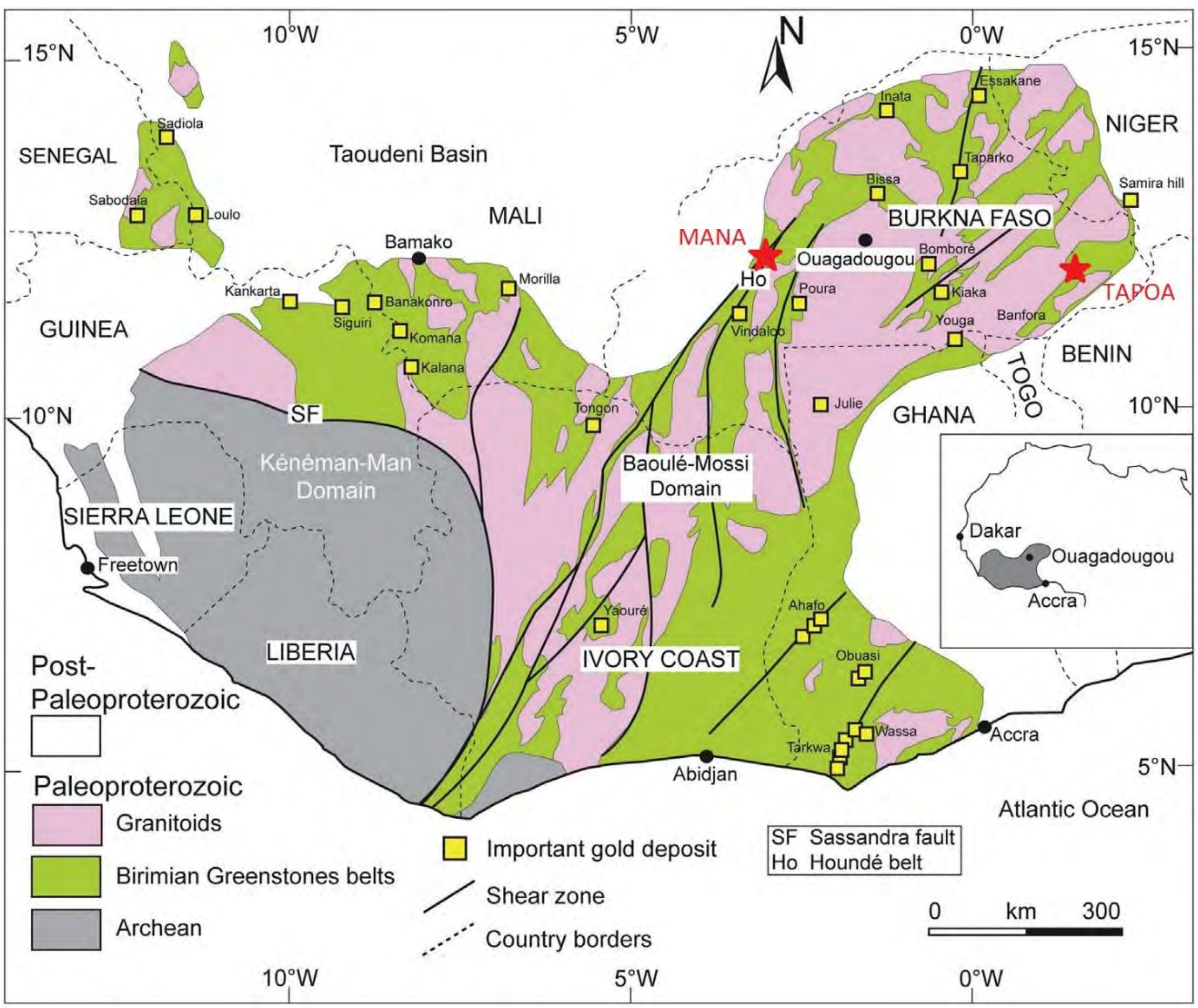
7.0 GEOLOGICAL SETTING AND MINERALIZATION

The Mana property has been extensively studied since 2009 through graduate studies by Jérôme Augustin, an employee of SEMAFO. Much of the following text and figures were derived from his work (Augustin, 2010), Augustin, J. and Gaboury, D., 2017 and Gaboury, 2011.

7.1 REGIONAL GEOLOGICAL SETTING

Among the three main periods of orogenic gold mineralization recognized worldwide including the Late Archean (2.7-2.5 Ga), Early Proterozoic (2.1-1.8 Ga), and Phanerozoic (< 1 Ga), the Early Proterozoic is of special interest due to the recent high rate of gold deposit discoveries relating to this period. This period roughly coincides with the formation of the Birimian greenstone belts that occur in Western Africa (see Figure 7.1).

Figure 7.1
Regional Geological Map of West Africa



Baratoux et al., 2011.

The lithostratigraphy of Burkina Faso is characterized by Birimian metavolcanic and metasedimentary sequences that occur as greenstone belts that are generally oriented north-northeast to south-southwest and north-south (as shown in Figure 7.1, above). Polycyclic deformations, which are referred to as the Eburnean orogeny (2,200-2,000 Ma), overprinted the volcanosedimentary rocks and induced folding, shearing and greenschist to amphibolite facies metamorphism. The greenstone belts are separated by granitoid domains with ages between 2,153 and 2,097±7 Ma. Multiple episodes of granitoid intrusion have been distinguished, such as the tonalite-trondhjemite-granodiorite suite and granitic intrusions.

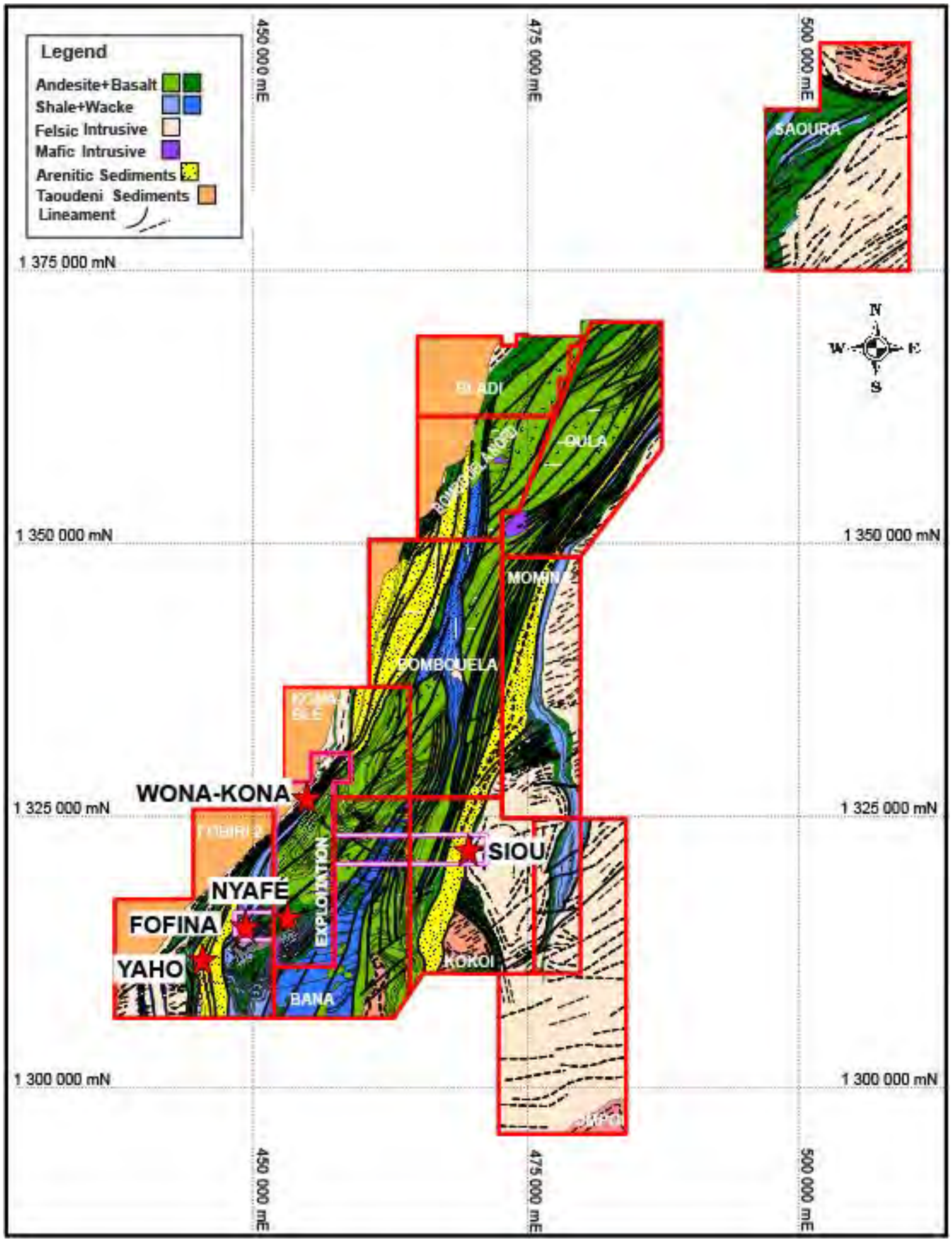
The greenstone belts comprise mafic tholeiitic volcanic rocks together with intermediate and acid calc-alkaline effusive suites that are typical of volcanic arc environments. Volcano-sedimentary units are interbedded with volcanic assemblages. In the Houndé belt, shallow water detrital sediments, which are considered genetically similar to the Tarkwaian metasediments in Ghana, occur as an approximately 400-km long and approximately 1-2-km wide unit. Later doleritic dykes crosscut all of the greenstone-related rocks.

The north-northeast to south-southwest trending Houndé greenstone belt comprises tholeiitic basalts and gabbros at the base (see "Ho" in Figure 7.1). At the top of the sequence, andesitic volcanic rocks occur in the central and southern part of the belt. The unit of basalt mafic rocks is bounded to the east by the Boni shear zone, which defines the contact with late Tarkwaian-type sedimentary rocks and which exhibits a maximum deposition age of between 2,171±7 Ma and 2,113±23 Ma. To the west, sedimentary rocks of the Neoproterozoic Taoudeni basin overlie the Paleoproterozoic basement.

7.2 LOCAL GEOLOGY

The Mana district is located in the northern part of the Houndé greenstone belt. Based on current knowledge, it is the most gold-rich portion of the belt. Five gold deposits, Wona-Kona, Nyafé, Fofina, Yaho and Siou, are hosted in different rock types (see Figure 7.2 and Table 7.1). The lithostratigraphic succession is typical of greenstone belts and is characterized at the base by a major tholeiitic basaltic suite with some intercalations of argillic sedimentary rocks that are overlain by predominant pelagic and detrital sedimentary rocks (shale, sandstones, greywacke and volcaniclastics). The Mana district basalt unit has undergone submarine hydrothermal alteration with epidote, chlorite and local albite, and shows zones of strong silicification, some of which are anomalous in gold. Accessory minerals include rutile and disseminated pyrite.

Figure 7.2
Mana Project Local Geological Map



Exploitation permit outlined in cerise.
SEMAFO, 2017.

In the southern part of the Mana district, the basalts exhibit distinctive pristine volcanic features such as amygdales, pillow lavas, pillow breccias and hyaloclastite deposits (e.g., Nyafé and Fofina deposits). Most of the basaltic rocks are aphyric and aphanitic. The maximum thickness of the basaltic pile is estimated to be approximately 6 km. Calc-alkaline volcanic series, including andesitic pillowed lavas, volcanoclastic flows and tuffaceous facies, occur at the top of the basaltic rocks. The Paleoproterozoic formations are affected by polyphase deformation and greenschist facies metamorphism with amphibolite facies assemblages that locally occur as metamorphic aureoles around some later-formed granitoids.

Table 7.1
Significant Deposits and Mineralized Zones on Mana Property

Deposit Name	Host rock	Structural Characteristics	Mineralization Style	Hydrothermal Alteration
Wona-Kona	Tholeiitic metabasalts, Metasediments, Granodiorite	Regional structure Wona-Kona sinistral shear zone	Quartz-sulphide veins, silicification and free visible gold	Quartz-sericite-chlorite-carbonates-epidote
Nyafé-Filon 67	Tholeiitic metabasalts	Small scale structure dextral shear zone	Quartz sulphide veinlets	Chlorite-epidote-carbonates
Fofina	Tholeiitic metabasalts, Metasediments	Anticlinal fold	Quartz-sulphide veins	Chlorite-sericite-carbonates
Yaho	Metasediments	Sinistral shear zone	Disseminated and quartz sulphide veins	Sericite-carbonates
Siou	Granodiorite, tholeiitic metabasalts, Tarkwaian-type sediments	Regional structure Boni sinistral shear zone	Quartz-sulphide veins and free visible gold	Sericite-hematite-carbonates

7.3 MINERALIZATION

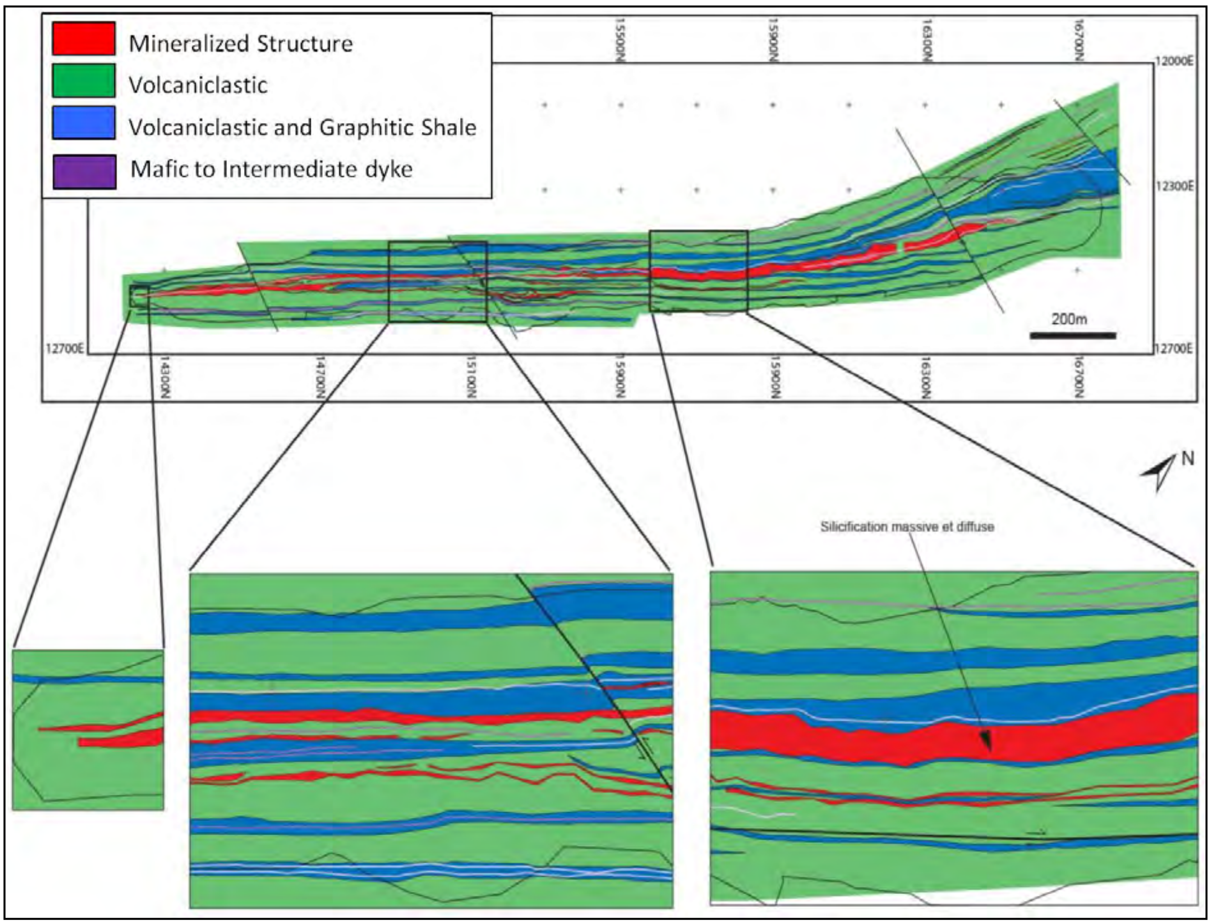
Outcropping mineral deposits under a tropical climate in general, and in western Africa in particular, are subject to intense meteoric alteration with the development of a saprolitic zone near the surface. Saprolite results from the kaolinization of original feldspars in volcanic rocks and associated iron sulphides are also generally transformed into iron oxides or hydroxides producing the characteristic yellow-brown colour of the mineralized saprolite. All the deposits on the Mana property are affected by this alteration which, in general, reduces the hardness and increases the gold recovery. The thickness of the saprolite varies considerably from less than 10 m to greater than 50 m. This is followed by a transition zone, known as saprock and generally less than 10 m thick, followed by bedrock. Within the saprock zone, the hardness increases significantly although the sulphides are mostly oxidized. Bedrock is marked by the virtual lack of oxidization.

The mineralization styles and alteration assemblages are summarized in Table 7.1. The major sulphides associated with the gold mineralization are pyrite and arsenopyrite. Free visible gold is encountered at the Wona-Kona and Siou deposits. Magnetite occurs as small millimetric prisms along schistosity planes in the walls of mineralized zones. The five major deposits are described below.

7.3.1 Wona-Kona

The Wona-Kona deposit is hosted in a series of deformed sedimentary, volcano-sedimentary and metavolcanic rocks. (See Figure 7.3). The gold mineralization has developed along a major northeast-southwest subvertical fault zone of regional extent. The shear zone is about 200 m wide in the Wona-Kona pit sector. The original stratigraphic sequence is a succession of pelitic sediments with graphitic horizons and volcanoclastics. They have been affected by a pervasive schistosity associated with vertical movements along the fault (the east block rising with respect to the west one) as well as sinistral lateral movements. Those foliated rocks are cut by mafic to intermediate dykes. The mineralization appears to be associated with movement along the fault accompanied by hydrothermal fluid circulation and intense silicification.

Figure 7.3
Wona-Kona Deposit Simplified Geological Map

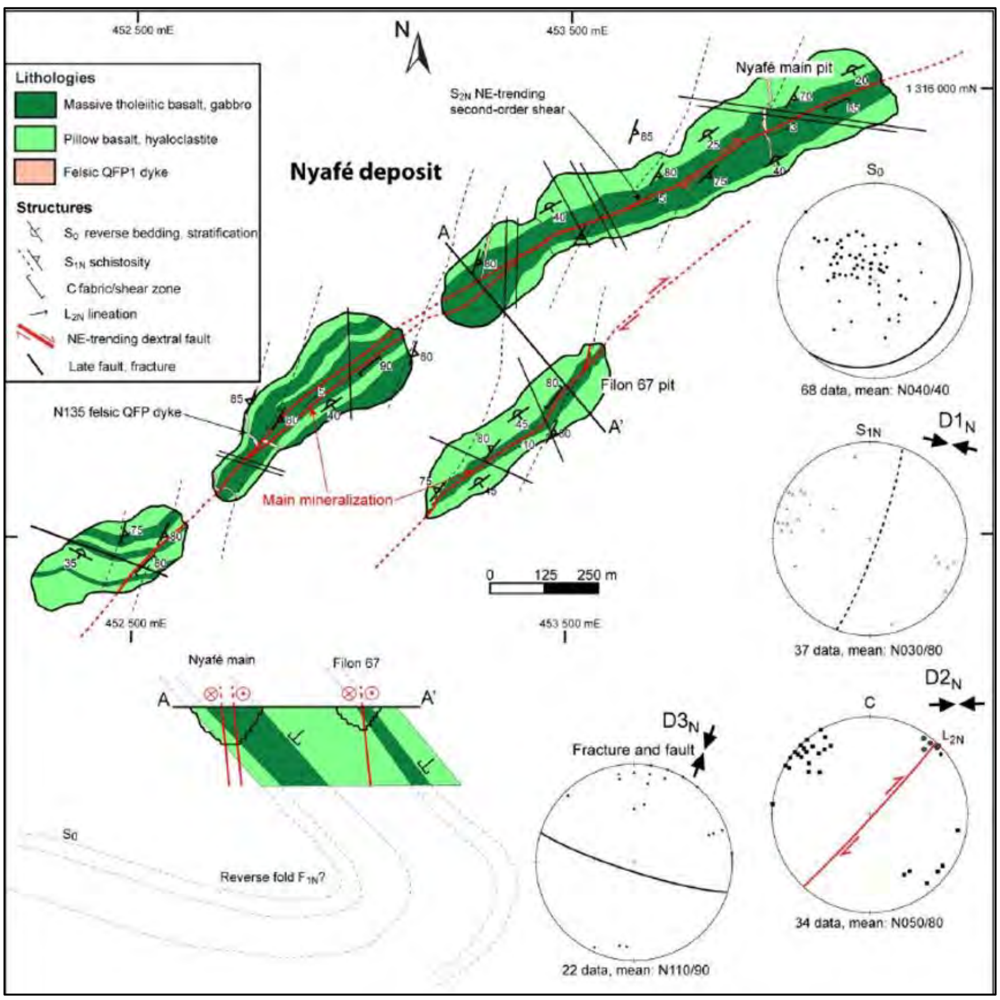


SEMAFO, 2017.

7.3.2 Nyafé and Filon 67

The Nyafé and related Filon 67 deposits are hosted in a purely volcanic sequence of basalt and mafic tuffs. (See Figure 7.4.) From the observed morphology of basalt pillows, the original stratigraphic sequence is subhorizontal and overturned; with pillow lava at the bottom, pillow breccias and finally massive lava at the top. Several subvertical decimetre scale dykes cross-cut the volcanic sequence; in particular, a north-south trending dyke of felsic porphyry (with quartz phenocrysts) and two mafic dykes on either side of the pit are parallel to the mineralization. The Filon 67 (F67) deposit, adjacent to Nyafé is composed of quartz veins associated to shear zones with dextral motion within a package of greenschist rocks. These composite veins show textures indicative of several successive phases of mineralization.

Figure 7.4
Geological Map of Nyafé and Filon 67 Deposits

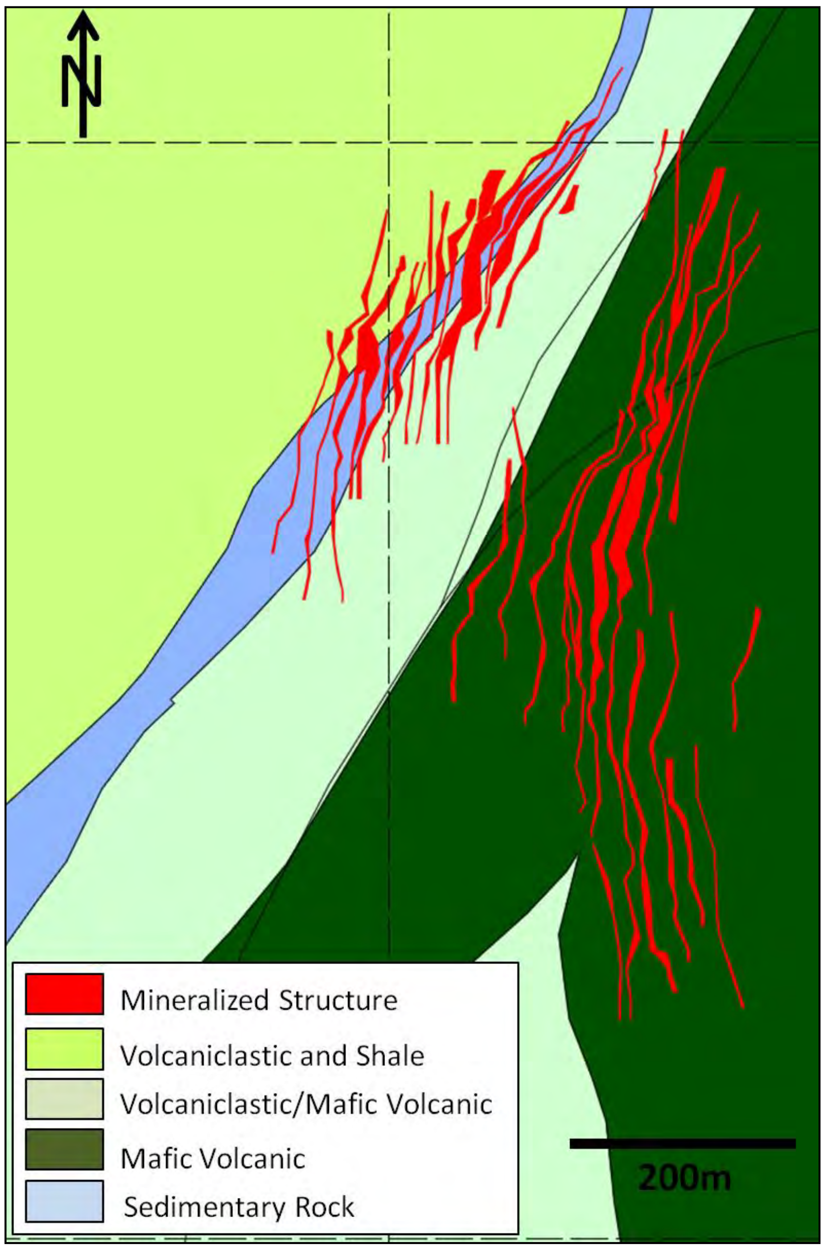


SEMAFO, 2017.

7.3.3 Fofina

The Fofina deposit is divided into two sectors separated by a zone of volcaniclastic/mafic volcanic rocks as shown in Figure 7.5. The western zones are located in a sheared sedimentary unit dipping moderately west and trending north-northeast. They are related to a rheological contact with a massive basalt unit to the east. The eastern zones are within the basaltic lavas and have similar characteristics to the Nyafé deposit.

Figure 7.5
Fofina Deposit Simplified Geological Map

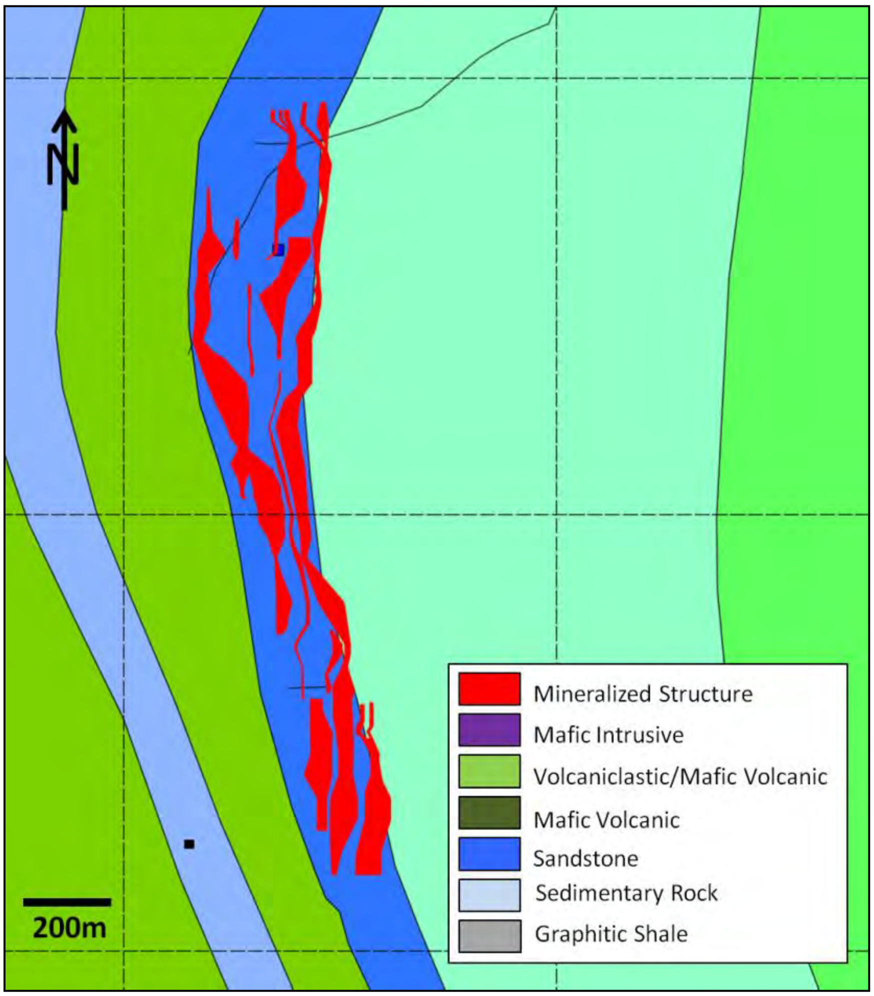


SEMAFO, 2017.

7.3.4 Yaho

The Yaho deposit is hosted in a wide north-striking and steeply west-dipping sandstone unit flanked by shales and siltstones to the west and basaltic flows to the east. (See Figure 7.6.) The mineralization is associated with silicified and sericitized corridors within the sandstone which also contain increased amounts of sulphides, pyrite and arsenopyrite.

Figure 7.6
Yaho Deposit Simplified Geological Map

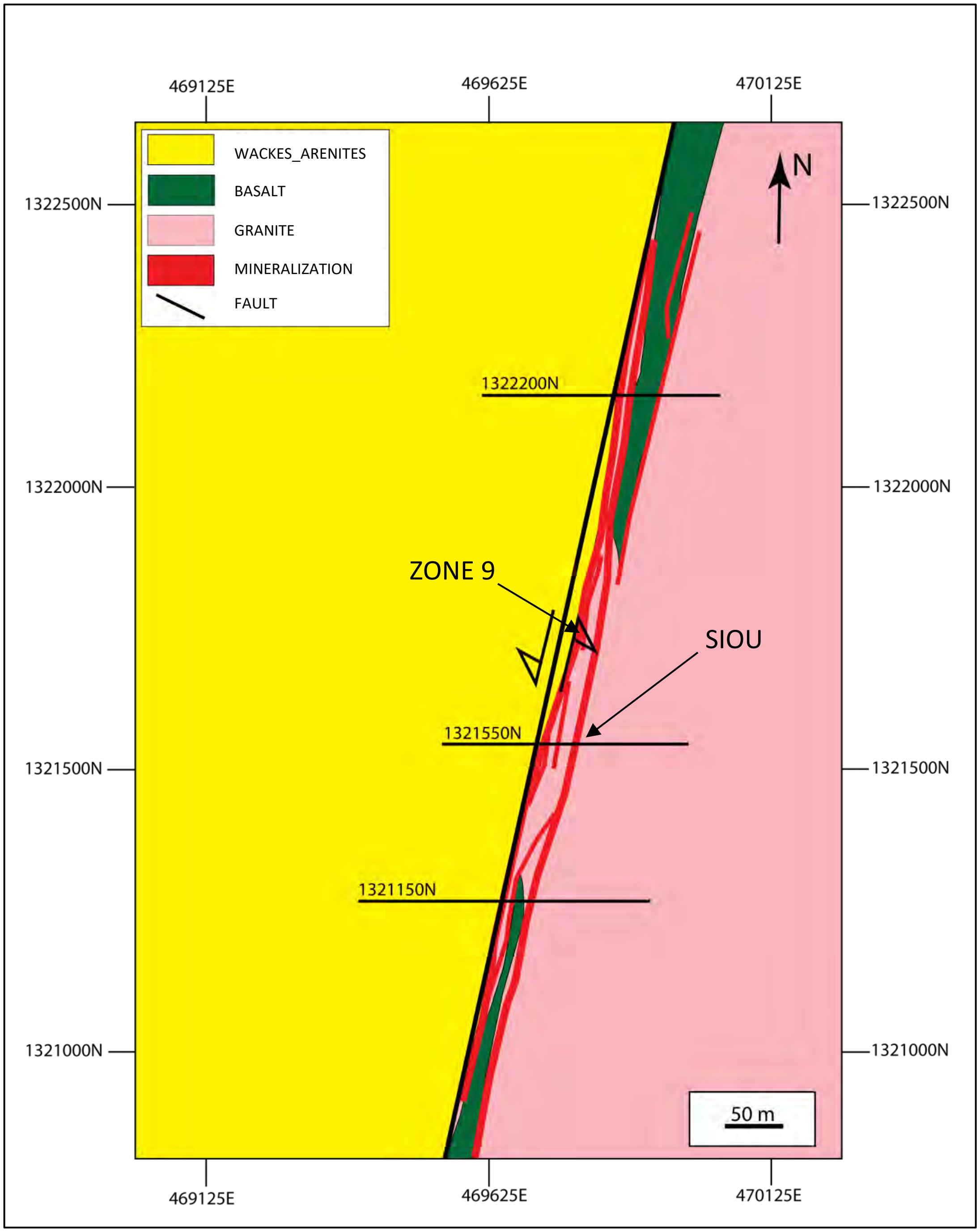


SEMAFO, 2017.

7.3.5 Siou

Finally, the Siou deposit is a typical shear-hosted quartz vein deposit. The two principal zones are the Siou and No. 9 zones, as shown in Figure 7.7. The Siou zone is hosted in a single quartz vein located within the Siou Granitic Intrusive, but near the contact with sandstones and shales to the west. The No. 9 zone is located at the contact between the sediments and the Siou Intrusive and generally consists of quartz veining and veinlets intruding the granitic intrusive. Both the Siou and No. 9 zones are north-striking and moderately east-dipping.

Figure 7.7
Siou Deposit Geological Map



SEMAFO, 2017.

8.0 DEPOSIT TYPES

All deposits on the Mana Property are characterized as typical West African, shear-hosted orogenic gold deposits. However, as shown earlier in Table 7.1, there are two types of host rocks. The Wona-Kona, Yaho, and Siou deposits are located at the margins of the Houndé greenstone belt where regional, deep-seated, subvertical shear zones have developed. The Nyafé and Fofina deposits are located within the Houndé greenstone belt and are hosted by secondary, local shear zones which cross-cut the flat-lying to gently dipping stratigraphy.

Hydrothermal alteration along the regional deep-seated structures is very intense and widespread surrounding the deposits, reaching widths of tens of metres. Meanwhile, the local, secondary structures show only limited hydrothermal alteration around the deposits, generally in the order of a few metres wide. In all cases, however, alteration consists of sericitization and silicification of the host rock. Quartz veining is also ubiquitous. Associated sulphide mineralization varies from one deposit to the next but generally consists of pyrite and arsenopyrite, with rare chalcopyrite and sphalerite.

The mineralization is often associated with brown-coloured carbonates (siderite, ferruginous-dolomite); the colour becomes progressively lighter with distance from the main controlling structure for each deposit. It appears that the pervasive carbonatization may have favoured the gold mineralization by sealing the deformation corridor and thus concentrating the mineralization fluids within that corridor.

SEMAFO's application of the shear-hosted orogenic gold mineralization model has resulted in the discovery of the Wona-Kona, Nyafé, Fofina, Yaho and Siou deposits, and development of the Wona-Kona, Nyafé, Fofina and Siou deposits. Ongoing exploration work employs this model.

9.0 EXPLORATION

9.1 OVERVIEW OF PROCEDURES/PARAMETERS

Exploration work on the Mana permits by SEMAFO commenced in 1997. The initial discovery of the Nyafé and Wona deposits was the result of geochemical exploration. It started with a large-scale stream sediment survey (spacing of about 1 km along streams) with bulk leach extractable gold (BLEG) processing (2 kg of sediments leached in an agitated bottle) of samples. The samples were collected from trap sites within the river bed. That campaign showed two strong anomalous zones (over 1,000 ppb Au) over Nyafé, but weak anomalies over Wona. This was followed by a soil sampling survey on a 200 m by 100 m grid (down to 50 m by 25 m). Each soil sample is taken by digging a hole approximately 20 cm in diameter to a depth of 30-40 cm. Approximately 2-3 kg of sample is collected from the bottom of each hole. The soil sampling program showed clear anomalies on the three segments of the Nyafé deposit, but only a weak anomaly (62 ppb Au) on Wona which was subsequently discovered after trenching.

As a result of this experience, exploration on the Mana permits follows a systematic approach. For grassroots targeting, stream sample geochemistry, airborne geophysics (helicopter-borne magnetic, Mag-Helitem) and surface mapping are used to identify areas for detailed investigation. Ground geophysics (IP profiling) is also used to test extensions of known large scale structures. The next step is sampling via auger or RAB (rotary air blast) drilling on fixed grids in order to reach the saprolite below the generally transported lateritic cover. Auger drill holes are vertical. Average hole length is 10.1 m and approximately 2-3 kg of sample is taken. The auger drilling is conducted along lines crossing stratigraphy and/or expected orientation of mineralization. Line spacing varies from 200 m to 800 m with holes drilled 25 m apart along the lines. Sample lengths are normally 1 m in the intermediate laterite/saprolite contact (ISAP) zone and 2 m in the saprolite (SAP) below. Some areas not amenable to auger drilling (e.g., high relief or outcropping areas), are generally covered by soil sampling following a similar grid as auger drilling.

Trenching and/or reverse circulation (RC) drilling is then used as a first pass to test the auger drilling anomalies. Sample sizes are approximately 2-3 kg and 2 kg for trenches and RC holes, respectively. Generally, exploration sample quality is considered as being sufficient to indicate significant gold mineralization but not representative of the overall grade associated with the deposit. Following positive results, RC drilling and core drilling are used to extend the information at depth and to delineate the mineralized bodies.

9.1.1 Summary of Sampling Procedures

Sampling procedures are described in detail in Section 11.0.

9.1.1.1 Soil and Auger Drilling Samples

Soil sampling is used as a first pass exploration tool and is effective in areas of outcrop and/or near surface saprolite exposure. Individual soil samples are taken by digging a hole approximately 20 cm in diameter down to a depth of approximately 30-40 cm. Approximately 2-3 kg of sample is collected from the bottom of each hole, placed in individual plastic bags and sent to the laboratory for analysis.

Auger drilling is a cost-effective method for geochemical sampling. Vertical holes are drilled to the in-situ saprolite horizon and samples taken from both the laterite/saprolite interface and within the saprolite. Sample size is approximately 2-3 kg.

9.1.1.2 Reverse Circulation and Core Drilling Samples

Reverse circulation (RC) samples are collected from every 1-m drill run in pre-labelled plastic bags directly from the cyclone on the drill rig. Approximately 30 kg to 40 kg of material is reduced using a tiered riffle splitter to obtain a subsample of about 2 kg which is packed in a poly bag. Trench samples are treated in the same way.

Diamond core samples are collected on a maximum of 1.2-m intervals or to the lithological/alteration/mineralization boundaries, with a minimum sample length of 0.2 m. The core is cut in half lengthwise using a diamond saw and the sampled half core placed in a plastic bag and labelled with the hole ID and depth. A sample ticket labelled with the hole ID and depth is also placed in the bag.

9.2 REPRESENTATIVENESS OF EXPLORATION SAMPLES

Stream sediment and soil samples only serve to detect mineralization but are not representative of the mineralization. Likewise, trench and auger/RAB samples are not representative of the grade of mineralization but serve to confirm the presence of significant mineralization.

Trench, rock chip and soil sampling programs are suitable to define areas of anomalous gold concentration for exploration targeting. RC and diamond drill sampling procedures are adequate for and consistent with the style of gold mineralization under consideration. Based on the quality control (QC) sample results, sampling conducted by SEMAFO has achieved reasonable precision and analytical accuracy.

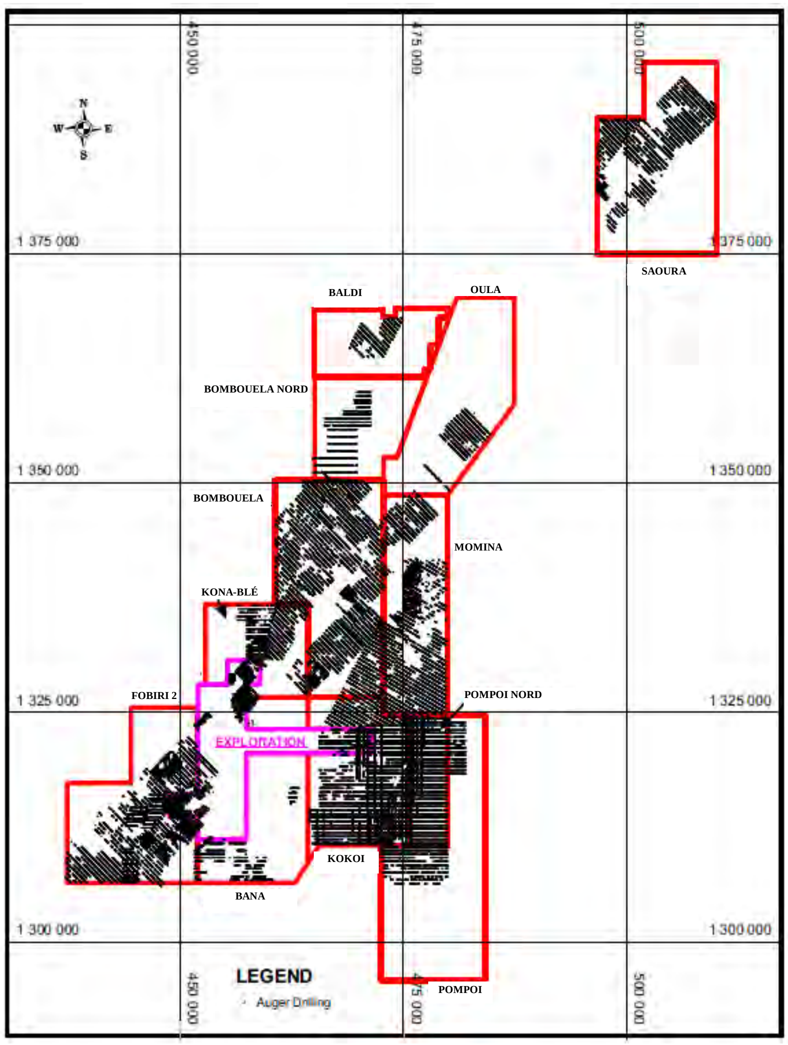
Sample collection and preparation procedures implemented at Mana are consistent with standard industry best practices. There are no factors which have resulted in sample bias.

9.3 EXPLORATION CAMPAIGNS

Exploration on the Mana property has been on-going since 1997 and it is inappropriate to break it into campaign periods. To date, several auger drilling programs have been completed on geochemical or geophysical anomalies and several significant anomalies have been identified.

Currently, the exploration database includes a total of 100,953 auger drill holes (1,021,977 m) covering most of the property. The corresponding geochemical sample database for auger drilling contains 38,776 BLEG assay results. The locations of the auger holes are shown on Figure 9.1.

Figure 9.1
Mana Property, Location of All Auger Holes



Exploitation permit outlined in cerise.
SEMAFO, 2017.

The exploration database also includes 349 trenches and pits (26,108 m).

SEMAFO continues to use a combination of ongoing detailed mapping, geophysical information, auger and/or soil sampling followed by drill testing of anomalies that appear to show continuity and a good relationship with known geological information.

The most comprehensive geophysical investigation on the Mana property is a multiphase airborne geophysical survey which commenced in 2009 and was completed in 2011. The resulting survey covers virtually the entire property (approximately 15,000 line-km) and consists of magnetic, radiometric and electro-magnetic (EM) surveys. Preliminary observations reveal that the combination of magnetic and EM data is an excellent mapping tool, particularly for sedimentary rocks containing graphitic shales, which stand out as conductive and non-magnetic; whereas massive mafic volcanic flows are typically magnetic and highly resistive. Linear structural features (faults and deformation zones) can also be observed as discontinuities in both EM and magnetic data. Over the course of 2011 and 2012, a property-wide surface mapping program was completed in order to confirm and further refine the geology interpreted based on geophysical data. Following the Siou discovery in 2012, most of the field work efforts have been dedicated to the eastern half of the property proximal to the Siou Intrusive including auger drilling and RC/diamond drilling (DD) exploration. This work has added considerably to SEMAFO's understanding of the eastern limit of the Houndé greenstone belt and work remains ongoing, particularly north of the Siou Deposit.

9.4 SIGNIFICANT EXPLORATION RESULTS

The initial exploration discoveries made between 1997 and 2008 were the Nyafé, Filon 67 and Wona deposits. The latter was renamed Wona-Kona following the discovery of the Kona deposit in 2010. These deposits have been in production continuously since 2008.

Exploration between 2010 and 2016 led to the discovery and delineation of five new mineralized zones, of which two, Siou and Fofina, have since contributed significantly to gold production. More recently, drilling has principally focused on evaluating the underground potential of the Siou deposit.

10.0 DRILLING

10.1 DRILLING TECHNIQUES

Drilling at the Mana property has been undertaken using a combination of air core (AC), reverse circulation (RC) and diamond drilling (DD). A summary of all drilling completed to date is shown in Table 10.1.

Table 10.1
Mana Property Drilling Summary

Drilling Technique	No. of Holes	Total Metres
Air Core	5,515	206,016
Reverse Circulation	7,409	850,876
Diamond Drilling	1,031	317,695
Totals	**13,955**	**1,374,587**

In addition, 20 holes were precollared as RC and terminated as diamond drilling (5,603 m) for cost saving purposes. The RC part of these multipurpose (MP) holes totals 2,769 m.

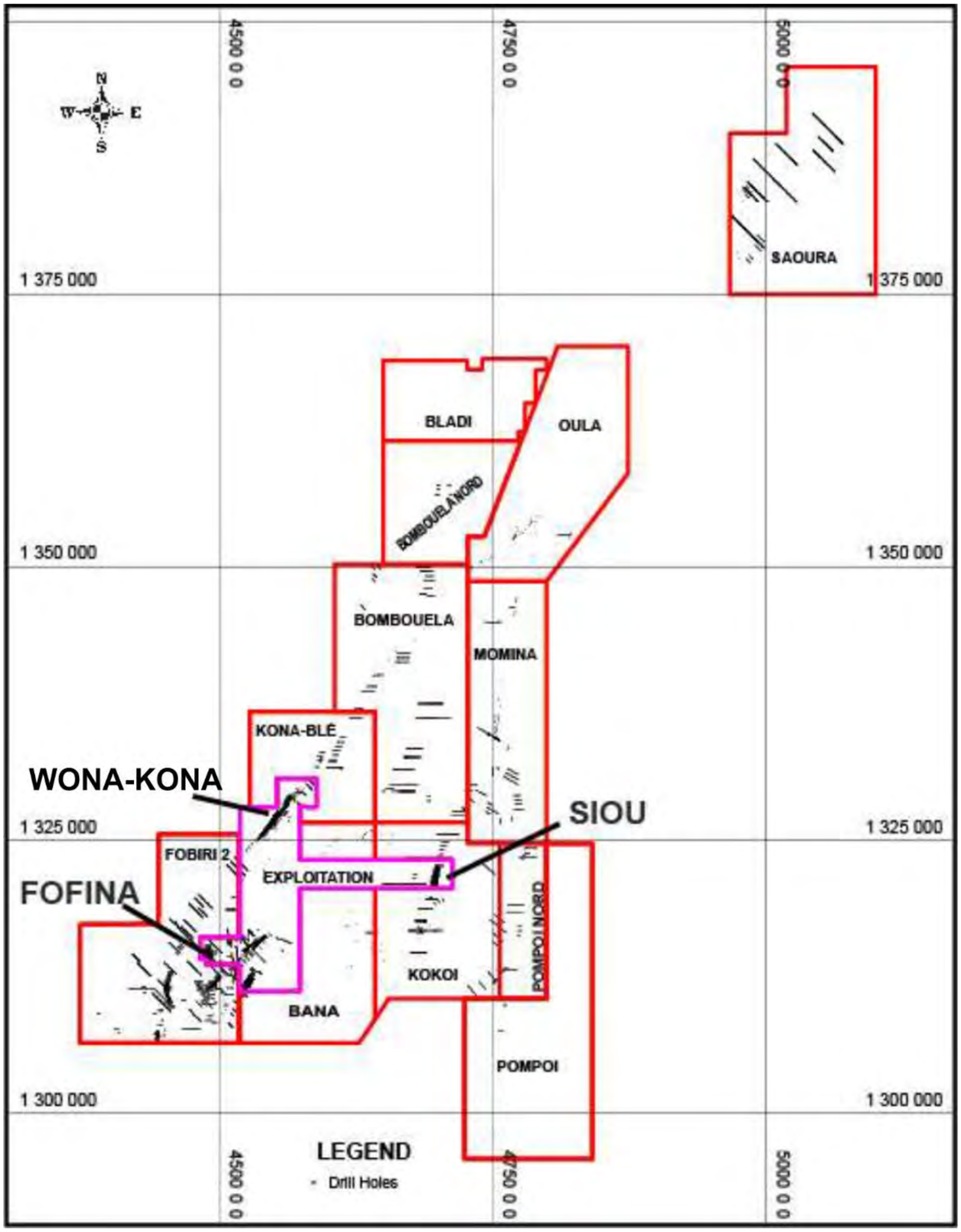
Air core (AC) drilling is limited to the soft horizons and generally stops at the base of the saprolite layer. This method is rapid and inexpensive and is typically used to test anomalies identified by the auger drilling (see Section 9.0) where the saprolite is expected to be thick. Typically, the holes are 50 m long (or to bedrock) and drilled at an inclination of 50º along exploration traverses. Because AC does not use an outer tube, contamination is possible and, hence, these holes have not been used for resource estimation. The method has limited use where there is thick laterite or overburden coverage as the percentage of each hole being in overburden is higher compared to longer RC holes. Further, since AC holes must be stopped at bedrock, geological information from this drilling is limited.

The drilling method of choice at the Mana property is RC using a dual-wall drill pipe. Air is passed down the hole through the outside annulus and into the hammer. The sample/drill cuttings are cleared from the bit by air and travel up through the centre tube of the drill rods to the surface sampling equipment remaining free from contamination. Recovery is generally very good and appropriate steps are taken to ensure that no sample bias is introduced during collection and reduction of the drill cuttings, with a riffle splitter used for sample reduction.

Oriented diamond drilling provides important geological information, such as dip direction and degree of alteration that is not available from RC chips. It also provides material for metallurgical testing along with density and RQD measurements.

The location of all drill holes is shown in Figure 10.1. (Note, apparent lines on the figure represent drilling fences).

Figure 10.1
Mana Property, Location of All Reverse Circulation, Air Core, Core Drill and Multipurpose Holes



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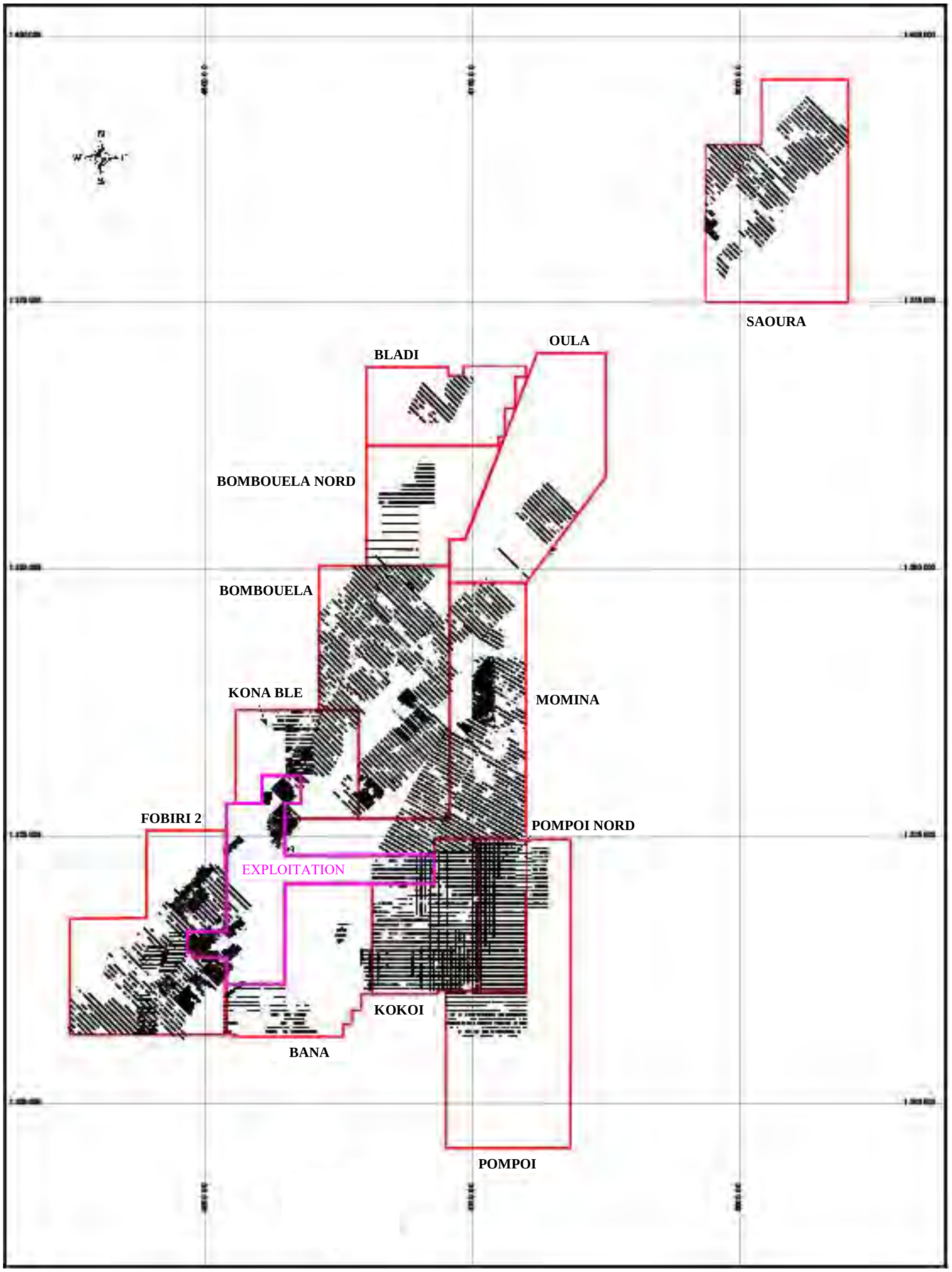
SEMAFO, 2017.

Figure 10.2
Mana Property, Location of Auger Drilling



Exploitation permit outlined in cerise.
SEMAFO, 2017.

10.2 COLLAR AND DOWNHOLE SURVEYS

10.2.1 Location of Data Points

All drill hole collars near the Wona, Fofina and Siou pits were surveyed by SEMAFO's topographic team using a Leica Viva Total Station system. Data from the instrument were downloaded directly to a laptop and processed using Leica Geo Office and Model Maker software. The Total Station System, operating in real-time kinematic (RTK) satellite navigation, has a reported accuracy of 10 mm horizontally and 20 mm vertically. The coordinate system used is WGS84 Zone 30N, or a local grid (Wona and Nyafé) obtained from a 45° rotation of the WGS84 coordinate system.

Prior to 2015, exploration drill holes were surveyed by a contractor (Issaka ZOUNGRANA) using a Leica TCR 307R Total Station system. Data from the instrument were downloaded directly to a laptop and processed using Leica Survey Office and COVADIS software. The Total Station System has a reported accuracy of 5 mm horizontally and 10 mm vertically. The coordinate system basis used is WGS84 Zone 30N.

Finally, from 2015 onward, exploration drill holes outside mine areas were surveyed by AGIIR-Topo (a topographic contractor) using a GNSS TRIMBLE R4-3 Total Station system. Data from the instrument were downloaded directly to a laptop and processed using Windows Mobile and Trimble Business Center 3.51 software. The Total Station System has a reported accuracy of 50 mm horizontally and vertically. The coordinate system basis used is WGS84 Zone 30N.

It is SEMAFO's opinion that the collar coordinates have been accurately surveyed and are appropriate for use in mineral resource estimation. Micon concurs with this opinion.

10.2.2 Downhole Surveys

The 2015 drill holes were all surveyed downhole using a REFLEX GYRO™ electronic surveying tool. Both the azimuth and dip were recorded at intervals of approximately 5 m intervals downhole. The REFELX GYRO™ system is not affected by magnetic interference from either the drill rods or magnetic minerals. The accuracy of the system is reported to be ±0.5° when measuring azimuth and ±0.2° when measuring dip angle.

Prior to 2015, drill holes were surveyed downhole using a REFLEX EZ-SHOT™ electronic surveying tool. Both the azimuth and dip were recorded at intervals of approximately 6 m downhole, within the PVC casing, and then at 30 m intervals until the bottom of hole was reached. Magnetic susceptibility readings were taken by the REFLEX EZ-SHOT™ device to indicate if the azimuth readings were being materially distorted by magnetic minerals. No readings have been rejected based on anomalous magnetic susceptibility. Readings with apparent errors were re-taken. The REFLEX EZ-SHOT™ camera has an accuracy of ±0.5° when measuring azimuth and ±0.2° when measuring dip angle.

10.3 LOGGING AND SAMPLING

All drilling, logging/sampling and transportation of samples are supervised by the project geologist.

For AC and RC drilling, sampling is done at the drill site at fixed intervals of 1 m as drilling progresses. In RC drilling, air is blown down the drill rods to create a pressure difference, allowing the sample chips to rise through the inner tube and reach a bell at ground level, which transports the sample to a cyclone where it dries out and is then riffle split down to two 2-kg samples. One sample is dispatched to the laboratory and the duplicate is kept for geological logging. Logging of the rock cuttings/chips is done following completion of each hole. The procedure is the same in AC drilling except that there is no inner tube to prevent contamination between samples; as noted above, therefore, AC holes are not used in the mineral resource database.

Unlike AC and RC drilling sampling, diamond drill hole sampling is conducted after the hole has been logged by the project geologist. Initially, a geotechnical description is recorded paying particular attention to core recovery, joint spacing, fracturing and alteration. The geological logging generally considers lithology, structure, alteration and mineralization. Sampling is done according to intervals corresponding to intersected lithologies or other geological features noted during logging. Thus, sample lengths can vary from 0.15 to 6 m. That said, efforts are made to ensure that sample lengths remain between 0.15 and 2.0 m. Upon completion of the logging and demarcating the sample intervals by the geologist, technicians saw the core into symmetrical halves. One half of the core is bagged, tagged with a sample number and the sealed; the other half is put back in the core boxes and stored for future reference. Samples are transported by truck in sealed bags to the Exploration Samples Department of the Mana site laboratory.

RC sample recovery and drill core recovery are good.

Quality control (QC) and quality assurance (QA) programs are in place to ensure the reliability and trustworthiness of exploration data. These include periodic verification of drilling, surveying and sampling procedures as part of SEMAFO's overall QA/QC, data management, and confirmation of database integrity.

10.4 SUMMARY OF RESULTS

AC drilling has been successfully used to confirm auger sampling anomalies leading to the discovery of several deposits within the Mana property. These deposits have already been described under Section 7.0 above. The results of RC and diamond drilling programs are manifested in the gold resources and reserves detailed in Sections 14.0 and 15.0 of this Technical Report.

10.5 MICON COMMENTS

Micon notes the following:

- AC drilling samples are susceptible to contamination and are not used in the estimation of mineral resources.
- SEMAFO's RC drilling utilizes a dual wall pipe which eliminates contamination between samples.
- The diamond drilling recoveries on the Mana property are generally good as observed during the site visit.

Based on these observations, Micon concludes that there are no drilling/sampling/recovery factors that could materially impact the accuracy and reliability of the results of samples used to estimate mineral resources/reserves in this Technical Report.

11.0 SAMPLE PREPARATION, ANALYSES AND SECURITY

Since July, 2013, SEMAFO has mainly used the services of its mine site laboratory facilities at Mana (SMF BF) for RC and core drilling samples, as well as the ALS Laboratory (ALS-OU) in Ouagadougou, Burkina Faso. SEMAFO has also retained the services of SGS Laboratory (SGS-OU) in Ouagadougou for assaying soil and auger drilling samples.

SGS-OU and ALS-OU are commercial laboratories independent of SEMAFO. The SGS laboratory was recognized in July, 2015 by the South African National Accreditation System (SANAS) as meeting the requirements of ISO/IEC 17025. The ALS Ouagadougou laboratory does not have recognized accreditation, but it is part of the ALS Group of laboratories that operates under a global quality management system under ISO 9001:2008, and participates in international proficiency testing programs. The SEMAFO mine site laboratory does not have recognized accreditation but participates in international proficiency testing programs.

11.1 SAMPLING

11.1.1 Soil Samples

Soil sampling is a good first pass exploration tool. It is most effective in areas of outcrop and/or near surface saprolite exposure. A regular grid pattern is followed to the extent possible, and this varies depending on the area to cover or required detail needed. Notes are taken to account for potential transportation of surface material (slopes or river beds). Individual soil samples are taken by digging a hole approximately 20 cm in diameter down to a depth of approximately 30-40 cm. Approximately 2-3 kg of sample is collected from the bottom of each hole, placed in individual plastic bags and sent to the laboratory for analysis.

11.1.2 Auger Drilling Samples

Auger drilling is a cost-effective method for geochemical sampling that consists of drilling vertical holes down to the in-situ saprolite horizon along a predetermined grid. A sample of approximately 2-3 kg is taken from both the laterite/saprolite interface and within the saprolite. The sample is then sent for gold assaying using the bottle-roll method. Given that the geochemical anomaly associated with the Wona-Kona deposit was below 75 ppb gold, low level gold detection limits are required in order to ensure a reliable dataset. Areas targeted for auger drilling are those where the soil cover or overburden is too thick to enable collection of samples from the saprolite zone by soil sampling or trenching. Trench samples are 2-5 kg in size.

11.1.3 Reverse Circulation Drilling Samples

RC samples are collected from every 1-m drill run in pre-labelled plastic bags directly from the cyclone on the drill rig. Approximately 30 kg to 40 kg of material is reduced using a tiered riffle splitter to obtain a subsample of about 2 kg which is packed in a poly bag. Sample tickets are placed into each poly bag and the hole ID and sample depth recorded on the remaining ticket stub. The riffle splitter is cleaned after each sample with a brush. A second split of the same size is kept on site for reference and the rest of the RC sample material discarded. A small sample of chips from each 1-m interval is removed with a sieve, washed and placed in labelled chip trays for logging and future reference. RC samples are collected dry 99% of the time.

Sample bags are then transported a) to the mine site facilities for crushing, pulverizing and assaying in the case of SMF BF mine site facilities; or b) to the on-site preparation laboratory for crushing and pulverizing prior to the sample pulps being transported to the ALS laboratory in Ouagadougou for assaying. Quality control samples, including reference materials and blanks are also submitted with these samples.

11.1.4 Core Drilling Samples

Diamond core samples are collected on a maximum of 1.2-m intervals or to the lithological/alteration/mineralization boundaries, with a minimum sample length of 0.2 m. The core is cut in half lengthwise using a diamond saw and the sampled half core placed in a plastic bag and labelled with the hole ID and depth. A sample ticket labelled with the hole ID and depth is also placed in the bag. Quality control samples are also submitted with these samples.

The other half is kept for reference in core storage shelters at the Bana exploration camp.

11.2 SAMPLE PREPARATION AND ANALYSIS

Soil and auger drilling samples are sent to SGS OU and ALS OU for assay. RC and core drilling samples are sent to SMF BF and ALS OU for assay.

11.2.1 SGS OU

For soil and auger programs, the samples are weighed, bar-coded and logged into the sample tracking system before the laboratory personnel riffle-split a nominal 1,000-g sub-sample for BLEG analysis. The gold cyanide leach analysis involves a 24-h bottle roll, with an atomic absorption spectrometry (AAS) instrument used to measure the gold concentration of an aliquot of the leach solution. The technique has a detection range of 0.001 ppm to 10 ppm for gold.

11.2.2 ALS-OU

An on-site sample preparation laboratory was set-up by ALS at the Bana exploration camp. Trench, RC and core samples are first registered, ordered and then weighed. Samples are oven dried at a nominal 100 °C for up to 12 h depending on the material. The whole sample is crushed to 70% passing 2 mm. One in 50 samples is screened to ensure 70% passing 2 mm. The crushed sample is split for pulverization using a rotary or riffle splitter. The remaining material is stored as a coarse reject. A 250-g split of the 2 mm material is then pulverized to 85% passing 75 µm in a bowl and puck pulverizer. One in 20 samples is screened to ensure 85% passing 75 µm. The 250-g subsample is collected (by scooping) and conditioned for shipping to the Ouagadougou laboratory. The remaining material (pulp reject) is returned to the original bag (or a plastic bag if the original is not suitable) and stored on-site. All preparation equipment is flushed with barren material prior to the commencement of each run. Cleaning of equipment (e.g., crushers and pulverizers) is by compressed air between each sample.

All samples are then analyzed using a standard 50-g fire assay procedure with AAS finish with a detection lower detection limit of 0.01 ppm gold and upper detection limit of 100 ppm gold. A prepared sample is fused with a mixture of lead oxide, sodium carbonate, borax, silica and other reagents as required, inquarted with 6 mg of gold-free silver and then cupelled to yield a precious metal bead. The bead is digested in 0.5 mL dilute nitric acid in a microwave oven. 0.5 mL concentrated hydrochloric acid is then added and the bead is further digested in the microwave oven at a lower power setting. The digested solution is cooled, diluted to a total volume of 10 mL with demineralized water, and analyzed by AAS against matrix-matched standards.

The ALS internal QA/QC process involves standards, blanks and duplicates. Each analysis batch consists of 84 samples, 78 of which are client samples and six are QC samples, comprising two reference material, one duplicate (taken before crushing), two pulp duplicates, one blank (pulp).

Assay reports from the primary laboratory are submitted as digital data files and as .PDF format certificates.

11.2.3 SMF BF

The SMF BF laboratory is used for grade control channel samples, RC, core drilling and trench sample analysis.

All samples (i.e., exploration and mine grade control) follow exactly the same procedures except that the preparation, crushing, and pulverization of exploration samples is run independently from the mine grade control samples, on a different set of equipment in a separate building.

The samples are first registered, ordered and weighed before being dried for between 8 and 10 h depending on moisture. Every ±2 kg sample is crushed to 70% passing 2 mm (-10 mesh) and quartered to get a first 250-g split of crushed material. The remaining 1.75 kg is returned to the Bana exploration camp and core shack near Nyafé for reference. The 250-g riffle split is pulverized to 85% passing 75 µm (200 mesh) and quartered to get a 50-g split. The remaining pulp (±200 g) is returned to the Bana exploration camp. All preparation equipment is flushed with barren material prior to the commencement of each run. Cleaning of equipment (e.g., crushers and pulverizers) is by compressed air between each sample.

All samples are analyzed using 50-g fire assay procedure with an AA finish with a detection lower detection limit of 0.01 ppm gold. Samples grading over 15 ppm gold are re-assayed using a 50-g fire assay procedure with gravimetric finish.

The SMF BF internal QA/QC process involves standards, blanks and duplicates. Each analysis batch consists of 25 samples, 20 of which are client samples and 5 are QC samples, comprising one reference material, one duplicate (taken before crushing), two pulp duplicates, one blank (pulp). SMF BF also participates in regular round robin programs to monitor for bias. A minimum of 5% additional pulp check assays are performed on all batches (depending on the number of anomalies present within a given batch).

Assay reports from the mine laboratory are submitted as digital data files.

11.3 QUALITY ASSURANCE AND QUALITY CONTROL PROGRAMS

Quality assurance (QA) and quality control (QC) programs are in place to ensure the reliability and trustworthiness of exploration data. These generally include periodic verification of various aspects of the exploration program such as drilling, surveying, sampling and assaying, data management, and database integrity. More specifically, analytical control measures involve internal and external laboratory control measures implemented to address the following:

1. Monitor the precision and accuracy of the sampling, preparation, and assaying.
2. Prevent sample mix-up.
3. Monitor potential sample contamination.

At SEMAFO, QA/QC programs have been an integral part of every SEMAFO exploration drilling campaign. In order to monitor the reliability of assaying results delivered by the assaying laboratories, SEMAFO has developed an assaying protocol that consists of systematically inserting blank samples, certified reference materials (CRM), field duplicates and laboratory replicates. Additionally, re-assaying of a set number of sample pulps at a secondary umpire laboratory is performed on a quarterly basis as an additional test of the reliability of assaying results.

This section details the analytical quality control measures implemented by SEMAFO since the July, 2013 (Last Ni 43-101 Technical Report) and September, 2017. The review covers the analytical results from samples collected at various locations on the Mana property, including results from deposits informing the mineral resources.

Prior to July, 2013, SEMAFO only used the SMF BF and ALS OU laboratories. Sample QA/QC protocols were comparable.

Between July, 2013 and September, 2017, a total of 147,496 samples were sent to SMF BF, 91,140 samples to ALS OU and 1,859 to SGS OU, for a grand total of 240,495 new samples added to the exploration database since the previous resource estimate.

11.3.1 Certified Reference Materials

Systematic insertion of control standards is used as the primary method of controlling assay quality as reported from the laboratory. They are submitted with samples for assay to identify assay problems with specific sample batches and possible long-term biases in the overall dataset.

Between July, 2013 and September, 2017, 33 different CRMs were inserted in the sampling sequence by SEMAFO. All CRMs (pulps) were purchased from Rocklabs Limited and were inserted at a rate of one in every 20 samples. Details of the standards are given in Table 11.1. The CRMs range from 0.452 g/t Au up to 18.17 g/t Au.

CRM results are analyzed by examining control charts and by assessing the location of the CRMs within the sample batch. Although the standards are not matrix matched, SEMAFO considers them appropriate for assessing laboratory analytical accuracy with respect to Mana mineralization types.

Table 11.1
CRM Details for Mana Deposits

CRM ID	Source	Expected Gold Grade (g/t Au)	One Standard Deviation (g/t Au)	95% Confidence Level (g/t Au)
HiSiLK2	Rocklabs	3.474	0.087	±0.034
OxD107	Rocklabs	0.452	0.014	±0.004
OxE106	Rocklabs	0.606	0.013	±0.004
OxE113	Rocklabs	0.609	0.014	±0.006
OxE120	Rocklabs	0.620	0.012	±0.005
OxF125	Rocklabs	0.806	0.02	±0.006
OxG98	Rocklabs	1.017	0.019	±0.006
OxH122	Rocklabs	1.247	0.031	±0.009
OxH97	Rocklabs	1.278	0.030	±0.009
OxI121	Rocklabs	1.834	0.050	±0.014
OxI81	Rocklabs	1.807	0.033	±0.011
OxI96	Rocklabs	1.802	0.039	±0.012
OxJ95	Rocklabs	2.337	0.057	±0.018
OxK110	Rocklabs	3.602	0.053	±0.023
OxK94	Rocklabs	3.562	0.131	±0.042
OxK119	Rocklabs	3.604	0.105	±0.029
OxL93	Rocklabs	5.841	0.164	±0.053
OxL118	Rocklabs	5.828	0.149	±0.041
OxN117	Rocklabs	7.679	0.207	±0.060
SE68	Rocklabs	0.599	0.013	±0.004
SF57	Rocklabs	0.848	0.030	±0.010
SF67	Rocklabs	0.835	0.021	±0.006
SG56	Rocklabs	1.027	0.033	±0.011
SG66	Rocklabs	1.086	0.032	±0.009
SH65	Rocklabs	1.348	0.028	±0.009
SH69	Rocklabs	1.346	0.026	±0.011
Si54	Rocklabs	1.780	0.034	±0.011

CRM ID	Source	Expected Gold Grade (g/t Au)	One Standard Deviation (g/t Au)	95% Confidence Level (g/t Au)
Si64	Rocklabs	1.780	0.042	±0.013
Si81	Rocklabs	1.790	0.030	±0.008
SJ80	Rocklabs	2.656	0.057	±0.016
SK62	Rocklabs	4.075	0.140	±0.045
SK78	Rocklabs	4.134	0.138	±0.040
SL61	Rocklabs	5.931	0.177	±0.057
SN60	Rocklabs	8.595	0.223	±0.073
SP73	Rocklabs	18.170	0.420	±0.120

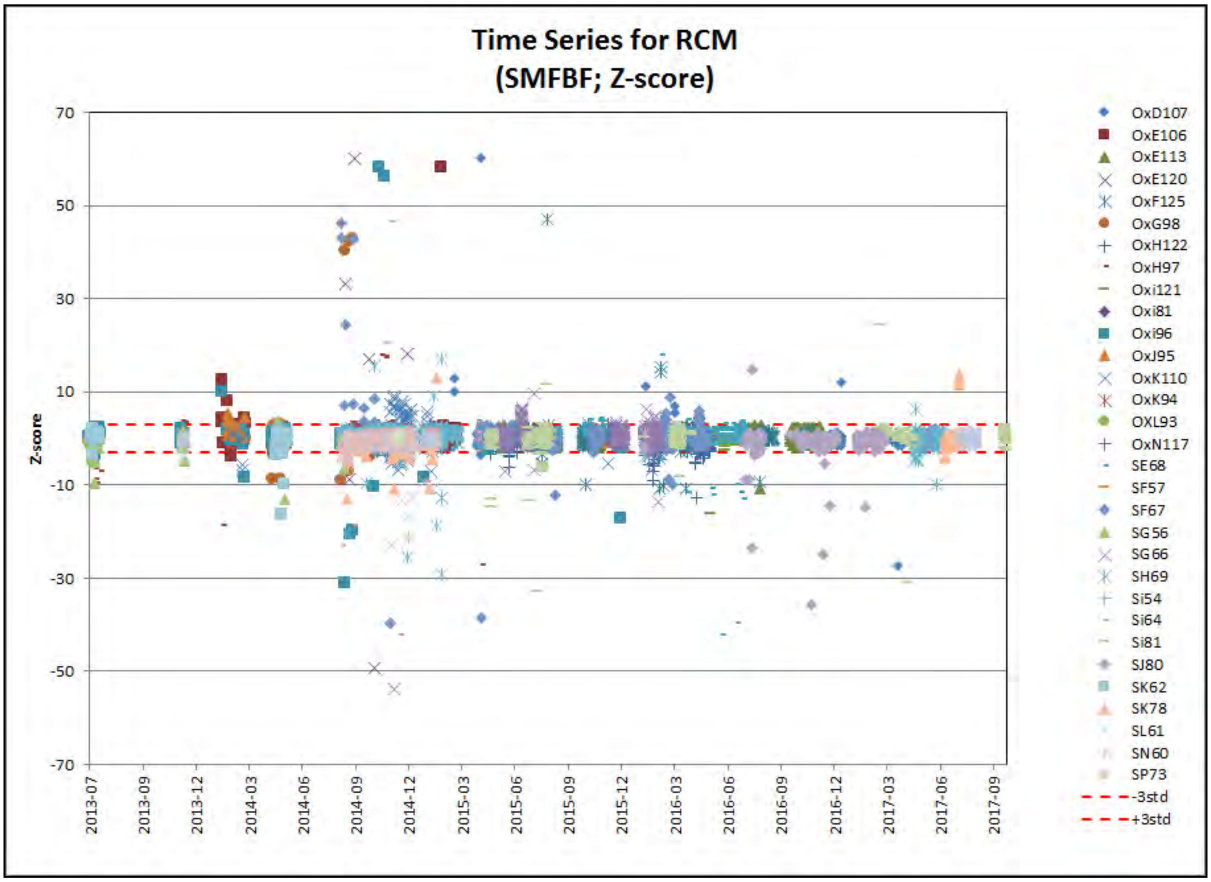
11.3.1.1 CRM Results – SMF BF

A total of 8,453 CRM samples were submitted with primary samples to the SEMAFO mine site laboratory. Of that total, 405 CRM fell outside the 3-standard deviation (SD) criterion, giving a rate of failure of 5%. Most of the failures were attributed to mislabelled standards and this was addressed by substantially reducing the number of different standards used during a given period. Reruns were successfully performed on some of the failed batches where deemed significant, but the remaining batches were maintained as is in the database because of insignificant results. The results are summarized in Table 11.2 and shown in Figure 11.1.

Table 11.2
2013-2017 CRM Results Assayed at SMF BF

CRM	COUNT	CERTFIED		OBSERVED		ACCEPTED		FAILURES			
		Value	S.D.	Mean	S.D.	Count	Rate	Count	Below 3StdDev	Above 3StdDev	Rate
_OxD107	510	0.452	0.014	0.456	0.05	501	98.2%	9	2	7	1.8%
_OxE106	162	0.606	0.013	0.620	0.06	154	95.1%	8	1	7	4.9%
_OxE113	658	0.609	0.014	0.618	0.08	656	99.7%	2	1	1	0.3%
_OxE120	271	0.620	0.012	0.616	0.07	264	97.4%	7	3	4	2.6%
_OxF125	369	0.806	0.020	0.809	0.06	356	96.5%	13	9	4	3.5%
_OxG98	98	1.017	0.019	1.032	0.14	89	90.8%	9	6	3	9.2%
_OxH122	393	1.247	0.031	1.223	0.06	361	91.9%	32	32	0	8.1%
_OxH97	251	1.278	0.030	1.316	0.10	219	87.3%	32	7	25	12.7%
_OxI121	166	1.834	0.050	1.816	0.07	165	99.4%	1	1	0	0.6%
_Oxi81	13	1.807	0.033	1.812	0.03	13	100.0%	0	0	0	0.0%
_Oxi96	499	1.802	0.039	1.810	0.17	485	97.2%	14	11	3	2.8%
_OxJ95	16	2.337	0.057	2.457	0.09	13	81.3%	3	0	3	18.8%
_OxK110	130	3.602	0.053	3.594	0.31	85	65.4%	45	18	27	34.6%
_OxK94	1	3.562	0.131	3.460		1	100.0%	0	0	0	0.0%
_OxL93	5	5.841	0.164	5.566	0.35	4	80.0%	1	1	0	20.0%
_OxN117	2	7.679	0.207	7.650	0.00	1	50.0%	1	1	0	50.0%
_SE68	736	0.599	0.013	0.619	0.12	681	92.5%	55	8	47	7.5%
_SF57	10	0.848	0.030	0.841	0.02	10	100.0%	0	0	0	0.0%
_SF67	723	0.835	0.021	0.846	0.13	694	96.0%	29	8	21	4.0%
_SG56	96	1.027	0.033	1.015	0.07	89	92.7%	7	6	1	7.3%
_SG66	463	1.086	0.032	1.105	0.05	435	94.0%	28	6	22	6.0%
_SH69	627	1.346	0.026	1.357	0.19	606	96.7%	21	16	5	3.3%
_Si54	2	1.780	0.034	1.826	0.02	2	100.0%	0	0	0	0.0%
_Si64	364	1.780	0.042	1.804	0.17	356	97.8%	8	5	3	2.2%
_Si81	431	1.790	0.030	1.795	0.09	410	95.1%	21	14	7	4.9%
_SJ80	446	2.656	0.057	2.619	0.16	434	97.3%	12	11	1	2.7%
_SK62	62	4.075	0.140	3.985	0.38	54	87.1%	8	8	0	12.9%
_SK78	442	4.134	0.138	4.064	0.27	422	95.5%	20	14	6	4.5%
_SL61	396	5.931	0.177	5.851	0.35	388	98.0%	8	8	0	2.0%
_SN60	107	8.595	0.223	8.383	0.53	96	89.7%	11	11	0	10.3%
_SP73	4	18.17	0.42	18.72	1.18	4	100.0%	0	0	0	0.0%

Figure 11.1
CRM Control Chart (z-score) Results Assayed at SMF BF



SEMAFO, 2017.

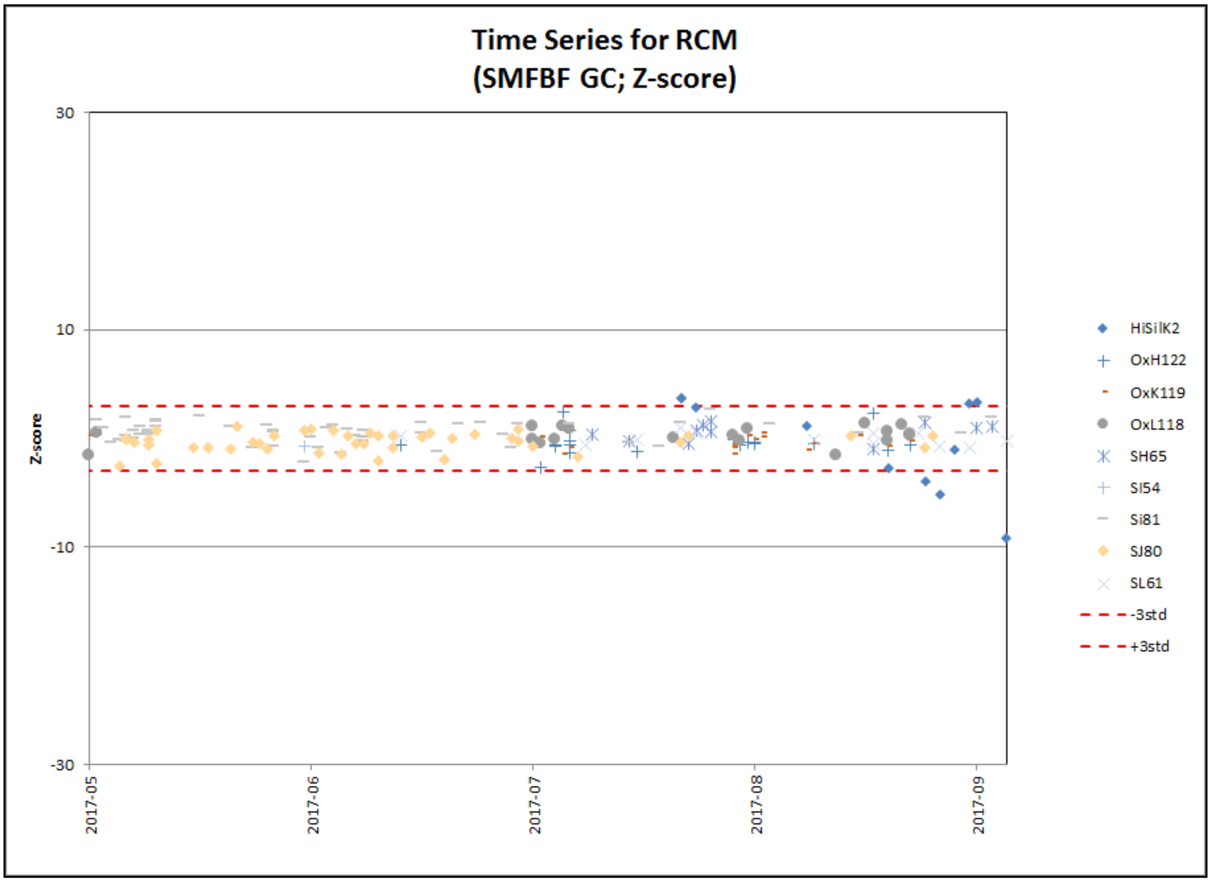
11.3.1.2 Grade Control CRM Results – SMF BF

Since the implementation of the grade control (GC) program in 2017, a total of 195 CRM samples were submitted with primary samples to the SEMAFO laboratory. Of that total, 8 CRM fell outside the 3 SD criterion, giving a rate of failure of 4%. Reruns were successfully performed on all the failed batches. The results are summarized in Table 11.3 and shown in Figure 11.2.

Table 11.3
2017 Grade Control CRM Results Assayed at SMF BF

CRM	COUNT	PERIOD (date)		CERTFIED		OBSERVED		ACCEPTED		FAILURES			
		From	To	Value	S.D.	Mean	S.D.	Count	Rate	Count	Below 3StdDev	Above 3StdDev	Rate
_HISILK2	11	2017-08-17	2017-09-30	3.474	0.034	3.462	0.1494	4	36.4%	7	3	4	63.6%
_OxH122	19	2017-07-10	2017-09-17	1.247	0.031	1.237	0.0359	19	100.0%	0	0	0	0.0%
_OxK119	23	2017-05-29	2017-09-17	3.604	0.105	3.570	0.0574	23	100.0%	0	0	0	0.0%
_OxL118	19	2017-05-29	2017-09-17	5.828	0.149	5.863	0.1221	19	100.0%	0	0	0	0.0%
_SH65	11	2017-08-05	2017-09-28	1.348	0.028	1.364	0.0236	11	100.0%	0	0	0	0.0%
_SI54	2	2017-06-27	2017-06-27	1.780	0.034	0.908	1.2012	1	50.0%	1	1	0	50.0%
_Si81	54	2017-05-30	2017-09-28	1.790	0.030	1.807	0.0297	54	100.0%	0	0	0	0.0%
_SJ80	44	2017-06-02	2017-09-20	2.656	0.057	2.638	0.0506	44	100.0%	0	0	0	0.0%
_SL61	12	2017-07-10	2017-09-30	5.931	0.177	5.927	0.1006	12	100.0%	0	0	0	0.0%

Figure 11.2
Grade Control CRM Control Chart (z-score) Results Assayed at SMF BF



SEMAFO, 2017.

11.3.1.3 CRM Results – ALS-OU

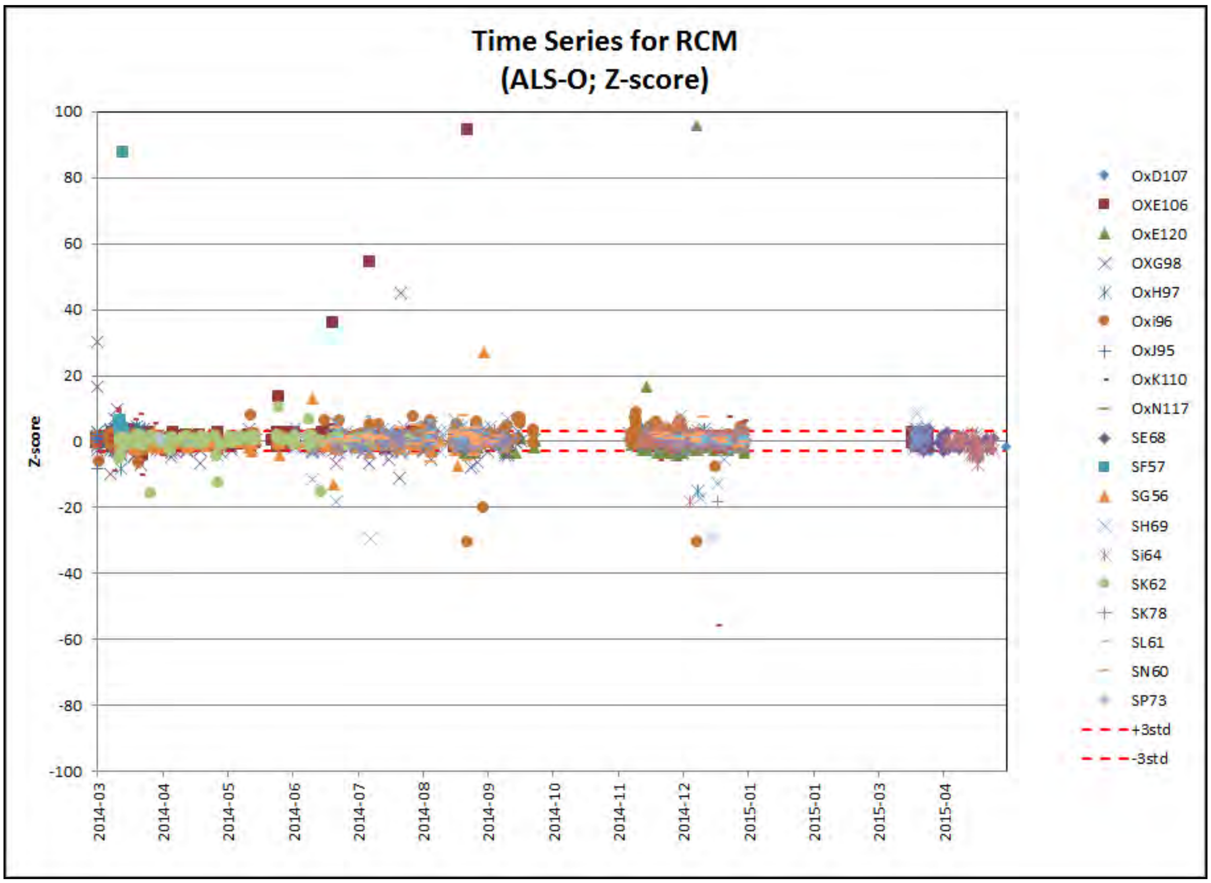
From 2014 to 2015, a total of 2,436 CRM samples were submitted with primary samples to the ALS laboratory in Ouagadougou. Initially, 259 (or 11%) failed the initial 3 SD control limits and reruns were requested by SEMAFO. Reruns were successfully performed on some the failed batches and the remaining batches were maintained as is in the database because of insignificant results. The results are summarized in Table 11.4 and shown in Figure 11.3.

CRM assay results show that reasonable analytical accuracy is being achieved at the SEMAFO mine site laboratory and ALS OU laboratory for all grade ranges, with no evidence for analytical bias.

Table 11.4
2014-2015 CRM Results Assayed at ALS-OU

CRM	COUNT	CERTFIED		OBSERVED		ACCEPTED		FAILURES			
		Value	S.D.	Mean	S.D.	Count	Rate	Count	Below 3StdDev	Above 3StdDev	Rate
_OxD107	49	0.452	0.014	0.44	0.02	43	87.8%	6	5	1	12.2%
_OXE106	296	0.606	0.013	0.62	0.09	286	96.6%	10	1	9	3.4%
_OxE120	146	0.62	0.012	0.62	0.10	133	91.1%	13	11	2	8.9%
_OxG98	283	1.017	0.019	1.03	0.29	244	86.2%	39	23	16	13.8%
_OxH97	115	1.278	0.03	1.30	0.07	94	81.7%	21	5	16	18.3%
_Oxi96	348	1.802	0.039	1.82	0.13	305	87.6%	43	7	36	12.4%
_OxJ95	9	2.337	0.057	2.32	0.18	8	88.9%	1	1	0	11.1%
_OxK110	131	3.602	0.053	3.58	0.30	105	80.2%	26	16	10	19.8%
_OxN117	4	7.679	0.207	7.66	0.06	4	100.0%	0	0	0	0.0%
_SE68	66	0.599	0.013	0.60	0.02	64	97.0%	2	0	2	3.0%
_SF57	21	0.848	0.03	1.00	0.57	16	76.2%	5	0	5	23.8%
_SG56	217	1.027	0.033	1.03	0.08	210	96.8%	7	4	3	3.2%
_SH69	254	1.346	0.026	1.36	0.10	213	83.9%	41	10	31	16.1%
_Si64	113	1.78	0.042	1.79	0.11	99	87.6%	14	7	7	12.4%
_SK62	109	4.075	0.14	4.06	0.41	101	92.7%	8	6	2	7.3%
_SK78	120	4.134	0.138	4.14	0.26	117	97.5%	3	3	0	2.5%
_SL61	92	5.931	0.177	6.06	0.26	85	92.4%	7	2	5	7.6%
_SN60	62	8.595	0.223	8.82	0.55	49	79.0%	13	5	8	21.0%
_SP73	1	18.17	0.42	18.65		1	100.0%	0	0	0	0.0%

Figure 11.3
CRM Control Chart (z-score) Results Assayed at ALS-OU



SEMAFO, 2017.

11.3.2 Blanks

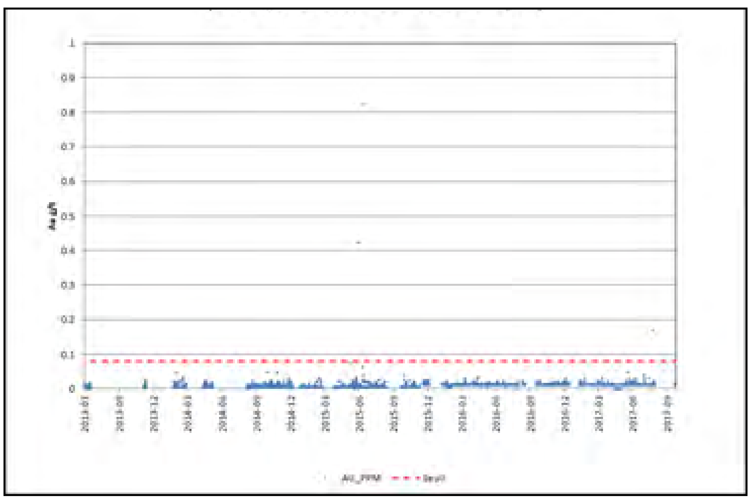
Blank material is submitted to the laboratory with samples to monitor possible contamination or sample cross-contamination caused when crushing or pulverizing equipment is not cleaned properly after mineralized samples are processed. A sandstone outcrop near the site is used to collect material to use as blank for the analyses. This material is considered appropriate.

The results are summarized below. Detailed results including relative precision charts are in Appendix 1.

11.3.2.1 Blanks Results – SMF BF

In between July, 2013 and September, 2017, a total of 8,167 coarse blank samples were submitted with the primary samples to the SEMAFO laboratory. Throughout this period, only three samples failed the 0.08 ppm Au threshold as shown in Figure 11.4.

Figure 11.4
SMF-BF Results of Blank Sample Analyses, 2013-2017



Those batches were rerun and validated. Additionally, 189 coarse blank samples were submitted with the GC samples. There were no failures.

11.3.2.2 Blanks Results – ALS-OU

Between March, 2014 and April, 2015, a total of 2,534 coarse blank samples were submitted with the primary samples to the ALS OU laboratory. Throughout this period, only one sample failed the 0.08 ppm Au threshold; this is considered insignificant.

11.3.3 Field/Laboratory Coarse Duplicates

Duplicates are used to verify the repeatability, the degree of precision of the analysis and to determine possible sampling bias. At SEMAFO, duplicates consist of ¼ drill core and RC laboratory coarse rejects selected at the end of each quarter, mainly driven by logistical considerations. Drill core duplicate analysis can provide an understanding of variability introduced by selecting one half of the drill core versus the other whereas RC laboratory coarse duplicates are used to verify the quality of the sample preparation.

Various plots are used to assess the results for pairs of duplicate samples. Scatter plots allow comparison of data pairs by assessing general dispersion and by identifying the presence of any outliers. A mean versus half relative difference plot is used to assess the precision and possible bias in each grade range. The mean of duplicate pairs is calculated along with the relative percentage difference between the two values, calculated as the difference divided by the mean multiplied by 100. The mean is then plotted against the relative difference for each sample pair. Precision plots are used to assess the repeatability (i.e., precision) of the duplicate results by plotting the average of the duplicate results against the half absolute difference of the pair. The number of sample pairs plotting between 5%, 10%, 20% and 100% difference lines are assessed as a measure of the precision of the results. As the grade approaches the detection limit of the analytical technique the precision, expressed as a percentage, decreases. A line of significance is typically plotted on the graph to exclude any results close to the detection limit to account for this. Quantile-quantile (QQ) plots are used to compare population distributions to assess potential bias. Relative percent difference and rank half absolute difference (HARD) plots evaluate the differences in per cent between pairs.

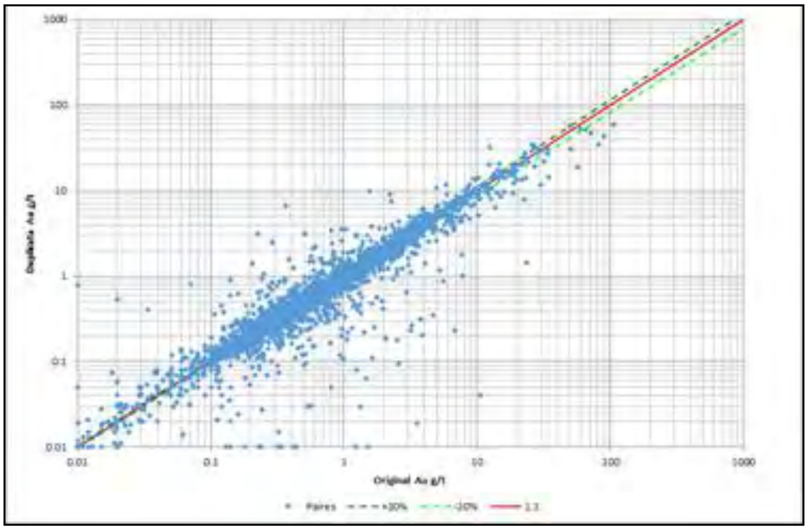
The results are summarized below. Detailed results including relative precision charts are in Appendix 1.

11.3.3.1 Field Duplicate Results – SMF BF

Between 2013 and 2017, there were a total of 3,108 RC laboratory coarse duplicates, 789 quarter core duplicates and 171 GC field duplicates submitted to the SEMAFO laboratory.

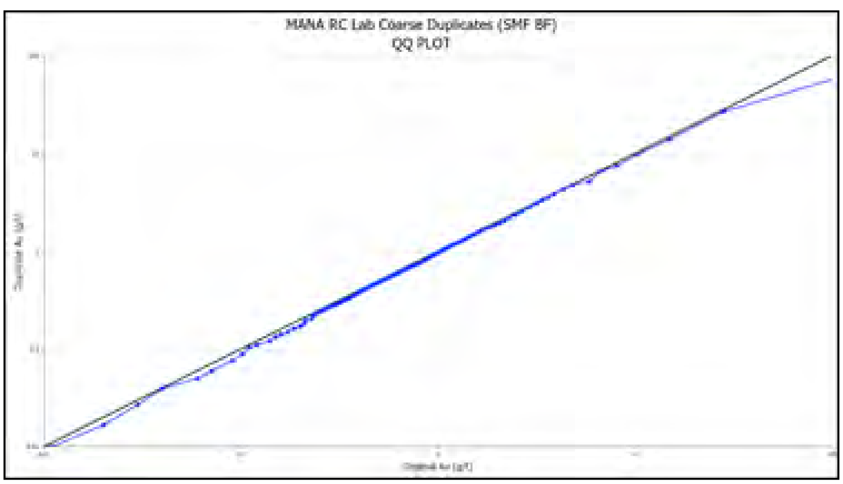
The scatter plot of RC laboratory coarse duplicate samples shows a good correlation (R=0.9575) with a larger spread for values between 0.1 and 10 g/t Au (Figure 11.5).

Figure 11.5
SMF BF RC Coarse Duplicates Bias Chart



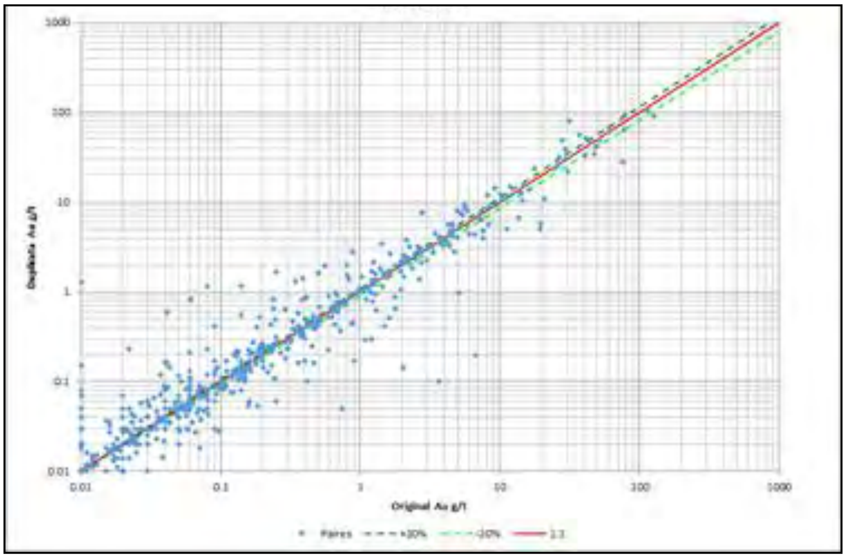
Rank half absolute difference (HARD) plots suggest that 65% of duplicate samples analyzed at SMF BF have HARD below 10%. This indicates that the quality of the sample preparation at the mine site laboratory is adequate. However, QQ plots (Figure 11.6) and various statistical tests show that a slight bias is present in the data whereas duplicate assays are slightly underestimated compared to the original.

Figure 11.6
SMF BF Coarse Duplicates QQ Plot



The scatter plot of quarter core field duplicate samples shows a good correlation (R=0.9575) with a larger spread for values below 1 g/t Au (Figure 11.7).

Figure 11.7
SMF BF Quarter Core Duplicates Bias Chart



HARD plots (Figure 11.8, Figure 11.9 and Figure 11.10) suggest that 55.8% of duplicate samples analyzed at SMF BF have HARD below 10%. This indicates the SMF BF laboratory had difficulty in reproducing the field duplicate results and this poor reproducibility is observed at all different grade ranges. However, QQ plots and various statistical tests show no evidence of bias that could have been introduced by preferentially submitting the more mineralized half of the core for assay. Poor reproducibility of quarter core field duplicates is not unexpected for sampling mineralization characterized by coarse gold and may suggest that gold grades display nugget effect.

Figure 11.8
SMF BF Quarter Core Duplicates HARD Plot

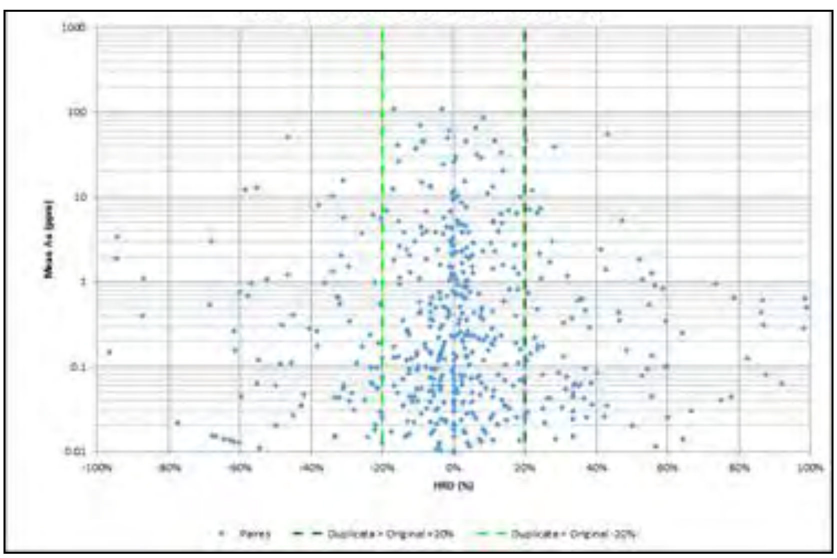


Figure 11.9
SMF BF Quarter Core Duplicates Mean versus Half Absolute Difference Plot

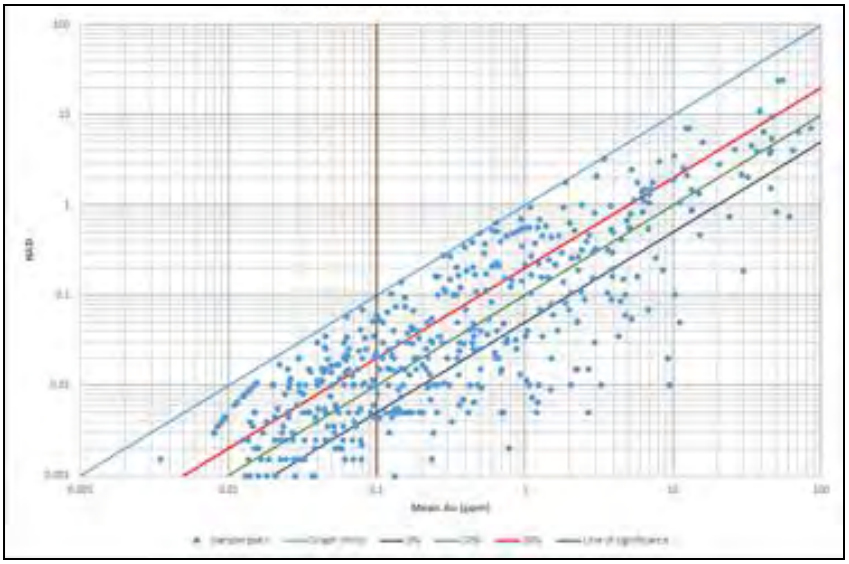
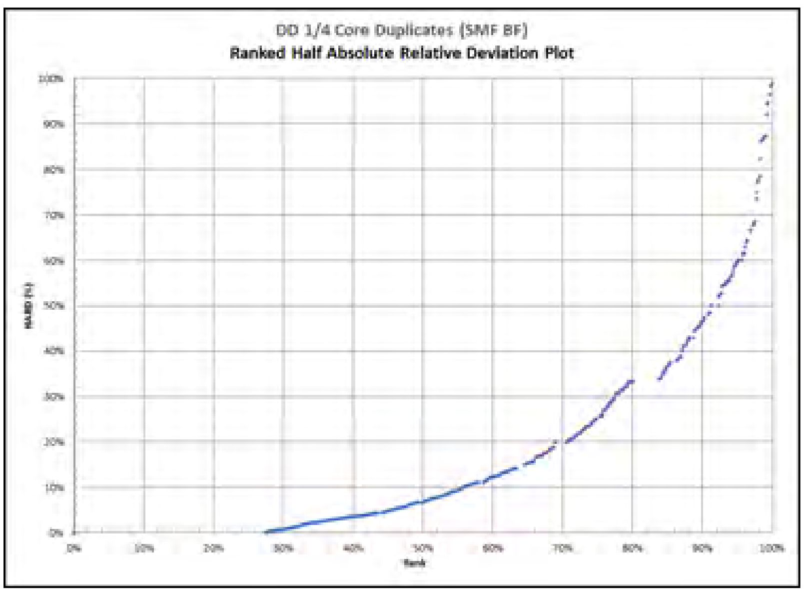


Figure 11.10
SMF BF Quarter Core Ranked Half Absolute Relative Deviation Plot



The scatter plot of GC field duplicate samples shows a good correlation (R=0.9701). HARD plots (Figure 11.11 and Figure 11.12) suggest that only 37.4% of duplicate samples analyzed at SMF BF have HARD below 10%. Again, this indicates that the SMF BF had difficulty in reproducing the field duplicate results and this poor reproducibility is observed at grade ranges between 0.1 and 10 g/t.

Figure 11.11
SMF BF Grade Control Field Duplicates Mean versus Half Relative Deviation Plot

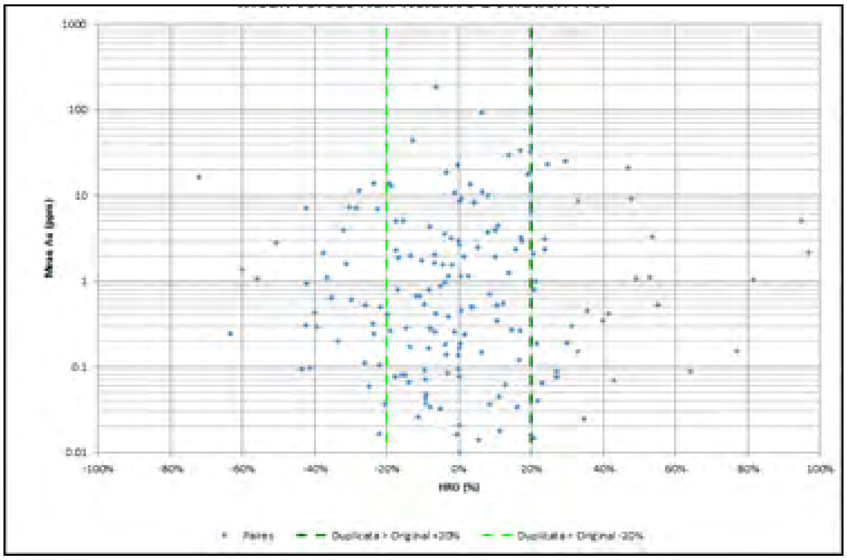
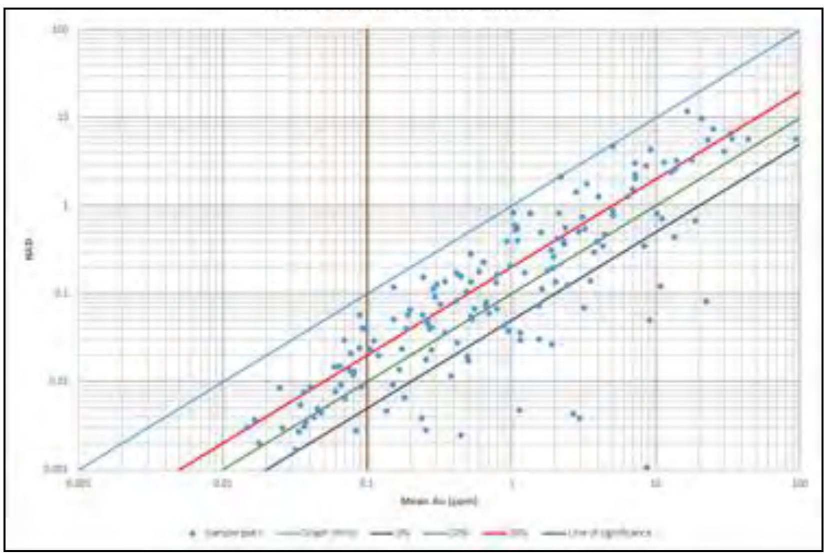
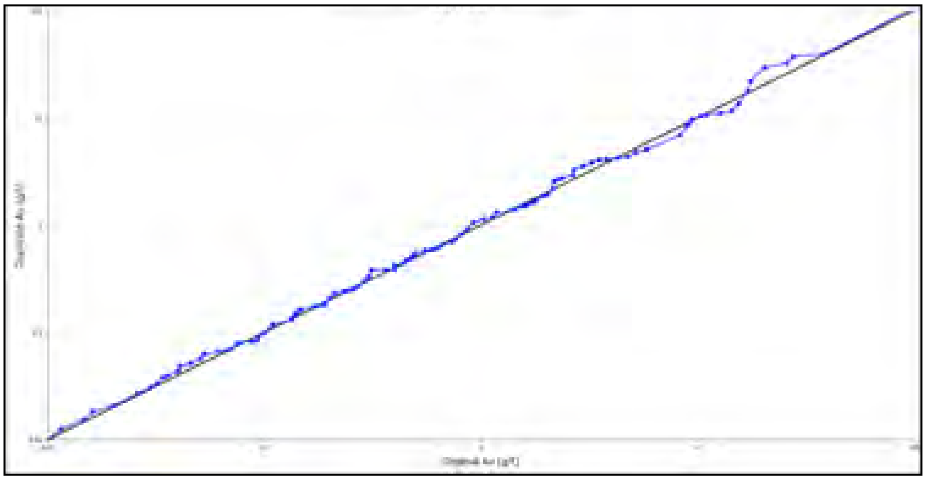


Figure 11.12
SMF BF Grade Control Field Duplicates Mean versus Half Absolute Difference Plot



However, QQ plots (Figure 11.13) and various statistical tests show no evidence of bias that could have been introduced by preferentially submitting the more mineralized half of the core for assay. Poor reproducibility of GC field duplicate duplicates is not unexpected for sampling mineralization characterized by coarse gold and may suggest that gold grades display nugget effect.

Figure 11.13
SMF BF Grade Control Field Duplicates QQ Plot



Overall, the populations compare reasonably well with some spread in the data typical of gold deposits containing visible gold. SEMAFO considers that there is no evidence to suggest that the primary sample varies significantly from the duplicate sample and that reasonable precision was achieved during the sampling and assaying process.

11.3.3.2 Field Duplicate Results – ALS-OU

In 2014 and 2015, there were a total of 644 RC laboratory coarse duplicates and 153 ¼-core duplicates submitted to the SEMAFO laboratory. Duplicate samples were analyzed at ALS OU. The results are broadly similar to those of SMF BF and are described below.

Scatter plot of RC laboratory coarse duplicate samples shows a correlation of 0.8851 with rare outliers. HARD plots suggest that 54.5% of duplicate samples analyzed at ALS OU have HARD below 10%. This indicates that the quality of the sample preparation at ALS OU is adequate. However, QQ plots and various statistical tests show that a slight bias is present in the data whereas duplicate assays are slightly underestimated compared to the original.

The scatter plot of quarter core field duplicate samples shows a correlation of 0.8996 with some outliers. HARD plots suggest that 56.2% of duplicate samples analyzed at ALS OU have HARD below 10%. This indicates the ALS OU laboratory had difficulty in reproducing the field duplicate results and this poor reproducibility is observed at different grade ranges. However, QQ plots and various statistical tests show no evidence of bias that could have been introduced by preferentially submitting the more mineralized half of the core for assay. Poor reproducibility of quarter core field duplicates is not unexpected for sampling mineralization characterized by coarse gold and may suggest that gold grades display nugget effect.

Overall the populations compare reasonably well with some spread in the data typical of gold deposits containing visible gold particles. SEMAFO considers that there is no evidence to suggest that the primary sample varies significantly from the duplicate sample and that reasonable precision was achieved during the sampling and assaying process.

11.3.4 Umpire Laboratory Checks

At the end of each quarters, pulps of selected sample series assayed at the primary laboratory are sent to a secondary umpire laboratory to test the reliability of assaying results.

The results are summarized below. Detailed results including relative precision charts are in Appendix 1.

11.3.4.1 SMF BF versus ALS-OU (2017)

In 2017, a set of 76 oxide and 340 sulphide pulp duplicate samples originally assayed at SMF BF were submitted to ALS OU as an umpire check of results from the primary laboratory. The results are discussed below.

Scatter plot of oxide pulp duplicates shows an excellent correlation of 0.9898 and HARD plot suggest that 74% of pulp duplicates analyzed at SMF BF and ALS OU have HARD below 10%. On the other hand, QQ plots and various statistical tests show that a slight bias is present in the data whereas duplicate assays are slightly underestimated compared to the original.

The scatter plot of sulphide pulp duplicates shows a correlation of 0.6329 and the HARD plot suggest that 53% of sulphide pulp duplicates analyzed at SMF BF and ALS OU have HARD below 10%. QQ plots show that a slight bias is present in the data within some grade intervals, but this is more pronounced over 10 g/t Au, where duplicate assays are underestimated compared to the original.

11.3.4.2 SMF BF versus SGS-OU (2014-2016)

Between 2014 and 2016, a set of 1,237 oxide and 1,147 sulphide pulp duplicate samples originally assayed at SMF BF were submitted to the SGS OU laboratory as an umpire check of results from the primary laboratory. The results are described below.

Scatter plot of oxide pulp duplicates shows a good correlation of 0.9669 and the HARD plot suggest that 62% of pulp duplicates analyzed at SMF BF and SGS OU have HARD below 10%. QQ plots and various statistical tests show that a slight bias is present in the data whereas duplicate assays are slightly underestimated compared to the original.

The scatter plot of pulp duplicates shows a good correlation of 0.9380 but the HARD plot suggests that 57% of sulphide pulp duplicates analyzed at SMF BF and SGS OU have HARD below 10%. QQ plots and various statistical tests show that a slight bias is present in the data whereas duplicate assays are slightly underestimated compared to the original.

11.3.4.3 ALS OU versus SGS-OU (2014-2015)

In 2014 and 2015, a set of 282 oxide and 347 sulphide pulp duplicate samples originally assayed at ALS OU were submitted to the SGS OU laboratory as an umpire check of results from the primary laboratory. The results are discussed below.

The scatter plot of oxide pulp duplicates shows a correlation of 0.9003 and the HARD plot suggest that 79% of pulp duplicates analyzed at ALS OU and SGS OU have HARD below 10%. QQ plots and various statistical tests show that a slight bias is present in the data between 0.1 and 1 g/t Au where duplicate assays are slightly underestimated compared to the original.

The scatter plot of pulp duplicates shows a good correlation of 0.9629 but the HARD plot suggests that 67% of sulphide pulp duplicates analyzed at ALS OU and SGS OU have HARD below 10%. QQ plots and various statistical tests show that a slight bias is present in the data where duplicate assays are slightly underestimated compared to the original.

Paired laboratory pulp replicate data, both oxide and sulphide, suggest that gold grades are difficult to reproduce, but that also may reflect differences in laboratory procedures. For example, the fact that SMF BF uses a gravimetric finish for values above 15 ppm Au compared to the AAS finish used by ALS OU might explain some of the bias observed in the results. A series of cross-validation tests was performed to investigate the possible causes of the systematic slight bias with limited definitive conclusions. It is presumed that different laboratory procedures may be the cause, but the level of potential inaccuracy does not warrant further investigation.

11.4 SAMPLE SECURITY

For material assayed by ALS OU and SGS OU, samples are trucked from the field by SEMAFO personnel to the Bana exploration camp. QA/QC samples are inserted by SEMAFO personnel into the sample stream. Assay samples are placed in sealed and numbered plastic bags and delivered by batch to the on-site ALS sample preparation laboratory. Samples are all crushed and pulverized on site by ALS personnel. Sample pulps are prepared for shipment and stored on site in a secure locked room until shipment to Ouagadougou. Ground transportation takes place with security guards. Personnel releasing the samples for shipment to the laboratory assume responsibility for sample security and paperwork with recorded sample numbers is accounted for prior to shipment to the laboratory. ALS OU checks the received samples against the paperwork and signs off on the receipt.

For material assayed by SEMAFO at the mine site laboratory, samples are trucked from the field by SEMAFO personnel to the Bana exploration camp. For GC material, samples are trucked directly from the deposits to the mine site laboratory. QA/QC samples are inserted by SEMAFO personnel into the sample stream, either at the exploration camp for the exploration samples or in the field for the GC samples. Assay samples are placed in sealed and numbered plastic bags and delivered by batch by truck to the mine laboratory. Personnel releasing the samples for shipment to the laboratory assume responsibility for sample security and paperwork with recorded sample numbers accounted for prior to shipment to the laboratory. SEMAFO BF checks the received samples against the paperwork and signs off on the receipt.

11.5 BULK DENSITY

Density measurements were performed on core samples from the Wona-Kona, Nyafé, Siou and Yama deposits and were derived from metallurgical studies for Fofina, Fobiri and Yaho.

The successive specific gravity measurement programs were performed either by SEMAFO or ALS technicians under geologists' supervision. Sample preparation and measurement conducted directly at the Bana camp site facilities used the water displacement method (weight in air divided by the difference between the weight in air and the weight in water). Samples were selected to be representative of the various facies present in the different deposits. Single pieces of core, averaging 10 cm in length, were selected and measured in each core box prior to splitting. Each sample was first dried in an electrical oven at 60°C for 24 h, and then weighed in air using a conventional Ohaus SP402 Portable, Scout Pro balance. Subsequently, the sample was coated in wax and weighed in air and immersed and weighed in water. The scale has an under-hook and zero adjustment, so it can be used on a stand allowing the samples to be weighted dry on the platen and then reweighed in a cradle suspended in water underneath. After testing, each sample was carefully replaced at its original location in the core box. Specific gravity data were subsequently classified by rock and material type.

Specific gravity measurement results for the various rock facies at different level of alteration confirm the relationship between the specific gravity with depth. The specific gravity increases through the weathering profile and becomes homogeneous within the fresh zone. The results also highlight the constant specific gravity of the quartz veins that host all the mineralization at Siou. Therefore, a constant 2.59 value was assigned in the resource model for all alteration facies since quartz veining is only slightly affected by the weathering process.

It is Micon's opinion that the equipment used and the procedure for measuring bulk density at Mana are appropriate for Mineral Resource estimation.

11.6 QUALIFIED PERSON'S OPINION ON ADEQUACY OF SAMPLING

Sample collection and preparation, analytical techniques, security and QA/QC protocols implemented at Mana are consistent with standard industry best practices.

Trench, rock chip and soil sampling programs are suitable to define areas of anomalous gold concentration for exploration targeting. Reverse circulation and diamond drill sampling procedures are adequate for and consistent with the style of gold mineralization under consideration. Based on the QC sample results (i.e., samples inserted by SEMAFO into the sample stream), sampling conducted by SEMAFO has achieved reasonable precision and analytical accuracy.

Assaying for gold has primarily been completed at SEMAFO BF and at ALS OU. Based on the results of the QC samples, along with multiple inspections, this has achieved reasonable precision and analytical accuracy.

In Micon's opinion, the sampling and assay data are adequate and reasonable for use in Mineral Resource estimation.

12.0 DATA VERIFICATION

The steps undertaken by Micon to verify the data in this Technical Report include visits to the SEMAFO head office in Montreal and to the Mana mine project in Burkina Faso, inspection of the facilities at the Mana mine laboratory where exploration samples are analyzed, analysis of monitoring reports on the performance of control samples, and validation of the resource database.

12.1 SITE VISITS

Micon visited the SEMAFO head office in Montreal on 11 July, 2017 for a presentation on the Mana mine project. The presentation and subsequent discussions centred on geology, mineralization, deposit types/genetic models, exploration, deposit modelling, grade control, current/future mining methods and processing/metallurgical aspects.

Following the Montreal head office visit, Micon conducted a site visit to the Mana mine project from 26 to 29 July, 2017 and accomplished the tasks discussed below.

12.1.1 Examination of Data Collection Techniques

Micon observed RC drilling and sampling at the Wona-Kona pit (see Figure 12.1). The RC chip samples are collected at regular intervals, in duplicate, as shown in Figure 12.2. One sample is sent for assay and the other kept for reference. This is in line with industry standard procedures.

Figure 12.1
RC Rig and Sampling Crew at the Wona-Kona Pit

Micon, July, 2017.

Figure 12.2
Detail of Figure 12.1 Showing Sampling in Duplicate

Micon, July, 2017.

Micon also observed drill core logging procedures and sampling at the Bana exploration base core shack (Figure 12.3) and found the procedures and sampling to be appropriate.

Figure 12.3
Drill Core Logging and Sampling at Bana Core Shack

Micon, July, 2017.

In summary, SEMAFO's logging and sampling are conducted satisfactorily and to industry standards.

12.1.2 Sample Quality

Micon examined mineralized intervals from several drill core holes and established that for drill core:

- Core recoveries were good and, therefore, there are no recovery factors that could materially impact the quality of the samples collected.
- The sampling respected the geology where deemed necessary; this facilitates modelling of the deposit.

For RC samples:

- The RC rig used by SEMAFO is equipped with a dual wall drill pipe which prevents contamination of samples.
- RC samples are collected at pre-set intervals (generally 1 m) making sure that no over-flows occur.

Overall, Micon believes that the samples collected give a fair representation of the mineralization of the Mana and Siou deposits.

12.1.3 Visual Characteristics of Mineralized Intervals

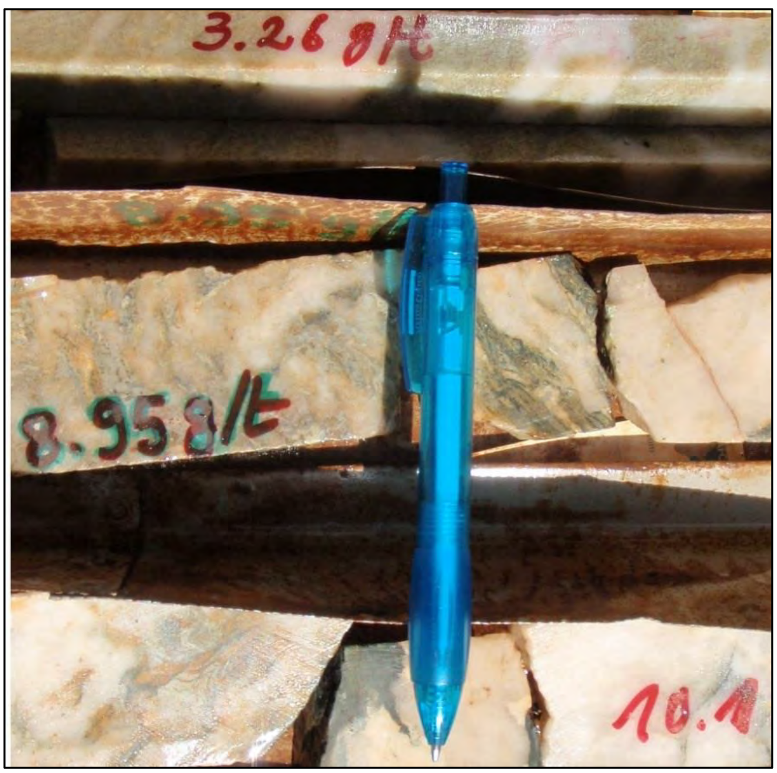
Micon examined several diamond drill hole cores from the Wona-Kona, Nyafé, Filon 67, Fobiri, Fofina and Siou deposits to verify the visual characteristics associated with the mineralization for geological/resource modelling purposes. The key features observed in the Wona-Kona mineralized intervals are silicification/quartz veining with disseminated mineralization, evidence of shearing and sericite alteration (see Figure 12.4). The Siou deposit is characterized by more distinct gold-bearing quartz veins (see Figure 12.5), with stockwork features in places. The mineralized intervals for the four southern deposits (i.e., Nyafé, Filon 67, Fobiri and Fofina) consist of quartz-rich veins in sheared and silicified volcanic rocks.

Micon's observations confirm that sericite alteration, shearing and silicification/quartz veining can be used, in combination with assays, to model the Mana gold deposits.

Figure 12.4
Wona-Kona Deposit – Mineralized Intercept in Drill Hole WDC 160

Micon, July, 2017.

Figure 12.5
Siou Deposit Zone 9 – Mineralized Intercept in Drill Hole WDC 594



Micon, July, 2017.

12.2 LABORATORY VISIT

Micon visited and inspected the facilities at the Mana mine Laboratory on 28 July, 2017. The laboratory maintains two separate sample receiving/preparation rooms (Figure 12.6). One section is dedicated to the Exploration Division samples whilst the other deals with the Mining Division samples. This arrangement ensures that the laboratory provides SEMAFO's exploration division with results that are sufficiently timely, precise and accurate for the proper evaluation of resources.

Figure 12.6
Mana Mine Laboratory Sample Preparation Rooms

Micon, July, 2017.

The sample preparation facilities were found to be well-maintained with adequate measures in place to avoid contamination between samples. Analytical equipment and the entire complex are kept in neat condition. Records of calibration and performance parameters are kept up to date for both testing and measuring equipment. The laboratory's internal QA/QC protocol also includes the insertion of a certified reference material (CRM) in every batch of 20 samples. Analytical procedures are considered to be satisfactory, and the laboratory has a good working relationship with the ALS and SGS Minerals Services laboratories in Ouagadougou which are used by SEMAFO to conduct independent check/repeat analyses from time to time.

An aspect of the mine laboratory's professional development involves taking part in round robin analyses together with other reputable laboratories.

12.3 Review of QA/QC Reports and Control Charts

Monitoring charts on quality control samples have already been discussed in Section 11.0 of this report. Micon's review of the monitoring reports reveals that adequate control samples incorporating high quality CRMs, blanks and duplicates were used to ensure accuracy of the analytical database. In a few instances where standards failed, appropriate investigations were conducted, and re-assaying was conducted whenever it was deemed necessary. Micon did not identify any flaws in the QA/QC protocols. Evidently, SEMAFO maintains industry norms and standards.

Overall, Micon considers the sample preparation, security and analytical procedures to have been adequate over the different drill campaigns to ensure the integrity and credibility of the analytical results used for mineral resource estimation.

12.4 Resource Database Validation

The resource database validation conducted by Micon involved the following steps:

- Reviewing the database construction and the categories of information contained within it.
- Checking for any non-conforming assay information such as duplicate samples and missing sample numbers.
- Checking drill hole collar elevations against the topographic surface.
- Checking the reasonableness of downhole survey information.

12.5 Data Verification Conclusions

Based on the verification procedures described above, Micon is satisfied that the database used for the resource estimate in this Technical Report was generated in a credible manner and properly assembled and is therefore suitable for use in estimating the mineral resource. The genetic models adopted are appropriate.

13.0 MINERAL PROCESSING AND METALLURGICAL TESTING

13.1 INTRODUCTION

External metallurgical testwork relating to the Mana operation has taken place in three phases relating to the development of feed from:

- The Wona-Kona and Nyafé deposits in 2002-2007.
- The Siou deposit in 2012.
- The South sector deposits, Fofina, Fobiri and Yaho in 2012-2013.

Given the metallurgical processing experience gained by SEMAFO with the different types of mineralization in the area, there is no plan to undertake further testwork in support of underground development at Siou.

13.2 WONA-KONA, NYAFÉ

The metallurgical testing carried out between 2002 and 2005 was supervised by Reminex (Morocco) (Reminex 2002, 2003, 2004) and Mintek (South Africa) (Mintek 2004). The process flowsheet design confirmation and optimization was developed in 2007 by Genivar, an engineering consultant based in Montreal, Canada, based on an extensive testwork program completed by SGS Lakefield using RC composite samples selected from the main mineralized zones.

The testwork results demonstrated that gold recovery was variable depending on the ore body (Wona-Kona or Nyafé), the depth of sample and the nature of the mineralization (oxide or sulphide). Following a detailed review of the testwork results, the carbon-in-leach (CIL) process was the selected gold recovery method.

13.2.1 Grinding

Orway Minerals Consultants of Perth, Australia, completed a comminution testwork program and design of the comminution circuit, including the equipment selection. Whole PQ diamond drill core (85 mm) representing typical mineralization from the deposit was used for this testwork. A summary of the comminution test results is shown in Table 13.1.

Table 13.1
Summary of Grinding Testwork Results (Orway Minerals)

Description	Wona-Kona			Nyafé	
	Oxides		Sulphides	Oxides	Sulphides
	Saprolite	Saprock	Bedrock	Saprock	Bedrock
Specific Gravity	2.3	2.5	2.7	-	-
Work Index - CWi (kW/t)	10.0	12.6	15.4	-	-
Rod Mill Work Index - RWi (kW/t)	7.5	14.2	17.2	-	-
Ball Mill Work Index - BWi (kW/t)	6.6	11.6	15.5	8.9	14.7
Abrasion Index Ai(g)	0.46	0.16	0.61	-	

13.2.2 Leaching

Mintek completed a detailed review of bottle roll leach testwork results from a testwork program undertaken by SGS (Ghana). A total of 91 Wona-Kona samples and 23 Nyafé samples were selected for this variability study. A summary of the standard CIL bottle roll results is presented in Table 13.2.

Table 13.2
Average CIL Testwork Gold Recoveries

Mineralization	Wona-Kona	Nyafé
Oxide		84.9%
Saprolite	90.2%	-
Saprock	87.1%	-
Sulphide	81.0%	64.0%

13.2.3 Acid Base Accounting

In 2010, SGS South Africa completed five standard acid base accounting (ABA) tests using samples of Wona-Kona bedrock (SGS South Africa, 2010a). A summary of these results is included in Table 13.3.

Table 13.3
Summary of Five Wona-Kona Sample ABA Tests

Description	Sample Number				
	3276	3277	3278	3279	3280
Total S (%)	1.83	3.82	5.38	4.92	3.62
Sulphide S (%)	1.57	3.01	4.74	4.20	3.35
Neutralizing Potential (NP)[1]	68	205	113	122	80
Acid Potential (AP)[1]	49	94	148	131	105
Net NP	18.8	111	-34.6	-9.3	-24.9
NP/AP	1.4	2.2	0.8	0.0	0.8

[1] Units for NP, AP are kg $CaCO_3$/t.

The ABA test results show that two samples could be considered acid producing, one sample non-acid producing and two samples potentially acid producing. These results suggest that certain areas of bedrock at Wona-Kona are potentially acid producing.

13.3 SIOU DEPOSIT

Metallurgical testing was carried out in December, 2012, by SGS South Africa using samples representing the Siou deposit (SGS South Africa, 2012c). This testwork program was based on RC composite samples comprising a total of 233 kg. The samples of the mineralized zone, which were selected by SEMAFO, ensured both spatial and grade representation of the deposit and, also, enabled comparison of oxidized and fresh rock characteristics.

The Siou deposit was divided into four quadrants, MSO, MSS, MNO and MNS, as listed in Table 13.4. The samples were collected and sent to SGS South Africa (Pty) Ltd. to perform the following tests:

- Bond ball mill working index (BBWI).
- CIL and specific gravity (SG).
- Gravity recoverable gold (GRG).
- Acid base accounting (ABA).
- Mineralogical characterization study.

13.3.1 Grinding

BBWI tests gave results that compared well with Wona mineralization (see Table 13.1), with values between 7.1 and 11.5 kWh/t for soft oxide mineralization and 14.0 to 16.8 kWh/t for medium-hard sulphide mineralization.

13.3.2 Leaching

Of the 36 samples collected for standard CIL tests, 19 samples were from the Siou zone and 17 samples from the Nine zone.

Cyanide leach test parameters were similar to those used in the Mana CIL circuit (grind fineness, cyanide consumptions, pH, etc.). Table 13.4 shows the CIL test recoveries for each mineralized zone.

Leach test results indicated excellent gold recovery using standard CIL processing. The recovery was consistently at or above 95% for all mineralization types including oxides and sulphides, which indicates a high proportion of free gold within the mineralized samples. Gold is almost exclusively associated with quartz veins.

Table 13.4
Siou Sample Gold Recoveries Using the Standard CIL Test Protocol

Mineralized Zone	Description	Total Weight (kg)	Head Grade (g/t Au)	Recovery (%)
MSO	South Zone – Oxidized	10	4.77	98
MSS	South Zone – Sulphide	8	7.54	98
MNO	North Zone – Oxidized	8	3.16	95
MNS	North Zone – Sulphide	10	6.70	96
Total		**36**		**97**

13.3.3 Gravity Separation

Gravity recoverable gold (GRG) results demonstrated excellent gold recovery potential using gravity concentration. Gold recoveries were 75% and 87% for MNO and MSS samples, respectively. These results demonstrate the high level of free gold in the samples.

13.3.4 Acid Base Accounting

The standard ABA tests by SGS South Africa using 10 samples of Siou mineralization gave mixed results, with some samples potentially acid producing (SGS South Africa, 2010a).

13.3.5 Mineralogy

The mineralogical study by SGS South Africa showed that the Siou samples contained a high concentration of silica (80 wt%) with lesser amounts of aluminum, iron, potassium and sodium. The gold was typically found in particles larger than 53 µm but less than 75 µm.

Multi elements analyses of composite samples indicated that there are no material deleterious elements present in the samples.

13.4 SOUTH SECTOR – FOBIRI, FOFINA, YAHO

The following description is based on the 2012 SGS South Africa report (SGS South Africa, 2012b).

Metallurgical testing for the Yaho, Fofina, and Fobiri deposits (South sector) used 111 representative core and RC composite samples. SGS South Africa executed a variety of tests in 2012 using standard conditions based on the Mana processing facility. Testwork included:

- JK Drop weight tests.
- Bond abrasion tests.
- Bond crushability tests.
- BBWI tests.
- GRG.
- Standard CIL tests.

The composite samples were carefully selected by SEMAFO to represent roughly 90% of the identified mineral resources. Individual samples were diluted when necessary with waste to respect average resource head grades. Variability was also evaluated with specific samples. Variability in the South sector indicating higher localized zones of sulphide such as pyrite, pyrrhotite and arsenopyrite, and graphitic zones were individually sampled (12 special samples) and tested by SGS to verify their response to the current Mana CIL process.

13.4.1 Grinding

The results from the comminution tests are summarized in Table 13.5.

Table 13.5
Comminution Testwork Results

Sample	Density (g/cm^3)	DWT Parameters		Work Indices (kWh/t)		Ai (g)
		Axb	T_a	CWI	BWI	
Fobiri	2.84	27.9	0.14			
WDC 259				16.2	14.9	0.130
WDC 442				14.1	14.2	0.087
WDC 444				14.3	14.2	0.118
Fofina	2.76	36.6	0.31			
WDC 246				15.4	15.4	0.146
WDC 247				16.2	15.2	0.130
WDC 248				16.8	14.8	0.152
Yaho	2.75	42.4	0.17			
WDC 301				16.3	13.2	0.356
WDC 303				16.6	12.4	0.214
WDC 445				15.1	13.6	0.245

These results suggest that mineralization from these deposits has similar grinding characteristics to Wona-Kona and Siou material.

13.4.2 Leaching

Table 13.6 summarizes the recoveries obtained by using the standard Mana CIL process protocol. These results suggest recoveries between 84% and 92% for saprolite, 71% to 84% for saprock and 19% to 48% for sulphide mineralization. These results suggest that the sulphide mineralization, especially at Fobiri and Fofina, is refractory.

A mineralogical study completed on Fofina samples showed that about 20% of the gold grains are encapsulated within the sulphides (pyrite, arsenopyrite) and that gold grain sizes are typically very small (below 10 µm).

Table 13.6
Results of Standard CIL Tests Using Fobiri, Fofina and Yaho Samples

Sector	CIL Gold Recoveries (%)		
	Saprolite	Saprock	Bedrock/Sulphide
Fobiri	84	71	19
Fofina	92	74	26
Yaho	87	84	48

SGS South Africa, 2012b.

Based on the results shown in Table 13.6, the Albion process, which includes sulphide flotation, ultrafine grinding (UFC) of sulphide concentrate and ultimately oxidation, was investigated by HRL Technology Group Pty Ltd. (HRL) testing laboratories in Queensland, Australia (HRL, 2012).

Heap leaching was also investigated to seek better economics of the South zone mineralization. Composite samples comprising Fofina and Yaho oxides (saprolite) and partially oxidized saprock were tested by SGS South Africa to determine heap leach potential recovery for gold (SGS South Africa, 2012a, 2013).

Internal economic assessment and sensitivity analysis based on these results indicated that neither the Albion nor the heap leach process was cost-effective.

Based on the results summarized in Table 13.6, it was decided to process Fofina oxides at the current Mana plant.

Additional studies will be undertaken on the other ore types and deposits in the next few years.

13.5 TAILINGS CHARACTERIZATION

Detoxification tests using tailings samples were carried out in 2010 by SGS South Africa. These tests indicated that the SMBS (sodium metabisulphite)/copper sulphite method achieved an average of 99.47% removal of WAD cyanide, with 99.48% removal of total cyanide and 99.87% removal of free cyanide. (SGS South Africa, 2010e).

A series of ABA tests using Wona-Kona tailings samples were completed by SGS South Africa in 2013. Of the 17 samples, none was characterized as acid producing. Five were classified as potentially acid producing, while the remaining 12 were non-acid producing.

14.0 MINERAL RESOURCE ESTIMATES

Nine different deposits, namely Siou, Wona-Kona, Nyafé, Yama, Fofina, Fobiri, Yaho, Maoula and F67, constitute the basis of the Mana Project Mineral Resources.

Resource block models have been created for each individual deposit. Three dimensional (3D) mineralized solids are first interpreted from drill hole data, limiting resources to the material inside those solids. Original drill hole samples within the mineralized solids are first capped and then transformed into fixed length composites. Mineralized solids are subsequently filled by blocks on a regular grid and block grade interpolation is performed from the grade of composites in the same solid. All blocks interpolated below the surface topography or the mine surface survey as of December 31, 2017 make up the mineral inventory at that date. Blocks are classified relative to proximity to composites and corresponding precision/confidence level. Technical and economic factors are then applied to the blocks in the form of pit-optimization, optimized stope designs and cut-off grades to constrain the resources to those that present a reasonable prospect of economic extraction.

Drill hole exploration data is stored and managed using the Geobank data management system from Micromine. Mineralized envelopes have been interpreted using Micromine software. Resources were modelled using Studio RM, NPV Scheduler and MSO (Mineable Shape Optimizer) software packages from Datamine.

14.1 DRILL HOLE DATABASE

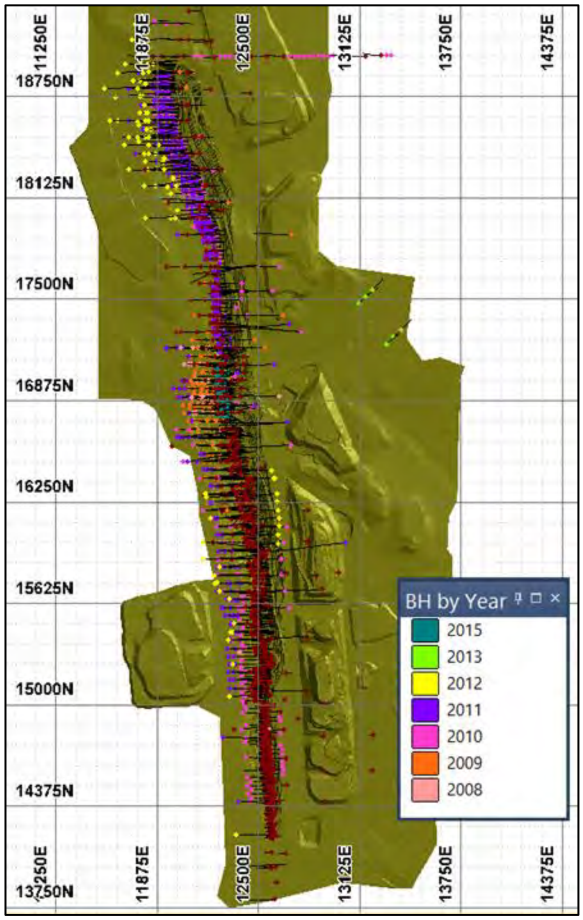
Deposit data are extracted from the central database system (Geobank) into eight different projects (i.e. Siou, Wona-Kona, Nyafé-F67, Yama, Fofina, Fobiri, Yaho, and Maoula).

14.1.1 Wona-Kona Database

The Wona-Kona database contains 1,775 drill holes and trenches totaling 315,310 m, which includes 23 trenches, 529 core holes, 1,063 RC holes including two special holes (WSHQ3 and WSPQ2), and 160 air core exploration holes. There is a total of 239,985 assay intervals totaling 243,884 m with gold values; these assay intervals are mostly 1 m long.

Wona-Kona holes are distributed over an area of 1.93 km by 7.59 km from 11,452E/13,798N to 13,378E/21,388N in the local coordinate system. The local north-south axis corresponds to the southwest-northeast axis of the regular UTM system. Holes are drilled along east-west sections with a maximum spacing of 50 m from 14,175N to 18,900N, i.e., 95 master sections. The drill-spacing is reduced to 25 m from 15,700N to 18,900N, and down to 12.5 m from 14,175N to 15,700N (see Figure 14.1).

Figure 14.1
Drill Hole Location Map at Wona-Kona over Digital Terrain Model as of December, 2017

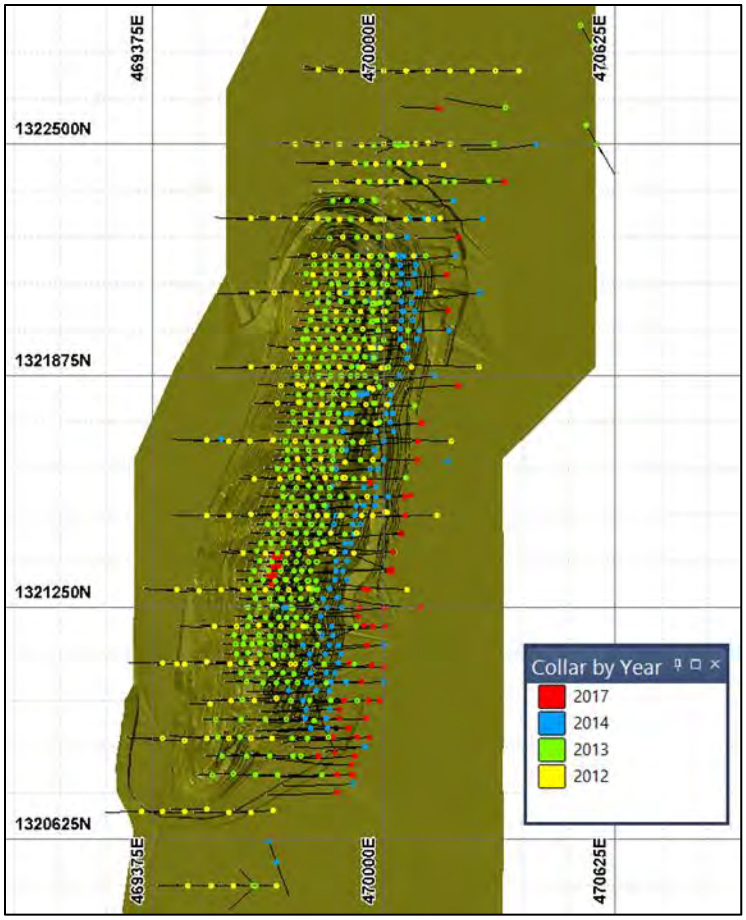


14.1.2 Siou Database

Between 2012 and 2014, the Siou deposit was drilled off on a 25 m by 25 m grid to define the mineralization down to a vertical depth of 250 m. Additional drilling completed in 2017 was aimed at confirming the continuity of the mineralization and increasing the level of confidence at depth to evaluate the underground potential. The database now consists of 855 holes totalling 151,679 m including 494 RC holes, 14 multi-purpose (MP) holes (i.e. pre-collared using RC drilling and diamond tails to complete the holes) and 347 core holes. Two RC holes have been excluded from the resource estimation due to possible contamination. A total of 121,260 samples were collected totaling 117,124 m, with samples averaging close to 1 m in length.

Siou holes cover a 1.62 km by 4.30 km area from 469,345E/1,320,499N to 470,969E/1,324,801N in the UTM reference system (see Figure 14.2). Between 1,320,900N and 1,322,200N, holes are drilled on a 25 m by 25 m grid spacing allowing a complete coverage of 25 by 25 m from surface to 250 m vertical depth. East-west section spacing increases from 50 m to 100 m and from 50 m to 200 m on the northern and southern extensions of the deposit, respectively. Hole spacing along sections also increases. Most holes are drilled N270 plunging -50° to the west. The Siou zones as defined by current drilling extend over a north-northeast strike length of about 1,700 m.

Figure 14.2
Drill Hole Location Map at Siou over Digital Terrain Model

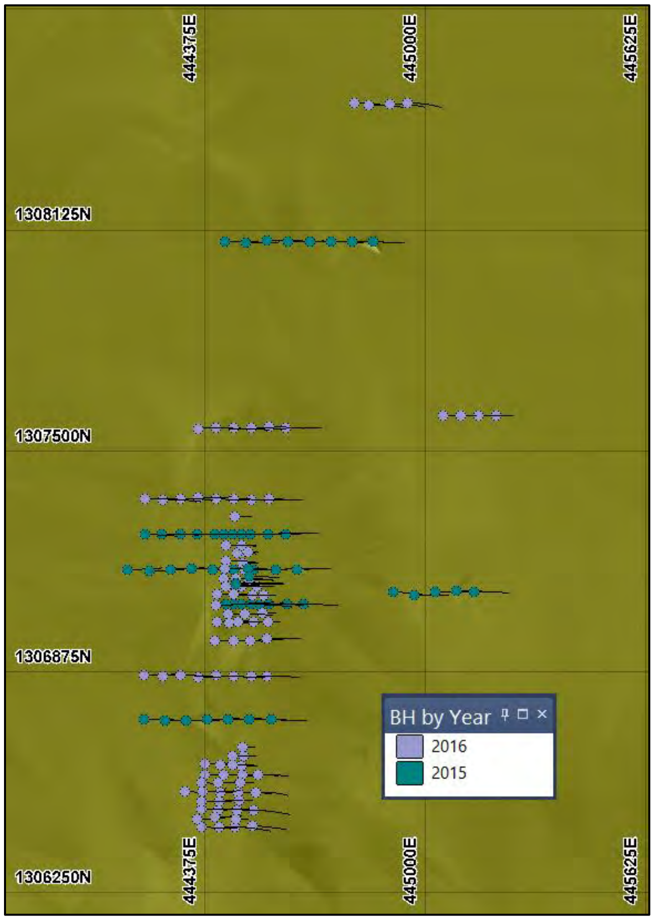


14.1.3 Yama Database

The Yama drill hole database contains 149 holes and trenches totaling 20,736 m, which consists of four trenches, one core hole, 138 RC holes, and six MP holes. There is a total of 20,254 assay intervals totaling 20,161 m, with intervals averaging 1 m in length.

Holes are distributed over an area 1.04 km by 2.05 km from 444,157E/1,306,435N to 445,199E/1,308,485N in the UTM reference system (see Figure 14.3). Holes are drilled on 25 m spacing on east-west sections over two mineralized sectors, i.e., Yama North from 1,307,015N to 1,307,365N and Yama South from 1,306,435N to 1,306,635N. Between sectors, drilling is on a maximum of 100 m spacing. Drill holes are generally 50 m apart on section.

Figure 14.3
Drill Hole Location Map at Yama over Digital Terrain Model

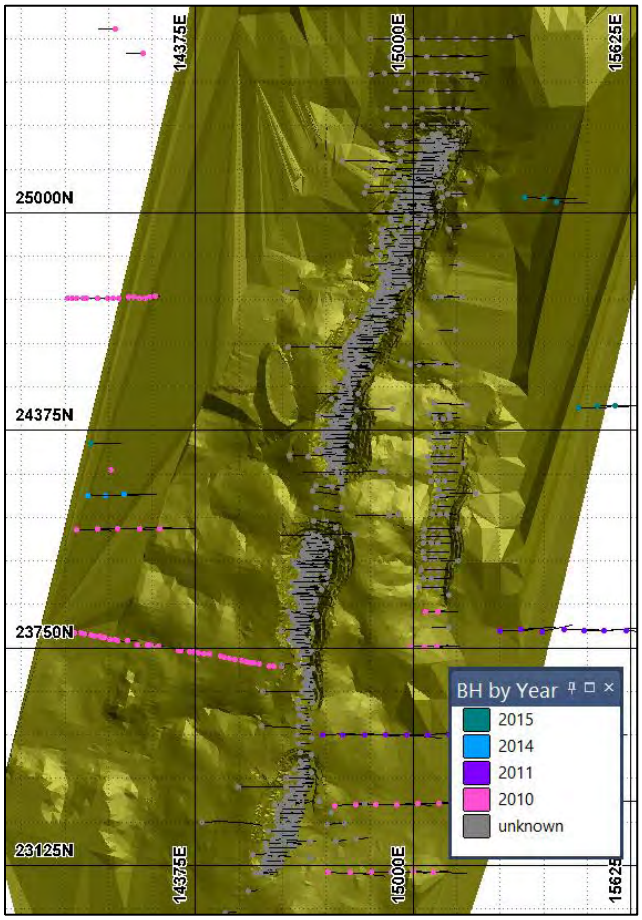


14.1.4 Nyafé-Filon67 Database

The Nyafé-F67 drill hole database contains 1,229 holes and trenches totaling 82,114 m, which comprises 79 trenches, 44 core holes, 1,022 RC holes, 82 AC holes and two shallow (3 m) wells. There is a total of 73,912 assay intervals totaling 77,183 m, with intervals averaging 1 m in length.

Holes are distributed over an area 1.96 km by 3.03 km from 14,006E/22,500N to 15,970E/25,529N in the local coordinate system with a north-south axis corresponding to the southwest-northeast axis of the regular UTM system (see Figure 14.4). At Nyafé, holes are drilled on 12.5 m spacing on east-west sections over three mineralized sectors, i.e., Nyafé North from 24,250N to 25,225N, Nyafé Centre from 23,600N to 24,075N and Nyafé South from 23,100N to 23,425N. Between sectors and to the north, drilling is on a maximum of 50 m spacing sections. Over Filon67, RC holes are on 25 m spacing on east-west sections from 23,925N to 24,425N.

Figure 14.4
Drill Hole Location Map at Nyafé and Filon 67 over Digital Terrain Model



Note: Definition drilling over the deposit was done pre-2010.

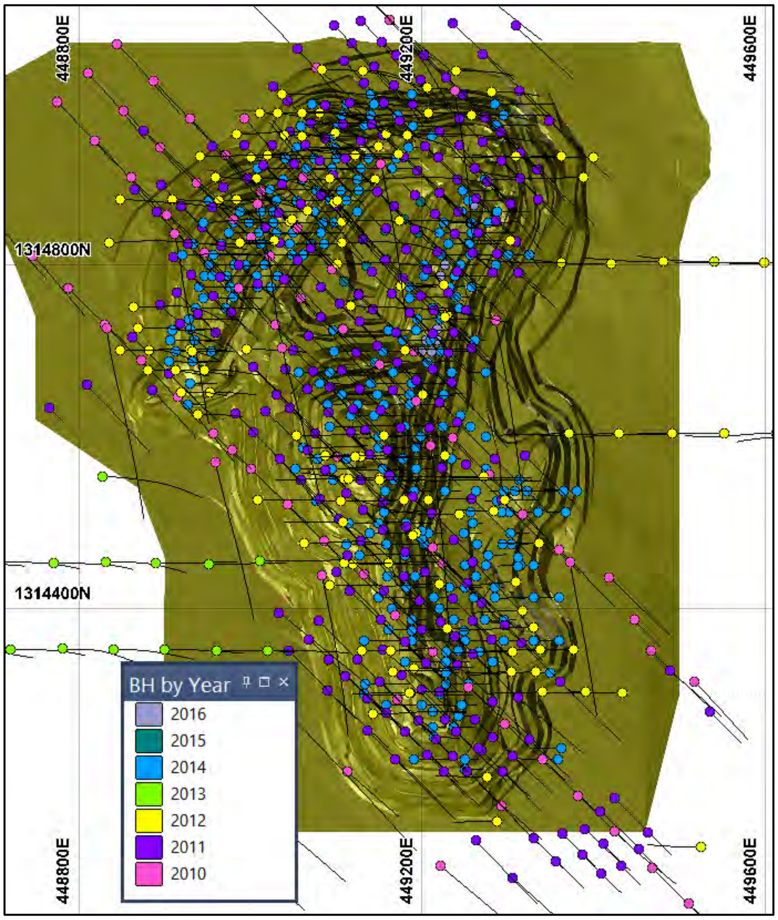
14.1.5 Fofina Database

The Fofina drill hole database contains 933 drill holes totaling 104,245 m consisting of 822 RC holes, 38 core holes, 57 AC holes and 16 trenches. There are 103,299 samples taken over 103,068 m of drilling, averaging 1 m in length.

Fofina holes cover an area of 1.58 km by 1.97 km zone from 448,403E/1,313,612N to 449,985E/1,315,580N in the UTM reference system (see Figure 14.5). Holes were drilled in two main directions. The 2010 and 2011 RC holes were drilled on northwest-southeast sections spaced at 25 m, spaced 25 m on section. Most holes have a dip of -50°. From 2012, RC holes were drilled either east- or west-dipping at -50° on 25 m sections, generally spaced at 25 m on sections.

Early Fofina core holes (WDC236 to 258) were drilled at -50° to N170 (almost south) on 100-150 m spaced north-northwest to south-southeast sections. Core holes WDC271 to 469 were drilled to the southeast and core holes WDC470 to 508 were drilled at N090 (almost east) with 25 m spacing.

Figure 14.5
Drill Hole Location Map at Fofina over Digital Terrain Model

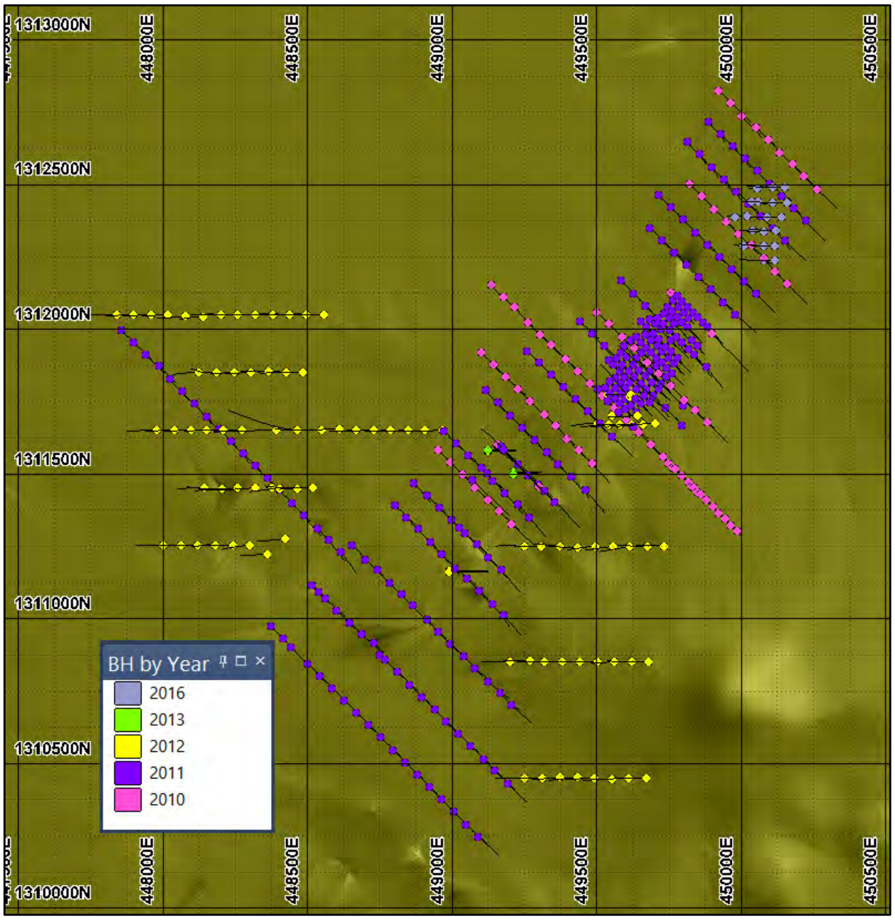


14.1.6 Fobiri Database

The Fobiri database contains 461 holes totaling 68,298 m. The drill hole database contains 16 AC holes, 425 RC holes, 10 core holes and 10 trenches. There is a total of 67,994 assay intervals totaling 67,869 m with intervals averaging 1 m in length.

Fobiri holes cover a 2.42 km by 2.58 km zone from 447,842E/1,310,248N to 450,260E/1,312,825N in the UTM reference system (see Figure 14.6). Holes were generally drilled on northwest-southeast sections dipping at 50° to the southeast. Spacing between lines started at 200 m (end of 2010), reduced to 100 m (a 2 km strike length) and down to 25 m in the area designated for mining (strike length of 450 m). Spacing between holes on the 100 m sections is generally 50 m, reduced to 25 m for holes on sections at 25 m spacing. Some RC holes were drilled on east-west sections to provide better understanding of the geometry of the mineralization.

Figure 14.6
Drill Hole Location Map at Fobiri over Digital Terrain Model

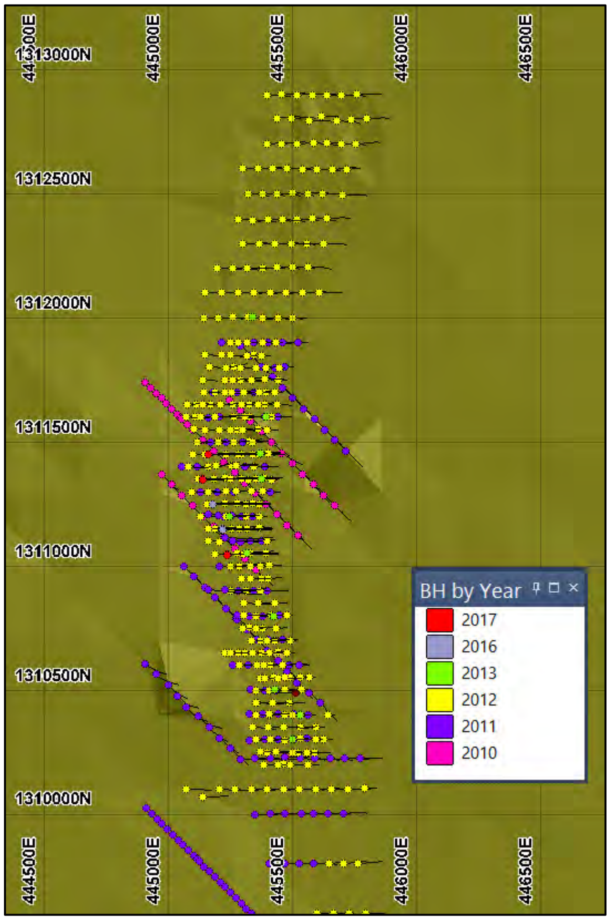


14.1.7 Yaho Database

The Yaho area is covered by 515 holes totaling 65,246 m. The database consists of 41 AC holes, 433 RC holes, 30 core holes and 11 trenches. A total of 64,528 assay intervals totaling 64,444 m with assay intervals averaging 1 m in length.

Yaho holes cover a 0.89 km by 3.49 km zone from 444,907E/1,309,409N to 445,798E/1,312,902N in the UTM reference system (see Figure 14.7). Most holes are drilled 50° to the east on 50 m spaced east-west sections over a north-south strike length of about 1,750 m (35 sections from 1,310,200N to 1,311,900N). On those sections, holes are generally spaced at 50 m. There are ten 100-m east-west sections to the north. Additional RC holes were drilled on six northwest-southeast sections (as at Fofina and Fobiri), generally separated by 200 m. On those oblique sections, holes are generally 60 m apart dipping 50° to the southeast.

Figure 14.7
Drill Hole Location Map at Yaho over Digital Terrain Model

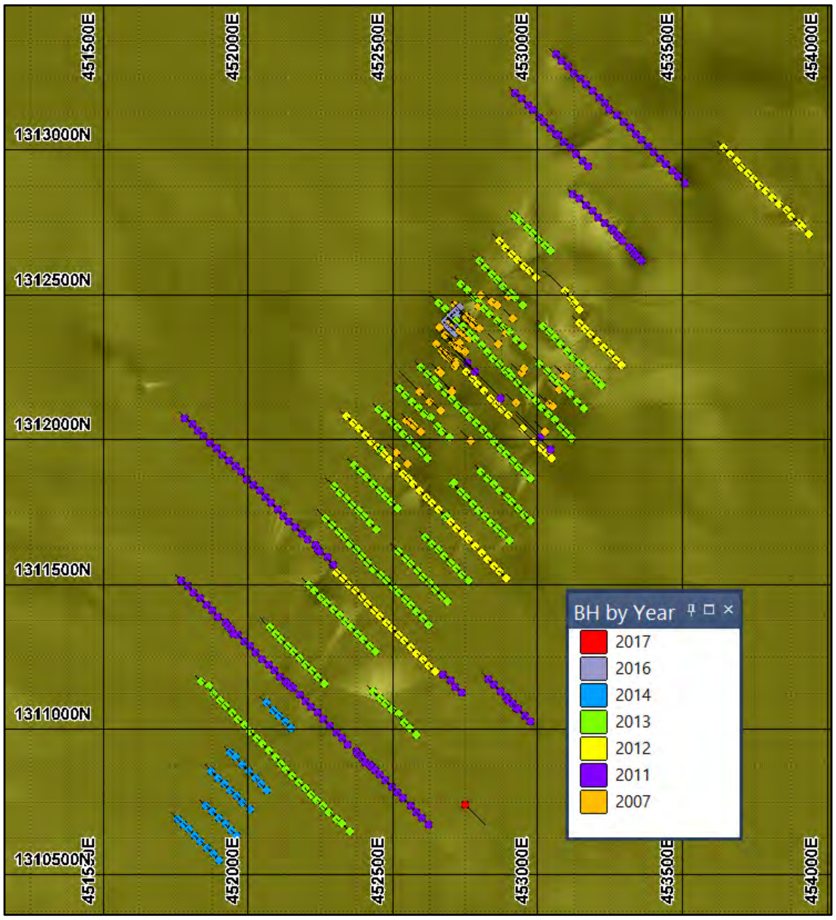


14.1.8 Maoula Database

Maoula drill hole database contains 585 holes and trenches totaling 34,198 m consisting of six DD holes, 391 RC holes, 141 AC holes and 47 trenches. Twenty-nine trenches were used for the geological modelling but were excluded from the resource estimation due to the availability of drill hole data. There are 34,039 assay intervals totaling 33,845 m, averaging 1 m in length.

Maoula holes and trenches cover an area 2.18 km by 2.78 km from 451,756E/1,310,549N to 453,937E/1,313,328N in the UTM coordinate system (see Figure 14.8). Holes are mostly drilled at N315 plunging -50° to the northwest and trenches are on 10 northwest-southeast sections. Spacing between sections is generally 50 m, extending for 800 m. Southwest and northeast extensions are covered by sections at 100 m and 200 m spacing. Drill hole spacing along sections is variable.

Figure 14.8
Drill Hole Location Map at Maoula over Digital Terrain Model



14.2 GEOLOGICAL MODELLING

Outlines of mineralized envelopes (i.e., wireframes) are interpreted from drill hole assay data on section and plan views using 0.3 to 0.5 g/t Au cut-off grades applied to original (i.e., generally 1 m) assay intervals to delineate mineralized material. Some internal waste material may be included to provide continuity of the mineralized envelopes between sections. Interpreted sectional outlines are connected through tie-lines to create mineralized solids. Mineralized intervals are generated from each hole crossing a mineralized solid to ensure that wireframes are snapped properly.

Subhorizontal alteration and oxidation surfaces are interpreted to divide the mineralized solids into various facies. The lateritic profile is very similar to the oxidation profile and generally consists of a hard-metallic cap below with extends a lateritic horizon (dubbed ATB clay) which may be locally mineralized. Between 20 to 40 m below that top surface, there is the saprolite/saprock contact surface and about 5 to 15 m below that is the saprock/fresh rock contact surface. Contacts are rather flat in most deposits, except at Nyafé where they are highly irregular with frequent deep pockets of saprolite and saprock extending into bedrock around mineralized intercepts. The depth of those contacts is derived from descriptions along drill holes and the corresponding control points are connected through a 3D model. The modelling of contact surfaces are essentially generated on individual east-west sections from holes within the section corridors; modelled surfaces may change abruptly from one section to the next. This indicates that the interpreted contact surfaces may carry uncertainty. The main potential influence of interpreted contact surfaces on estimated resources is on tonnage (and metal content), because of the differences in density of the different horizons.

Descriptions of the approach to geological modelling are given below for Wona-Kona, Siou and Yama.

14.2.1 Wona-Kona Modelling

A complete re-interpretation of the previous model was done in 2015 to account for observations gained from the mining operations. Isolated structures were regrouped which led to a substantial reduction in the number of different mineralized solids. The Wona-Kona deposit is now made up of nine different parallel structures (see Figure 14.9 and Figure 14.10). Note that some of the structures on these figures are not discernable due to the small scale.

The main zone at Wona-Kona, which contains most of the remaining resources is Zone 11. It extends over almost the entire deposit, from the extreme south of Wona to half way through Kona (section 14,240N to 18,300N). Zone 8 is limited to the Wona portion of the deposit and extends from section 14,140N to 16,330N. Finally, Zone 3 is mostly observed to the north in the Kona portion of the deposit and extends from 17,500N to 19,000N.

14.2.2 Siou Modelling

The Siou deposit is made of eight mineralized structures (namely, Zones 9, 17, 18, 20, 25 Siou, 55, 56 and 57) extending over a distance of 2 km with an average north-northeast to south-southwesterly strike and dipping 45° to 60° to the east (see Figure 14.11 and Figure 14.12). The main structures are Zones 9, 25, 55 and 56 but are not easily discernable on the figures due to the small scale.

Mineralized structure Zone 9 straddles the contact between the sediments and the intrusive. It generally dips 40-45° to the east, increasing to 60° as it approaches the surface. True thickness varies between 0.5 and 13.6 m, averaging 3.1 m. The structure is mainly characterized by a stockwork of relatively thin quartz veinlets. Zone 25 is a massive, continuous quartz vein averaging 4.2 m in true thickness. It is located within the intrusive and dips 40-45° to the east. Locally it is in contact with the basalts. Mineralized structures Zones 55, 56 and 57 occur as a conjugate shear vein system between Zones 9 and 25. Average true thickness varies between 1.7 m and 1.9 m.

Figure 14.9
Plan View and Longitudinal Views of the Main Zones at Wona-Kona

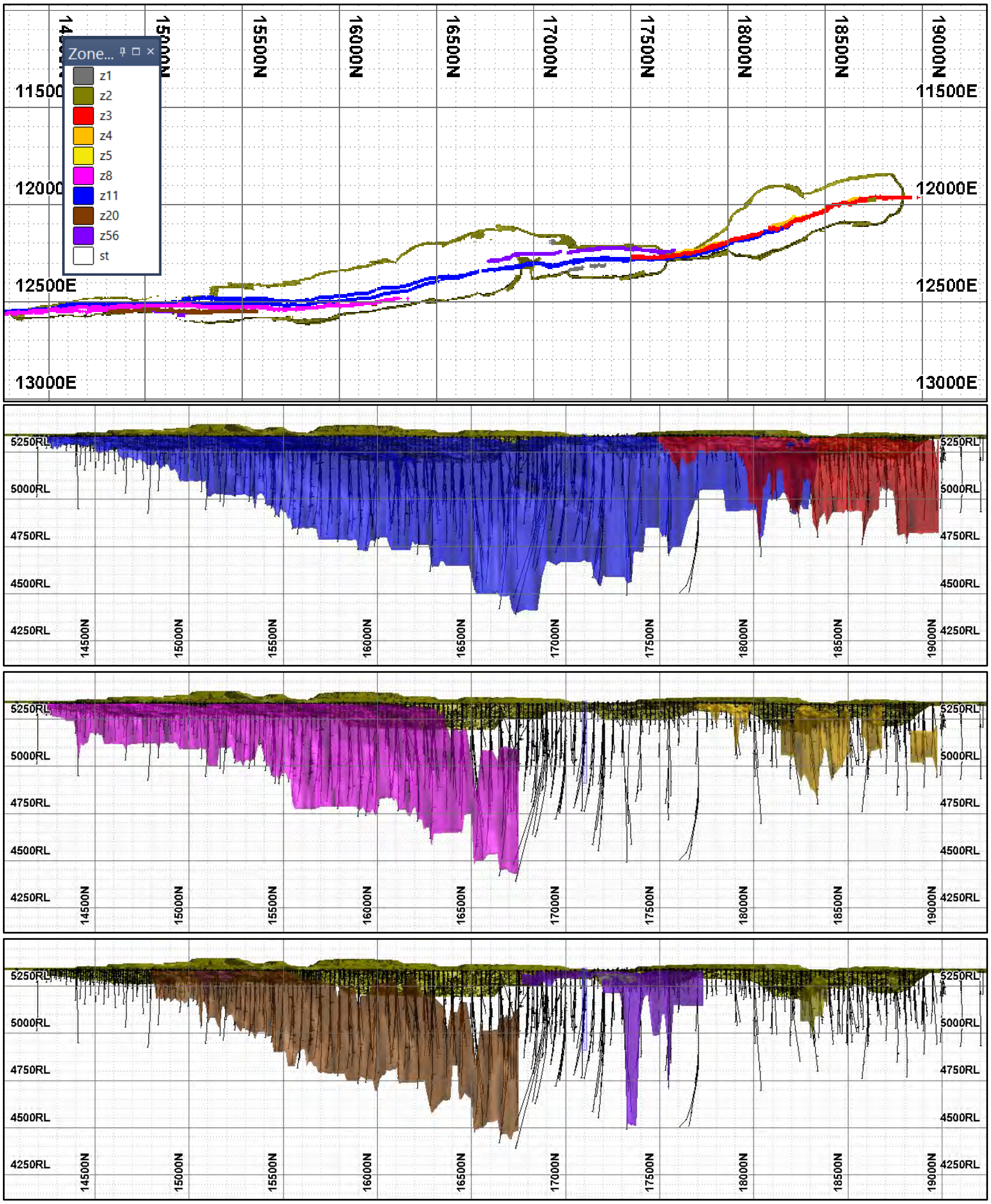
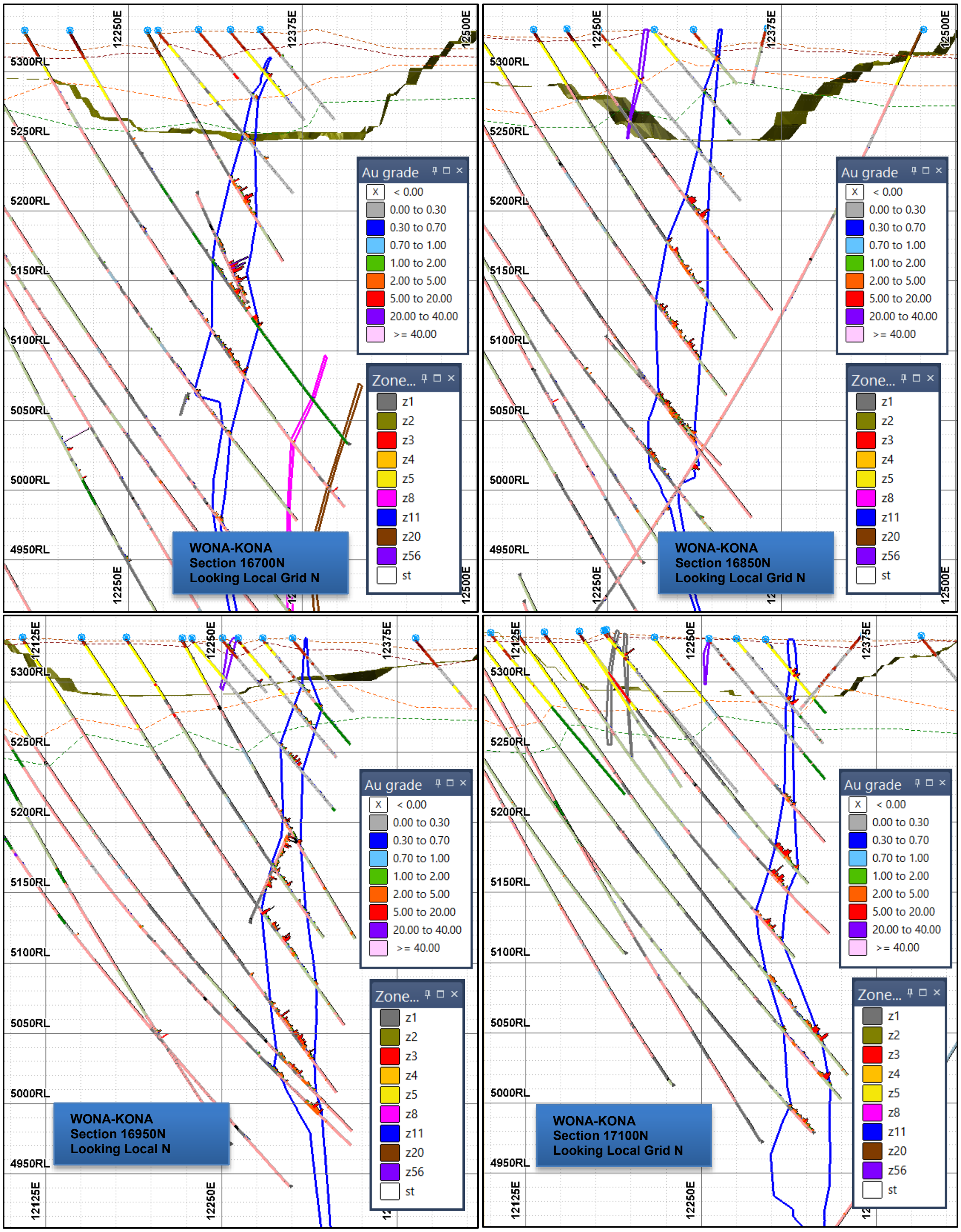


Figure 14.10
Wona-Kona E-W Drill Sections with Interpreted Mineralized Solids



Sections show surfaces for topo as of December, 2017 (green), bottom of the iron cap (brown), top clay ATB unit (dark red), saprolite/saprock (orange) and saprock/bedrock (dark green).

Figure 14.11
Plan View and Longitudinal Views of the Main Mineralized Zones at Siou

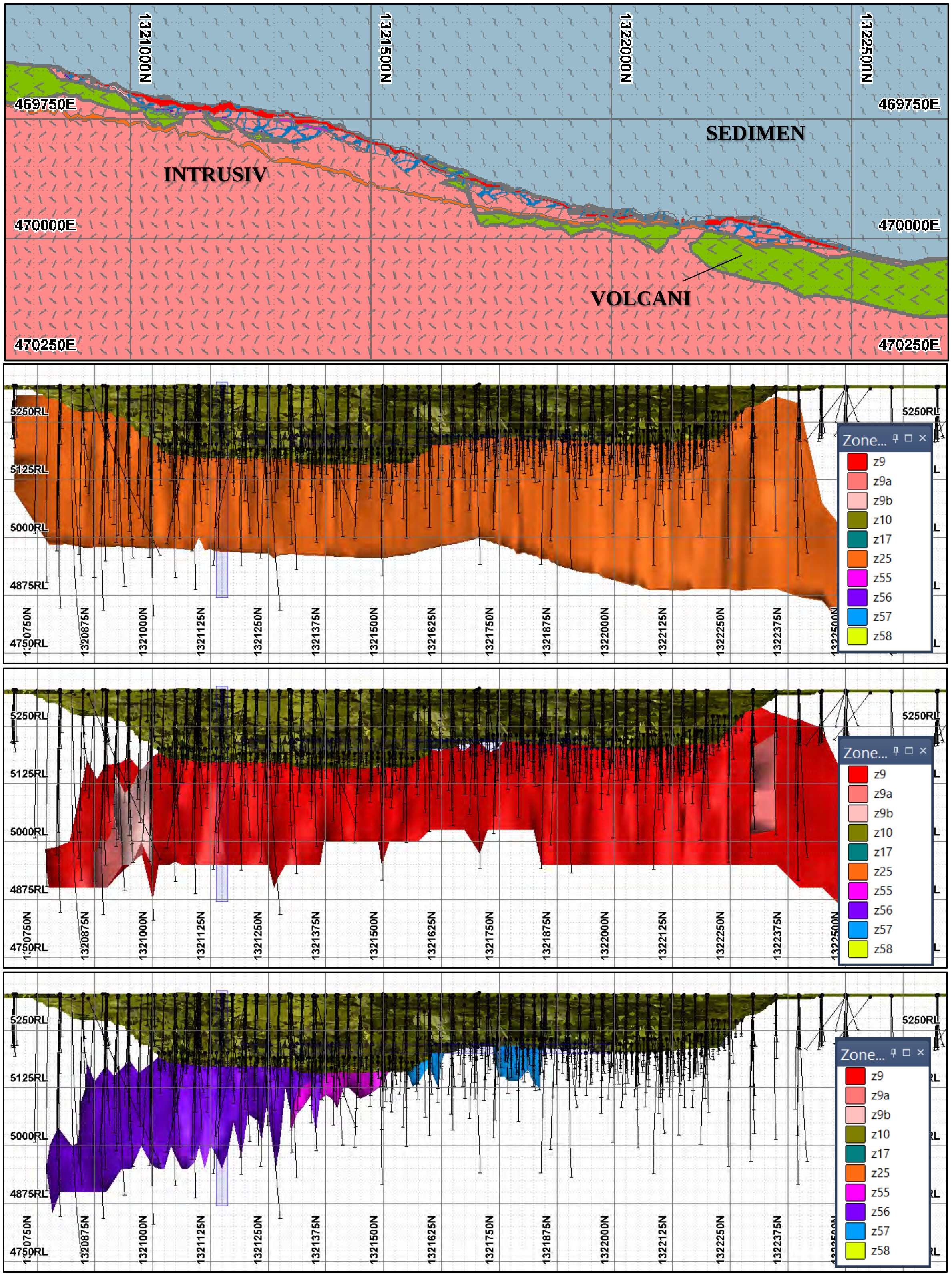
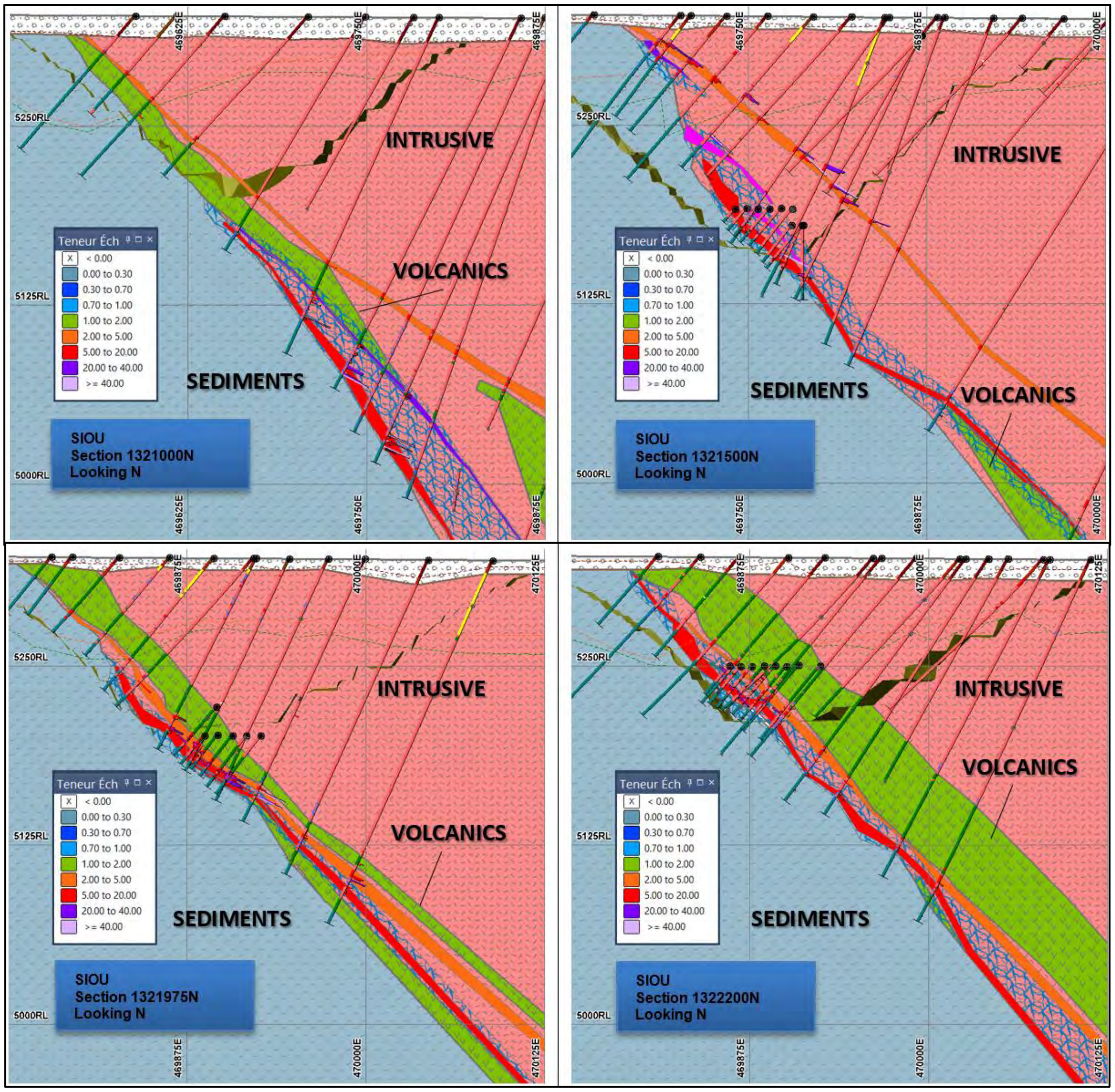


Figure 14.12
Interpreted Mineralized Structures of Siou on Selected Drill Sections

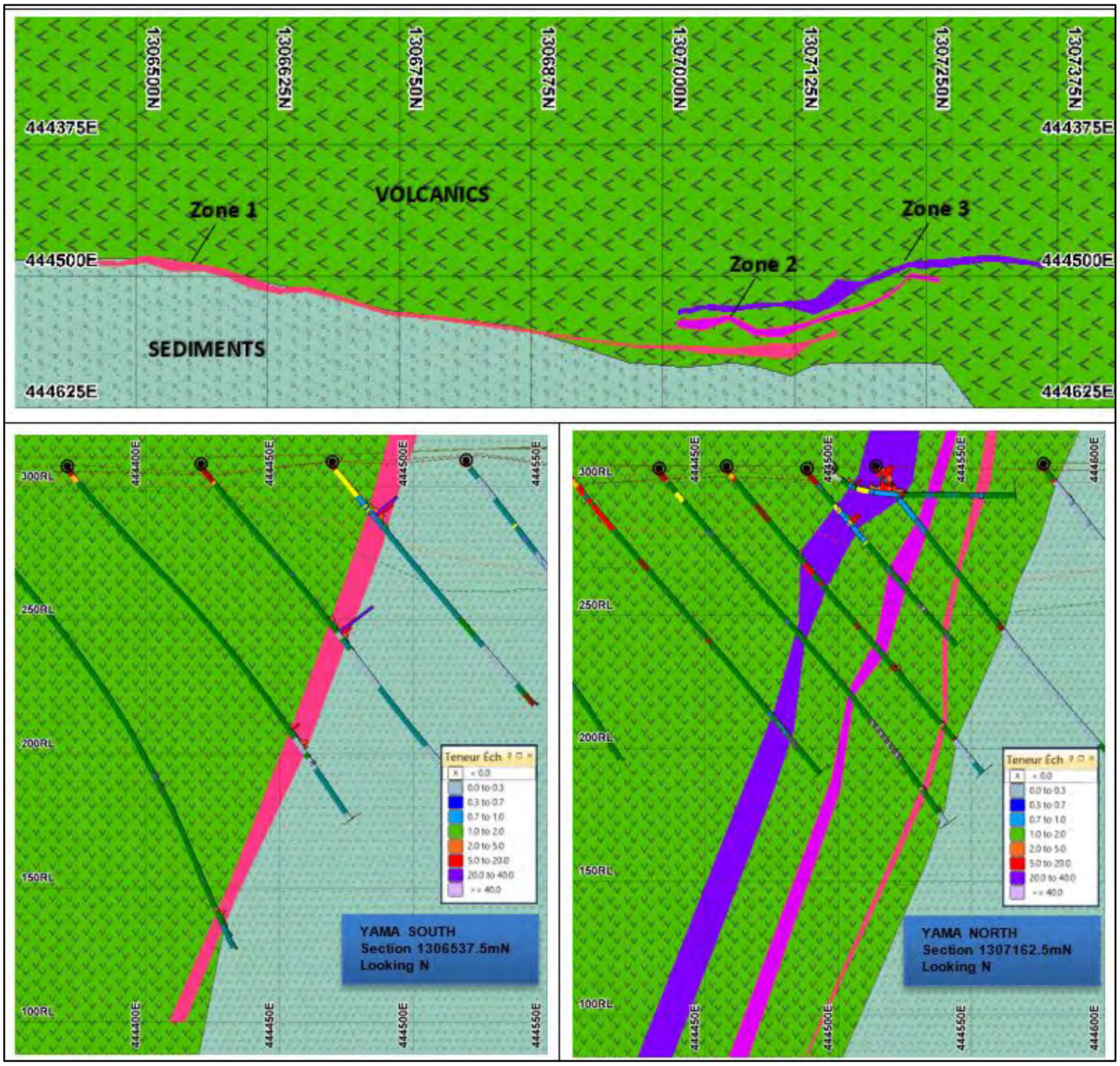


Sections show surfaces for topo as of December, 2017 (green), bottom of the iron cap (brown), top clay ATB unit (dark red), saprolite/saprock (orange) and saprock/bedrock (dark green).

14.2.3 Yama Modelling

The Yama deposit is subdivided in two areas, namely North and South. Mineralization occurs mainly at the contact between the sediments and the volcanics within the southern area, extending to the north where it shifts progressively within the volcanic pile. Two additional mineralized zones appear in the volcanics but only in the northern area. The three parallel zones generally dip strongly to the west along a general north-south trend (see Figure 14.13).

Figure 14.13
Interpreted Mineralized Structures of Yama on a Selected Drill Sections



Sections show surfaces for surface topo (green), bottom of the iron cap (brown), top clay ATB unit (dark red), saprolite/saprock (orange) and saprock/bedrock (dark green).

14.3 BLOCK MODEL AND DENSITY DISTRIBUTION

Mineralized solids are filled with blocks on a regular grid parallel to the coordinate axes of the local or UTM reference system. In most cases, blocks are split into smaller sub-blocks to account for the complexities of the solid geometry and contact surfaces. Blocks can be split in four along the Y and Z axes. Minimum sub-block thickness (along the X axis) can be as low as a few millimetres.

Parent block size varies from deposit to deposit to reflect mining parameters (mining bench height), drill hole spacing and the mineralized envelope geometry. The selected block size along the X, Y and Z axes of the local or UTM grids are as follow:

- Wona-Kona: 5 m by 5 m by 5 m.
- Siou: 2.5 m by 5 m by 5 m.
- Nyafé: 10 m by 10 m by 10 m.
- Fofina: 5 m by 5 m by 5 m.
- F67: 10 by 10 by 3.33 m.
- Yama: 5 m by 5 m by 2.5 m.
- Yaho: 5 m by 5 m by 5 m.
- Fobiri: 5 m by 5 m by 5 m.
- Maoula: 10 m by 10 m by 5 m.

The bulk density of each block or sub-block is assigned based on the ore type of the block or sub-block (hence its position with respect to the interpreted contact surfaces between ore types). The density used for the resources and reserves reported herein, as summarized in Table 14.1, are supported by extensive sets of density measurements on core samples in the Wona-Kona, Siou, Yama and Nyafé deposits, as well as metallurgical studies for Fofina, Fobiri and Yaho.

Table 14.1
Mana Densities by Deposit and by Mineralization Types
(t/m^3)

Facies	Wona-Kona	Siou[1]	Fofina	Nyafé/F67	Yama	Yaho	Fobiri	Maoula
Iron cap	2.3		2.3		2.3	2.3	2.3	2.3
Laterite	1.9		1.9		1.9	1.9	1.9	
Saprolite/Oxide	2.3		2.35	2.4	2.30	2.35	2.35	2.3
Saprock/Transitional	2.4		2.6		2.40	2.6	2.6	2.4
Bedrock/Sulphide	2.85		2.87	2.8	2.75	2.87	2.87	2.85

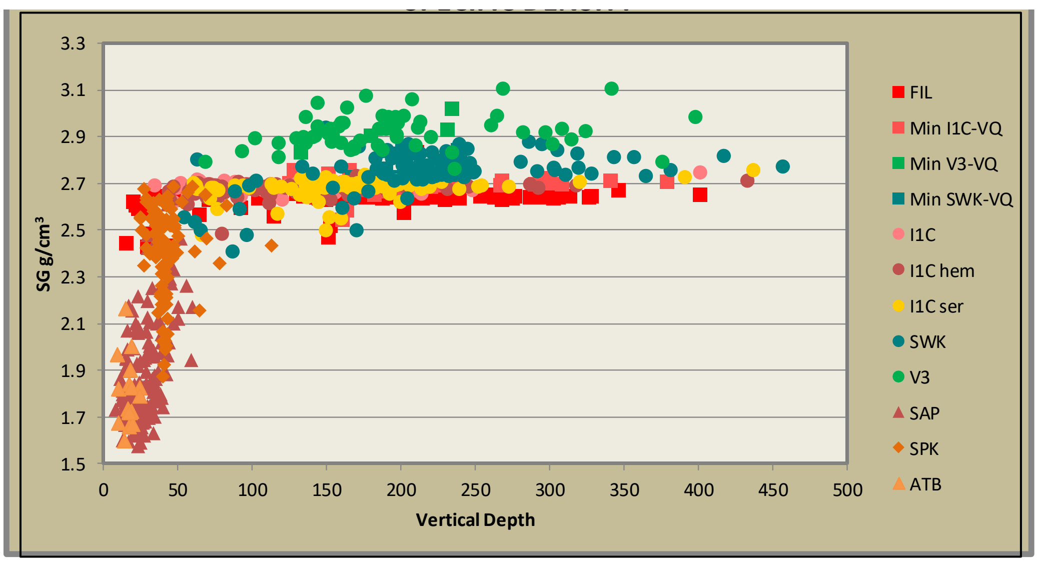
[1] See Table 14.2 and discussion in text below.

An extensive SG measurement program was undertaken at Siou in 2013 and 2014. Data were collected throughout the lateritic profile for the different lithologies. Table 14.2 summarizes the results for the various rock facies at different level of alteration and Figure 14.14 illustrates the relationship between the specific gravity with depth. The graph shows that the specific gravity increases through the weathering profile and becomes homogeneous within the fresh zone. The graph also highlights the constant specific gravity of the quartz veins that host the mineralization at Siou. Therefore, for Zones 25, 55 and 56, a constant 2.65 t/m^3 value was assigned in the resource model for all alteration facies since quartz veining is only slightly affected by the weathering process. For all the other zones, a value of 2.70 t/m^3 was applied.

Table 14.2
Specific Gravity Results for Siou Deposit

Litho Code	Count	Mean	Min	Max	S.D.
FIL	116	2.64	2.43	2.83	0.048
Min I1C-VQ	55	2.70	2.54	2.76	0.036
Min SWK-VQ	14	2.82	2.71	2.96	0.067
Min V3-VQ	6	2.86	2.66	3.02	0.120
ATB	18	1.80	1.60	2.16	0.141
SAP-I1C	131	1.85	1.58	2.64	0.178
SAP-SWK	13	2.26	2.00	2.48	0.142
SAP-V3	5	2.03	1.78	2.61	0.336
SPK-I1C	90	2.41	1.49	2.69	0.210
SPK-SWK	8	2.54	2.35	2.69	0.135
SPK-V3	1	2.16	2.16	2.16	
BDK-SWK	92	2.75	2.41	2.94	0.092
BDK-V3	62	2.92	2.76	3.11	0.072
BDK-I1C	244	2.68	2.48	2.77	0.035

Figure 14.14
Specific Gravity Against Vertical Depth for Siou Deposit



14.4 Samples in Mineral Zones and Capping

Wireframes of the mineralized envelopes are first filled with blocks or sub-blocks of the resource model, then samples that may influence the grade of those blocks are selected. Block or sub-block grades within a specific mineralized solid can only be interpolated from the grade of samples contained in that same solid, if they are close enough. In narrow solids, like those used to model some of the mineralized structures of Mana, it is important to check that 1) all valid samples within interpreted mineralized intercepts are selected (un-selected samples are excluded from the interpolation) and 2) all samples, including low or zero grade samples, are also selected within the mineralized intercepts (a revised interpretation of the mineralized boundaries may be needed if there are too many of them). The selected samples are then capped to limit the influence of some of the extreme grade values. Finally, the original samples are transformed into fixed length composites before they are used in block grade interpolation.

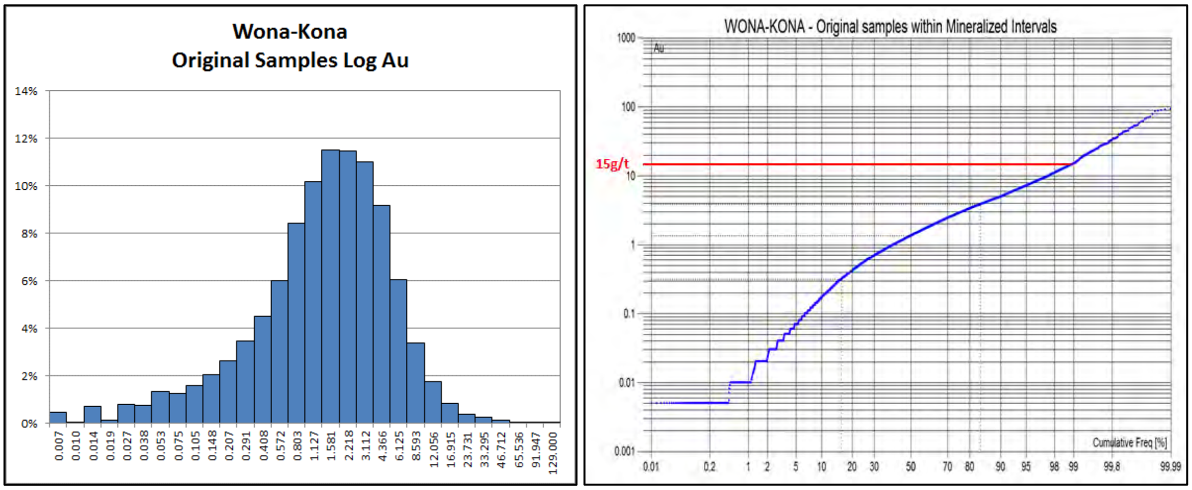
Table 14.3 shows statistics of original assays before and after capping within mineralized intercepts for the different deposits. Total length represents the sum of assayed intervals within the mineralized intercepts, which can be slightly different from the total length of mineralized intercepts due to lost core or missing assays.

In the Wona-Kona deposit, there are 2,858 intercepts of drill holes within the mineralized solids totalling 28,694 m, averaging 10.04 m per intercept. The 29,108 original assay samples within those mineralized intercepts have gold values ranging from 0.01 g/t Au to 129 g/t Au. The total length of intercepts (28,425 m) illustrates that most of those assay intervals are 1 m long although, in the core holes, the high-grade intervals tend to be shorter. Statistics of the reported grade of those assay intervals are shown in Table 14.3. A capping of 15 g/t Au was applied to the original data before using them in block grade interpolation as some very high-grade samples were intercepted in some of the ore zones (see Figure 14.15 for Wona-Kona). This value caps the grade of 0.98% of the samples and reduces the total gold quantity by approximately 5.5%.

Table 14.3
Gold Grade Statistics for Assay Intervals Within Mana Deposit Mineralized Intercepts

Sector	Number of samples	Total Length (m)	Average Grade (g/t Au)	Gold Cap Limit (g/t Au)	Average Capped Grade (g/t Au)	Percentage Capped	Percentage Gold Lost
Wona-Kona	29,108	28,424.8	2.30	15	2.17	0.98	-5.5
Siou	19,521	18,580.21	4.53	40	3.83	2.55	-15.6
Yama	1,028	994.85	1.56	15	1.47	0.68	-5.6
Fofina (V1-V7)	4,086	4,265.50	3.83	30	3.53	1.59	-1.6
Fofina (Principal)	5,236	4,949.80	1.76	30	1.69	0.4	-3.9
Nyafé	4,229	4,239.4	6.54	30	6.29	2.6	-3.5
F67	261	261.0	3.22	15	3.02	3.0	-6.0
Fobiri	1,753	1,724.6	1.07	12	1.05	0.2	-2.1
Yaho	18,733	18,700.8	0.69	10	0.68	0.14	-1.3
Maoula	1,279	1,275.4	1.35	10	1.27	1.25	-5.8
All	**85,234**						

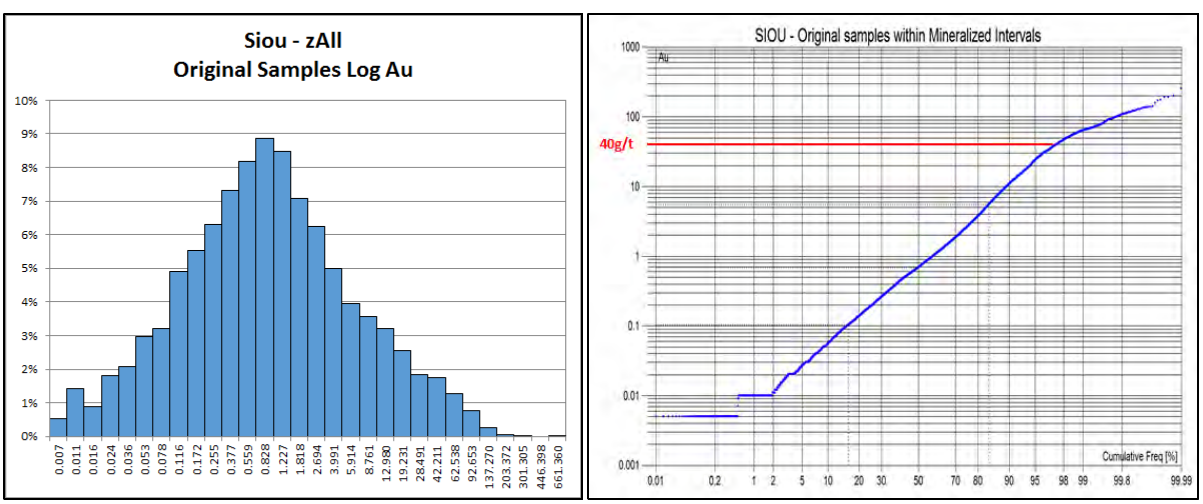
Figure 14.15
Cumulative Frequency Plot of Assay Samples at Wona-Kona



Horizontal axis shows % sample below a grade limit on the vertical axis (with a log scale).

At Siou, an updated interpretation was completed in 2017 to account for new data at depth and grade control RC drilling. The mineralized envelopes were also adjusted to the channel samples and bench mapping. Therefore, production data superseded drill hole data in the upper levels of the pit. There are 19,521 original assay intervals within the 3,707 hole intercepts (i.e., exploration and grade control holes, channel sampling) within the mineralized solids (see Table 14.3, above). Their gold values range from 0.01 g/t Au to 661.36 g/t Au with an average of 4.53 g/t Au. Total length of the mineralized intercepts totals 18,580.21 m, averaging 5.01 m. A 40 g/t Au cap limit has been applied to all zones, capping 2.55% of the samples and reducing the total gold quantity by 15.6% (see Figure 14.16).

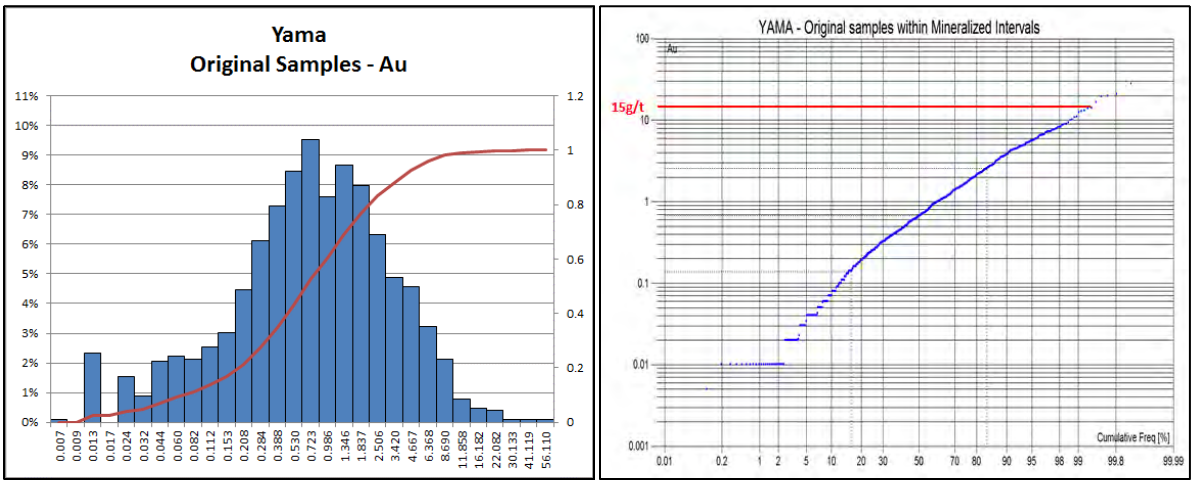
Figure 14.16
Cumulative Frequency Plot of Assay Samples at Siou



Horizontal axis shows % sample below a grade limit on the vertical axis (with a log scale).

At Yama, there are 1,028 original assay intervals within the 161 hole intercepts within the mineralized solids (see Table 14.3, above). Their gold values range from 0.01 g/t Au to 56.11 g/t Au with an average of 1.56 g/t Au. Total length of the mineralized intercepts totals 994.85 m, averaging 6.18 m. A 15 g/t Au cap limit has been applied to all zones, capping 0.68% of the samples and reducing the total gold quantity by 5.6% (see Figure 14.17).

Figure 14.17
Cumulative Frequency Plot of Assay Samples at Yama



Horizontal axis shows % sample below a grade limit on the vertical axis (with a log scale).

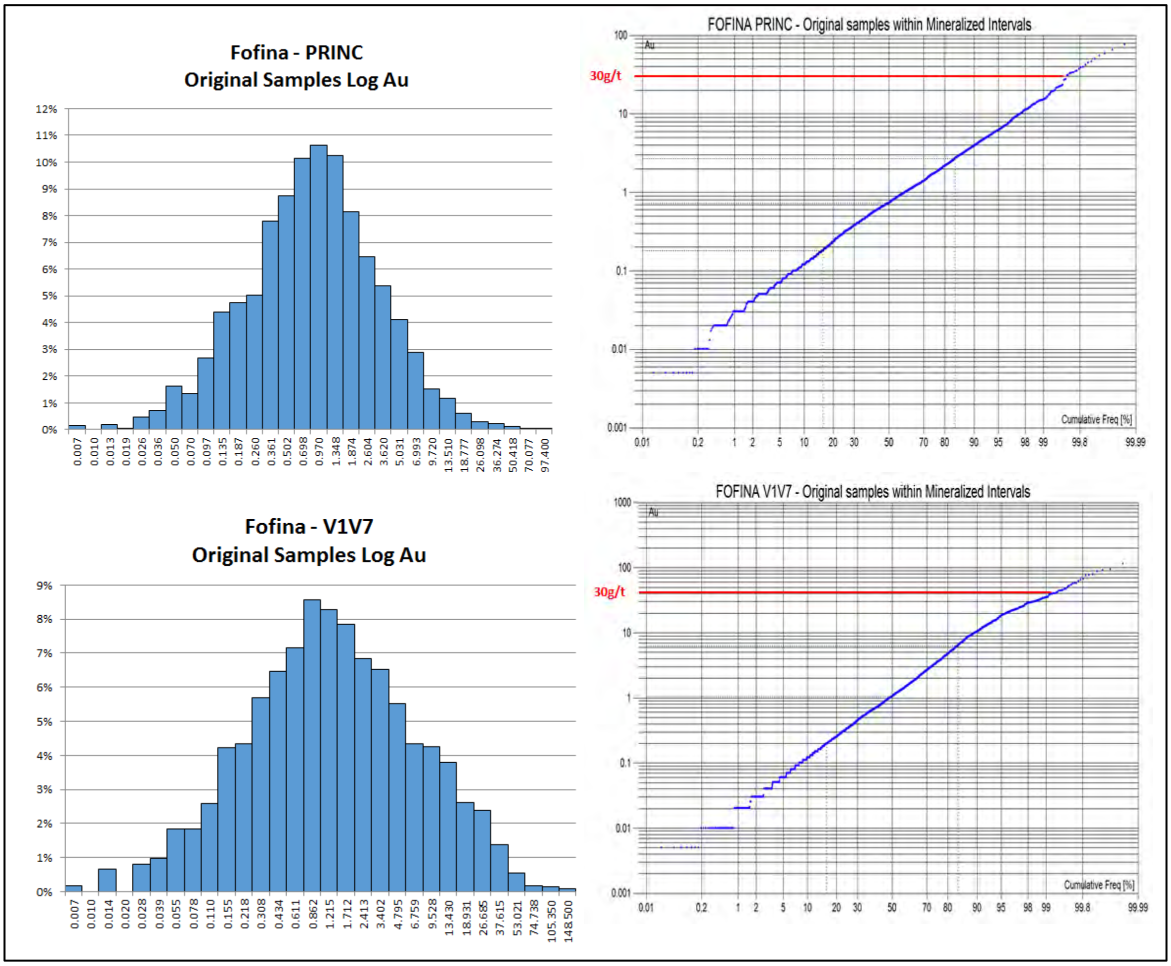
At Fofina, there are 9,322 original assay samples within the 1,992 hole intercepts within the mineralized solids (see Table 14.3, above). Their gold values range from 0.01 g/t Au to 148.5 g/t Au averaging 2.80 g/t Au. A 30 g/t Au cap limit has been applied to the Zone V1-V7 sector; it caps 65 samples (1.59%) while reducing the total gold quantity by 6.1%. A 30 g/t Au cap has been applied to the Principal Zone sector; it caps 21 samples (0.40%) while reducing the total gold quantity by 3.9% (see Figure 14.18).

At Yaho, there are 1,093 mineralized intercepts totalling 18,737 m (see Table 14.3, above). Within those intercepts, 18,733 samples totalling 18,701 m have a grade from 0.0005 g/t Au to 76.4 g/t Au, averaging 0.689 g/t Au. The cap is 10 g/t Au. It limits only 26 samples and only 1.3% of the gold metal.

At Maoula, there are 1,279 assay intervals in the 394 intercepts of holes and trenches within the mineralized solids (see Table 14.3, above). The reported gold grades range from 0.01 g/t Au to 49.25 g/t Au and average 1.35 g/t Au. The length of the mineralized intercepts totals 1,311.40 m, averaging 3.33 m. Capping the 16 intervals above 10 g/t Au eliminates 5.8% of the gold.

In Nyafé, there are 4,239 original assay intervals within the 1,237 intercepts of holes and trenches within the mineralized solids (see Table 14.3, above). Gold values range from 0.01 g/t Au to 74.84 g/t Au and average 6.54 g/t Au. At Nyafé, a 30 g/t Au limit caps 2.6% of the samples and eliminates 3.5% of the gold metal.

Figure 14.18
Cumulative Frequency Plot of Assay Samples in Fofina for Principal (top) and V1-V7 (bottom)



Horizontal axis shows % sample below a grade limit on the vertical axis (with a log scale).

At Filon 67, the capping limit is the same as at Wona-Kona and is set at 15 g/t Au. There are 261 1-m assay intervals within the mineralized solids with grades from 0.01 g/t Au to 36.5 g/t Au, averaging 3.22 g/t Au. It caps 3% of samples and 6% of the gold metal.

At Fobiri, the 291 mineralized intercepts comprise 1,753 assay intervals totalling 1,725 m with gold values from 0.01 to 46.5 g/t (see Table 14.3, above). The cap limit is 12 g/t Au. Capping affects only three samples and 2.1% of the gold metal.

Altogether, the Mana resources at the end of 2017 are derived from 85,234 assay intervals totalling 83,416 m and averaging 2.50 g/t Au after capping. Capping eliminates 5.1% of the gold (see Table 14.3, above).

14.5 COMPOSITING AND GEOSTATISTICAL ANALYSIS

Prior to grade interpolation, capped assay intervals within mineralized intercepts were composited into 2-m intervals for Wona-Kona, Nyafé, Fobiri and Yaho and 1-m intervals for F67, Fofina, Siou, Yama and Maoula. The average gold grade of nearby sub-blocks was estimated from only nearby composites included in the same mineralized envelope. Compositing standardizes the length of assay intervals within the mineralized intercepts. The composite length is selected to reflect the average width (along the X axis) of blocks being interpolated. Thus, blocks can be interpolated from composites having a length that compares with the intercept length of an inclined hole within a block. This ensures that block grades will include some of the dilution of the drill hole intercepts within blocks and that the estimates above cut-off are realistic. Datamine adjusts the length of composites to the length of mineralized intercepts.

The composite lengths are summarized as follow:

- Wona-Kona: 14,951 composites range from 1 m to 3 m with a mean of 1.92 m.
- Siou: 18,632 composites range from 0.75 m to 1.5 m with an average of 0.995 m.
- Yama: 997 composites range from 0.833 m to 1.225 m with an average of 0.998 m.
- Fofina Principal: 5,183 composites range from 0.61 m to 1.1 m, averaging 1.0 m.
- Fofina V1-V7: 4,077 composites range from 0.75 m to 1.4 metre, averaging 1.0 m.
- Nyafé: 2,563 composites range from 1 m to 2.5 m averaging 1.7 m.
- F67: 222 1-m composites.
- Fobiri: 1,098 composites range from 1.0 m to 2.5 m with an average of 1.83 m.
- Yaho: 9650 composites range from 1 m to 2.6 m, with an average of 1.94 m.
- Maoula: 1,620 composites range from 0.9 m to 1.2 m with an average of 1 m.

Statistics of the capped composite grades are shown in Table 14.4. In Wona-Kona and Nyafé, the average composite grade is slightly less than the average sample capped grade reflecting the fact that thin intercepts with short composites (i.e., 1 m) are generally of lower grade than thicker intercepts with standard 2 m composites.

Table 14.4
Statistics of Composite Grades in Mana Mineralized Zones

Sector	Number of Composites	Minimum Capped Grade (g/t Au)	Median Capped Grade (g/t Au)	Average Capped Grade (g/t Au)	Maximum Capped Grade (g/t Au)	CV of Capped Grades
Wona-Kona	14,951	0.005	1.54	2.16	15	0.97
Siou	18,632	0.001	0.74	3.83	40	2.11
Yama	997	0.005	0.68	1.47	15	1.48
Fofina (Principal)	5,183	0.005	0.73	1.69	30	1.83

Sector	Number of Composites	Minimum Capped Grade (g/t Au)	Median Capped Grade (g/t Au)	Average Capped Grade (g/t Au)	Maximum Capped Grade (g/t Au)	CV of Capped Grades
Fofina (V1-V7)	4,077	0.005	1.04	3.53	30	1.72
Nyafé	2,563	0.006	3.74	5.83	30	1.03
F67	222	0.005	0.742	2.18	15	1.54
Fobiri	1,098	0.0025	0.53	0.93	11.06	1.30
Yaho	9,650	0.0008	0.41	0.68	10	1.24
Maoula	1,620	0.005	0.68	1.33	10	1.38

CV is the coefficient of variation of composite grades, i.e., their standard deviation divided by their mean.

For deposits where composite length averages 1 m, the average capped grade compares well with original assays top-cut average grade (see Table 14.3 above). For those deposits where assay intervals were composited at 2 m, the average top-cut composite grade can be lower, as at Nyafé. This reflects the dilution effect of standardized 2 m composites.

Statistics of the final capped 1 m composites within the different zone intercepts at Siou are given in Table 14.5. Capping of original intervals (mostly 1 m) is at 40 g/t Au, mostly affecting data in Zones 9 and 25, with an overall 15.6% gold reduction.

Table 14.5
Statistics of the Composite Grades in Siou Mineralized Zones

Zone	Composites	Minimum Capped Grade (g/t Au)	Median Capped Grade (g/t Au)	Average Capped Grade (g/t Au)	Maximum Capped Grade (g/t Au)	CV of Capped Grades
Zone 9	6,432	0.005	0.819	3.276	40	2.07
Zone 25 (Siou)	8,110	0.001	0.651	4.484	40	2.06
Zone 55	1,258	0.008	0.759	4.280	40	2.06
Zone 56	1,850	0.010	0.847	3.507	40	2.10
Zone 57	923	0.007	0.640	1.930	40	2.13
All	**18,632**	**0.001**	**0.74**	**3.83**	**40**	**2.11**

CV is the coefficient of variation of composite grades, i.e., their standard deviation divided by their mean.

Histograms of composite grades for some of the main mineralized structures at Wona-Kona and Siou are shown in Figure 14.19 and Figure 14.20.

Figure 14.19
Histograms of 2-m Composites Grades in Wona-Kona Main Mineralized Zones

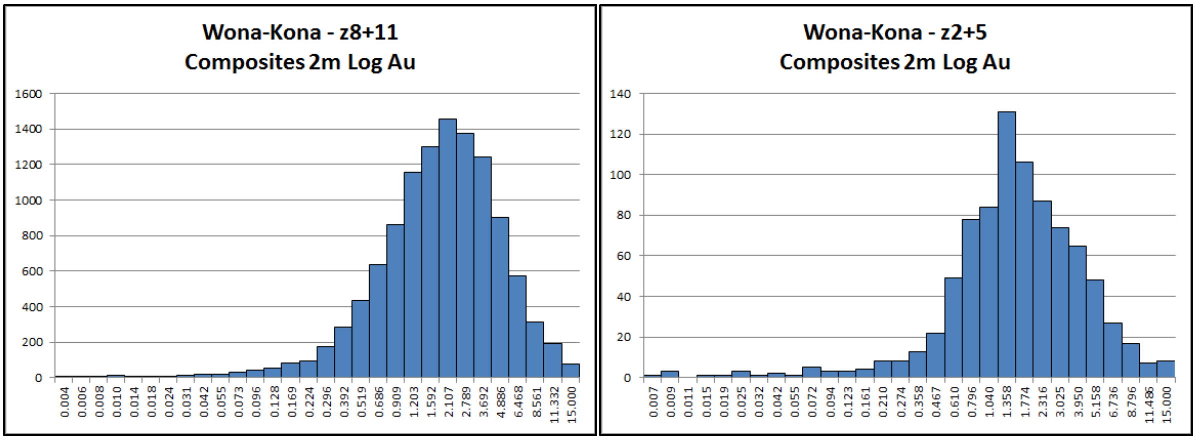
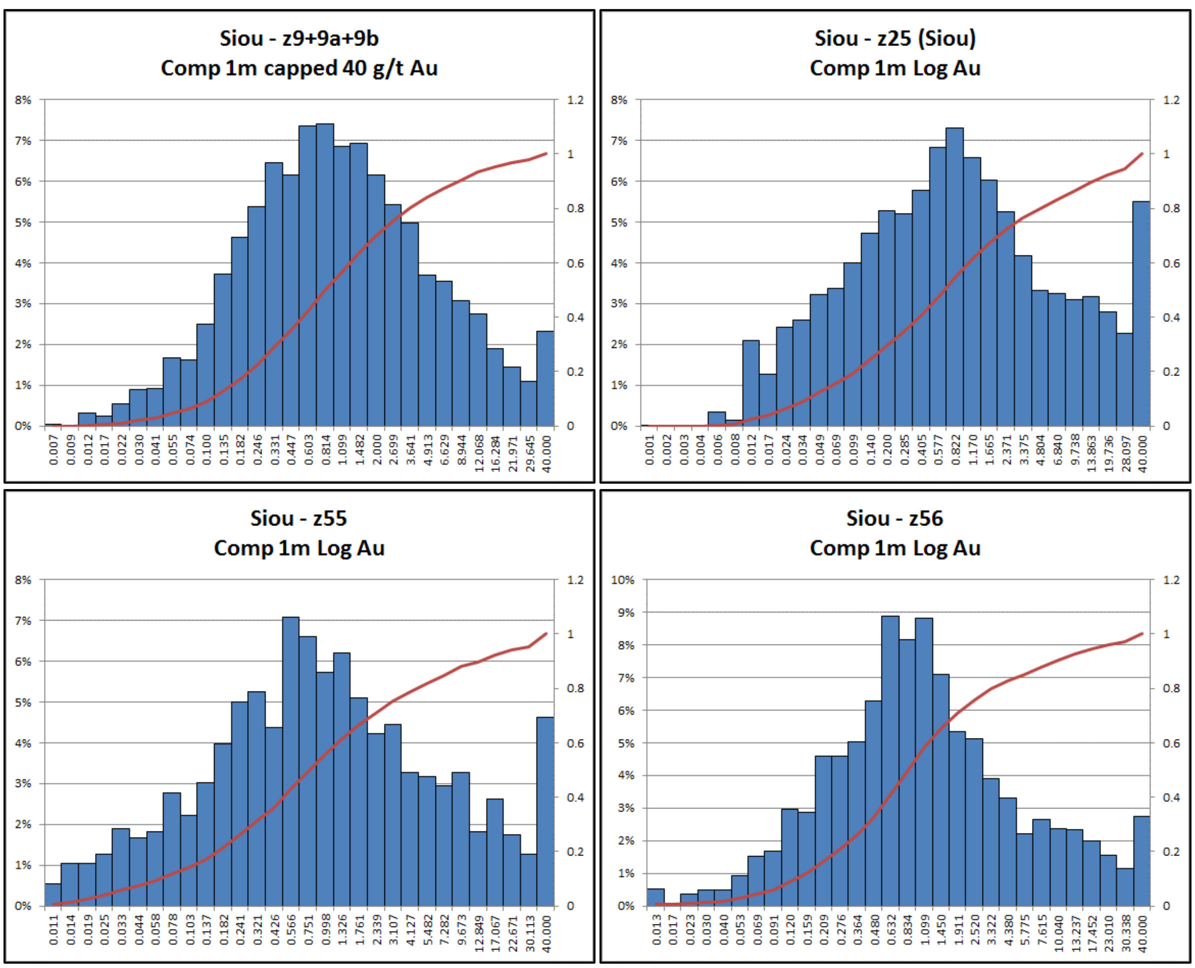


Figure 14.20
Histograms of 1-m Composites Grades in Siou Main Mineralized Zones



The spatial continuity of top-cut composites within mineralized solids is assessed with variograms or correlograms. A correlogram examines the decrease of the correlation (measured by a correlation coefficient from -1 to +1) of composite grades in any given direction as the distance between composites increases along that direction. Composite pairs in the appropriate direction +/- an "angular tolerance" are selected and classified into various distance bins based on a given lag along the direction being considered. A correlation coefficient is calculated for each bin from the pairs available in that bin. By graphing 1-correlogram, a curve is drawn showing increasing average grade differences between composites as the distance increases, which is similar to a traditional variogram. The sill of this "pseudo-variogram" is generally around 1.0 and it corresponds to a correlation coefficient of zero (i.e., no correlation between composite grades). Correlograms are generally preferred to traditional variograms since they are considered more robust with respect to outliers and non-stationary features such as trends and proportional effect (i.e., variability increasing with grade). Correlograms have been calculated but they are presented herein as variograms by graphing the function: 1-correlogram.

All variogram analysis and modelling were performed using the Geostat Plus module. The variogram modelling was based on the combination of three or four metrics of the capped composites and the relevant correlogram. Models are oriented in the plane of gold mineralization, representing the direction of maximum continuity.

At Wona-Kona, variograms have been computed along several directions from composites in the two principal high-grade zones of Wona (8+11) and Kona (2+5) (see Figure 14.21). Composites in the same zone (2, 5, 8, or 11) are separated from composites in the other zones so that pairs made of composites in different zones are never used. From the variograms, it can be observed that the relative nugget effect is 30%, the long and intermediate ranges are within the vertical north-south plane, and the short range is along the horizontal east-west plane. It can also be observed that for distances ranging from 5-30 m, the best continuity is along a weakly dipping direction of 20-40° to the north of the north-south vertical long section. For longer distances (+30 m), the best continuity is along the horizontal of the north-south vertical long section. To account for this particular feature, a two-component model is used with different anisotropy directions.

At Siou, 3D variograms of 1-m composite data for Zones 9, 25 and 56 have been computed separately along the principal horizontal N010 strike and average dip direction (dipping 40° to the east). Also, variograms along the drill hole direction (short distance variogram) were computed separately from those computed along the average strike and dip directions (long distance variogram) to facilitate the interpretation. In Zone 25 (see Figure 14.22), the short distance variogram is characterized by a relative nugget effect of 25% with a short range of 3 m, which is much lower than the short distance variogram of Zone 9. The variogram along strike is systematically below the one along dip for distances up to 200 m. Variograms along the intermediate directions (N055 and N145) dipping at 30.7° appear in between those along strike and dip, confirming the anisotropy within the average plane. This anisotropy can only be observed at distances of 150 m or longer where the continuity is greater along strike. The proposed model is made of a first spherical component that is isotropic up to 20 m, and then the next two are anisotropic with ranges of 100 m and 60 m for the second component and with ranges of 400 m and 200 m for the third component.

Figure 14.21
Variograms of 2-m Composites Grades in Wona-Kona Main Mineralized Zones

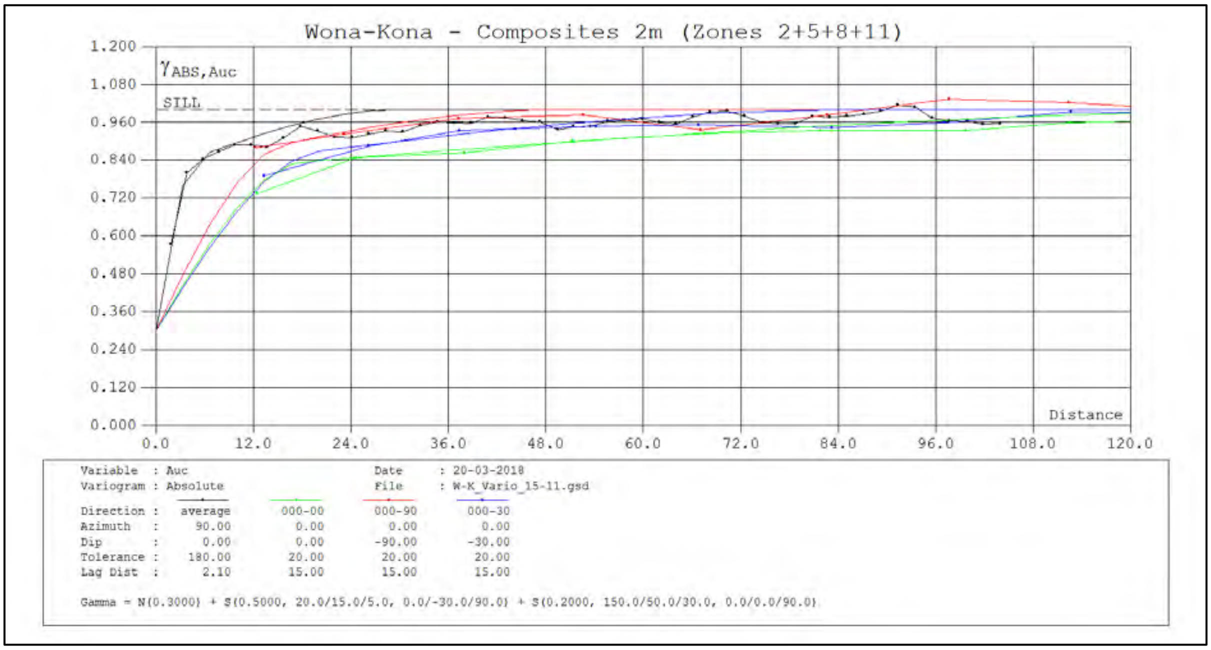
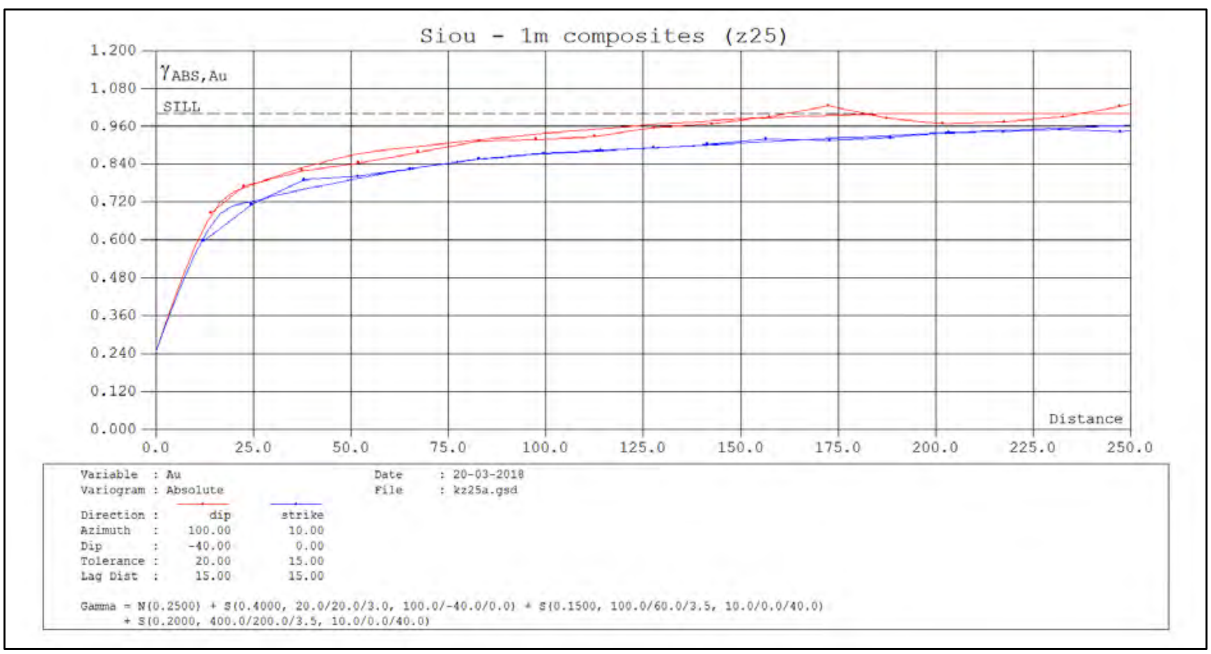


Figure 14.22
Variograms of Top-cut 1-m Composites for Zone 25 at Siou



In Zone 9 (see Figure 14.23), the short distance variogram is characterized by a relative nugget effect of 50% with a short range of 5 m. Along the average dip of -40° to N100, the variogram displays a range of 20-25 m. On the other hand, the variogram along strike (horizontal N010) displays a 40-50 m range. Both variograms along the intermediate directions (N055 and N145) confirm the anisotropy within the average plane. Zone 9 has a similar anisotropy as Zone 25 but can only be observed for distances less than 75 m. Thus, the model is made of a first anisotropic spherical component with ranges of 25 and 15 m, and then it becomes isotropic with a range of 100 m.

In Zone 56 (see Figure 14.24), the short distance variogram is characterized by a relative nugget effect of 30% with a short range of 2.5 m. The variogram along strike (horizontal N015) displays a 50 m range and along the average dip of -50° to N105, the variogram displays a shorter range of 20-25 m. The model is made of a first anisotropic spherical component with ranges of 20 m and 15 m, and a second anisotropic spherical component with ranges of 60 m and 40 m.

Figure 14.23
Variograms of Top-cut 1-m Composites for Zone 9 at Siou

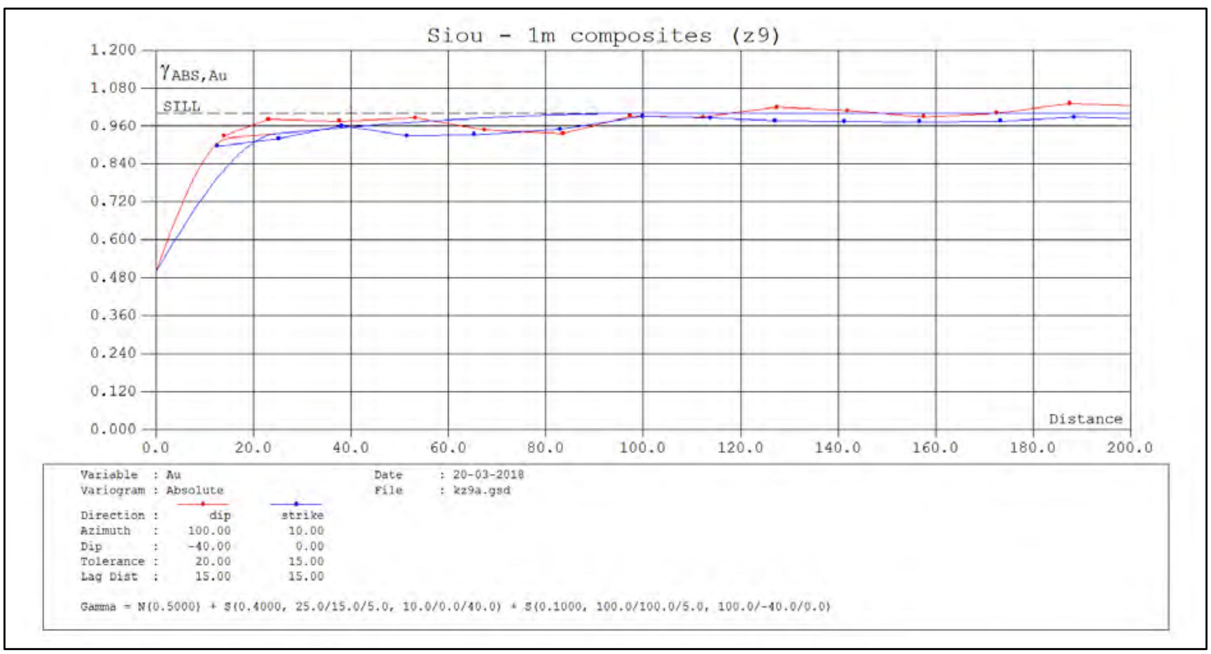
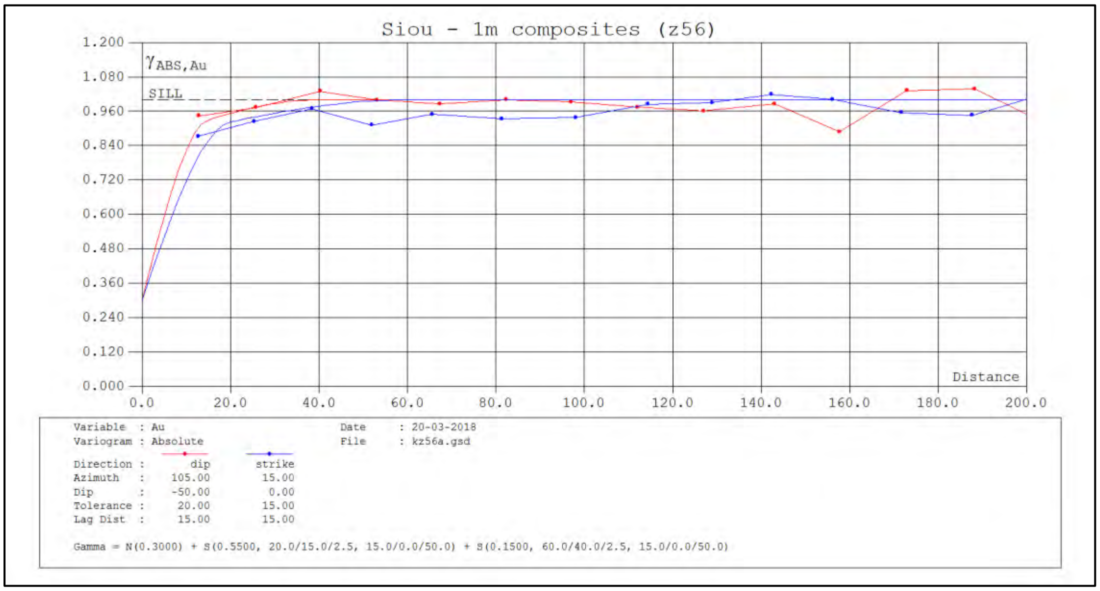
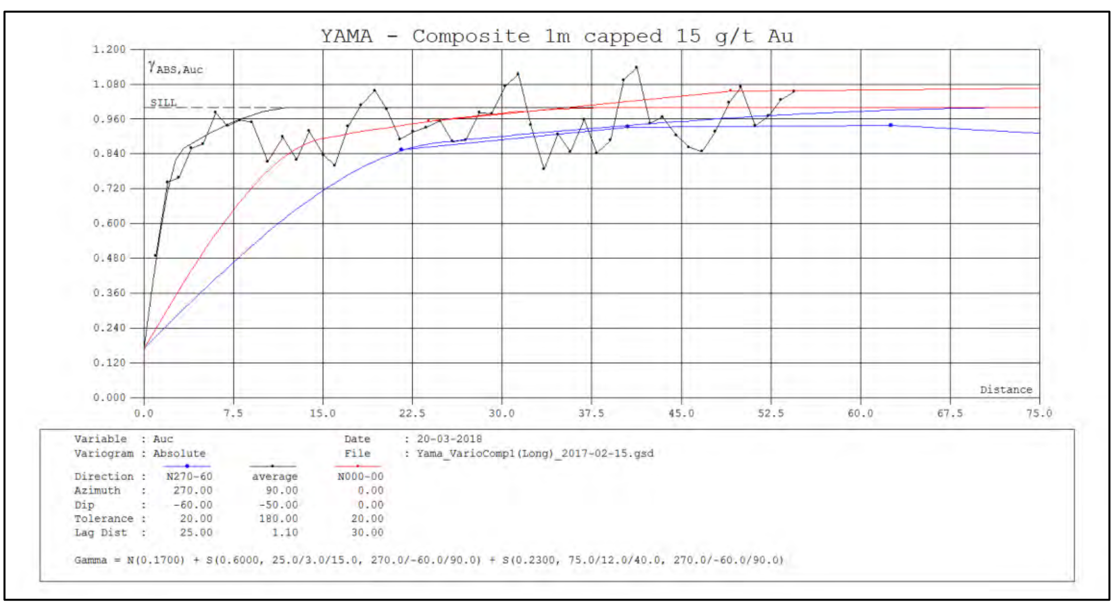


Figure 14.24
Variograms of Top-cut 1-m Composites for Zone 56 at Siou



At Yama (see Figure 14.25), the long and intermediate ranges are within an inclined plane dipping -60° to N270. The short distance variogram is characterized by a relative nugget effect of 17% with a short range of 3 m. The variogram along the average dip of -60° to N270 displays a range of 45-50 m and a shorter range of 25-30 m along strike (horizontal N000). The model is made of a first anisotropic spherical component with ranges of 25 m and 15 m, and a second anisotropic spherical component with ranges of 75 m and 40 m.

Figure 14.25
Variograms of Top-cut 1-m Composites for at Yama



14.6 BLOCK GRADE INTERPOLATION AND VALIDATION

Average block or sub-block grades are interpolated from nearby composites within their respective mineralized solids. Block grade interpolation is either by ordinary kriging (OK) for Wona-Kona, Siou, Yama, Nyafé, F67, Fobiri and Yaho, ID2 for Fofina V1-V7, Maoula or by inverse distance cubed (ID^3) for Fofina Principal. The different variogram models used for kriging have been presented in the previous section. The procedure is run in several passes with search conditions (size of search ellipsoid, minimum data in search ellipsoid) relaxed from one pass to the next until most blocks within the mineralized solid are interpolated. Interpolation conditions such as the ellipsoid orientation and size as well as the min/max number of data used in the ellipsoid may vary between deposits. As will be seen subsequently, those interpolation passes are also used as a starting point to classify the resources in the blocks. Search parameters used to interpolate block grades are listed in Table 14.6.

Table 14.6
Search Parameters for Block Grade Interpolation of Mana Deposits

Deposit	Zone	RotY (º)	RotZ (º)	Rmax (m)	Rint (m)	Rmin (m)	MinH	MinC	MaxC	Block Size (m)
Wona-Kona	All	0	0	30	25	6	2 2 1 1	3 3 2 1	20	5x5x5
Siou	9, 17,25	40	10	15	15	7.5	3 3 3 2	7 7 7 5	30	2.5x5x5
	55	45	15							
	56,57	50	15							
Yama	Nord	0	30	55	25	3	3 3 2	5 5 4	20	5x5x2.5
	Sud	20	0	25	15	5				
Nyafé	All except noted below	-50	15	35	25	10	2 1 1	3 2 1	50	5x5x3.33
	1,4,9,17,25,53,54	-28	19							
	11	-8	11							
	3	-30	40							
	6	-35	-10							
	2	-15	0							
	1,6,8,11,17,43,	45	15						20	
	3,9,10	30	15							
F67	9	60	5	30	25	10	2 1 1	3 2 1	50	5x5x3.33
	10	72.5								
	6	42								
	3	50								
Fofina	(Principal) 1,2,3,4,5,6,7,9,10,11	45	30	35	25	5	3 2 1	5 4 2	25	5x5x5
	(V1-V7) all	0	0	30	30	30	3 2 1	5 4 2	20	
Fobiri	All	0	0	25	25	10	2 2 1	3 3 1	20	5x5x5
Yaho	(Sector 1) 2,3,5,6,8,11,17	50	20	30	30	10	3 2 1	3 2 1	20	5x5x5
	(Sector 2) 2,3,5,6,8,11,17	50	0							
	(Sector 3)	55	350							

Deposit	Zone	RotY (°)	RotZ (°)	Rmax (m)	Rint (m)	Rmin (m)	MinH	MinC	MaxC	Block Size (m)
	2,3,5,6,8,11,17									
Maoula	(S2) 2,3,4,5,6,7	30	30	110	40	25	3 3	5 5	20	10x10x5
	(S0-S1) 10, 11, 12, 13, 16, 17, 18, 19, 26, 27, 34, 36, 42, 54, 55	0	0	150	150	150	3 3	5 5	20	

RotY = rotation counter clockwise around Y (NS of grid) i.e. RotY =-5 puts Z (Rmax) dipping 85° to west and RotY= +60 puts Z dipping 30° to east.
RotZ = rotation clockwise around rotated Z i.e. RotZ=-8 puts Y(Rint) striking N352 and RotZ=15 puts Y striking N15.
Rmax = max search radius (along rotated Z i.e. dip).
Rint = intermediate search radius (along rotated Y i.e., strike).
Rmin = minimum search radius (along rotated X i.e., across dip+strike).
Min H = minimum number of holes with composites in each interpolation pass (SVOL from 1 to 3 or 4).
MinC = minimum number of composites in each interpolation pass (SVOL from 1 to 3 or 4).
MaxC = maximum number of composites retained in search ellipsoid (closest to block centre).

The basic search ellipsoid (SVOL=1) is defined to accommodate 1) the mineralized envelope geometry and 2) at least three composites in a minimum of two different drill holes on 25 m spaced sections or less. If there are not enough composites in that basic ellipsoid, radii of the next search ellipsoid (SVOL=2) are extended 1.5 to 2 times those of the basic ellipsoid. For the third pass (SVOL=3), radii are 1.25 to 2 times those of the second ellipsoid. If there are no composites in that third ellipsoid, the block is not interpolated (SVOL=0).

At Wona-Kona, blocks are interpolated in four different passes. The basic search ellipsoid is 30 m by 25 m by 6 m, expanding to 60 m by 50 m by 12 m for the second pass and 75 m by 62.5 m by 15 m for the third pass. If there are less than two composites in the third ellipsoid, a fourth pass (SVOL=4) is attempted with a 150 m by 125 m by 30 m ellipsoid and a minimum of 1 composite.

For Siou, the basic search ellipsoid (SVOL=1) is 15 m by 15 m by 7.5 m with a 15 m long radius along strike and a 15 m intermediate radius along dip which is considered appropriate to accommodate the composites in holes drilled for grade control (i.e., 12.5 m by 6.25 m pattern). A minimum of seven composites in three different holes were used as search conditions for this first pass. Ellipsoid axis lengths are doubled for the next three passes with a minimum of seven composites in three different holes for SVOL= 2-3 and a minimum of 5 composites in two different holes for SVOL= 4.

At Fofina V1-V7, the basic search ellipsoid (SVOL=1) is isotropic with a maximum search radius in all directions of 30 m given the complex geometry of the mineralized structures.

At Maoula, interpolation is done in only two passes but with different search ellipsoids depending on the dip of the structures. For the vertical S2 structures, the basic search ellipsoid (SVOL=1) has a 100 m long radius along strike and a 40 m intermediate radius along dip to accommodate the sheet like geometry of the mineralized structures. For the S0-S1 undulating horizontal structures, the basic search ellipsoid (SVOL=1) is isotropic with a maximum search radius in all directions of 150 m. This isotropic search is considered adequate given the sheet like geometry of mineralized structures and the fact that sub-blocks in any given structure can only be interpolated by 1 m composites in the same structure.

Interpolation of blocks in a given solid is limited to composites within the same solid. Within a given solid, a block or sub-block in any given ore type may be interpolated from samples in a different ore type which is appropriate since drill hole data tends to show that there is no abrupt change of mineralized zone geometry or grade as ore type boundaries are crossed (i.e., from saprolite to saprock or from saprock to fresh rock). Block grade interpolation results of that procedure are illustrated in Figure 14.26 for Zone 11 of Wona-Kona and in Figure 14.27 for Zone 25.

Figure 14.26
Block Grade Estimation Showing the Composite Grades (top) and the Interpolated Blocks Grades (bottom) in Mineralized Zone 11 at Wona-Kona

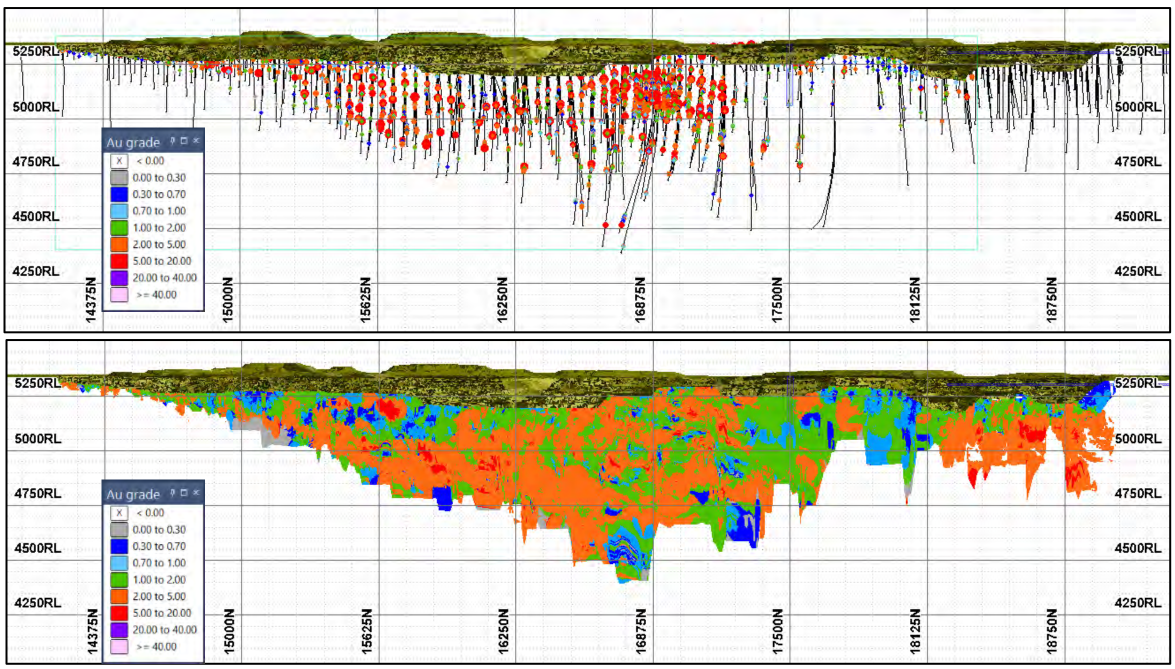
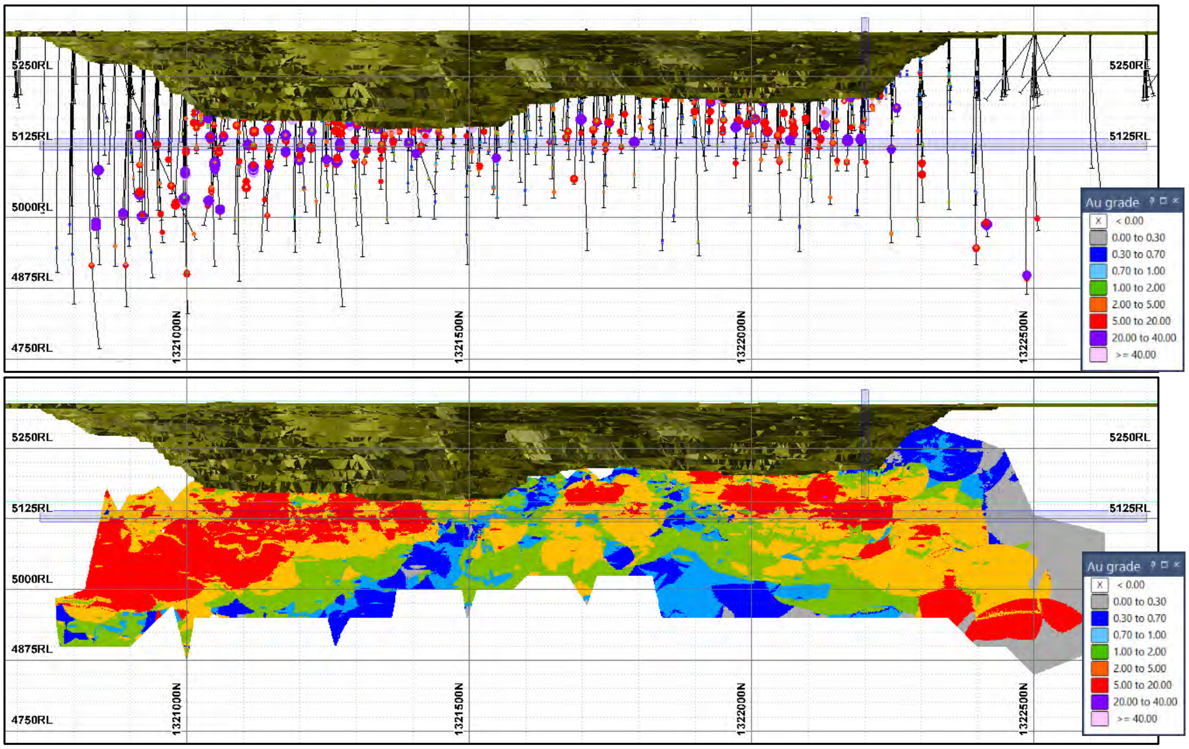


Figure 14.27
Block Grade Estimation Showing the Composite Grades (top) and the Interpolated Blocks Grades (bottom) in Mineralized Zone 9 of Siou



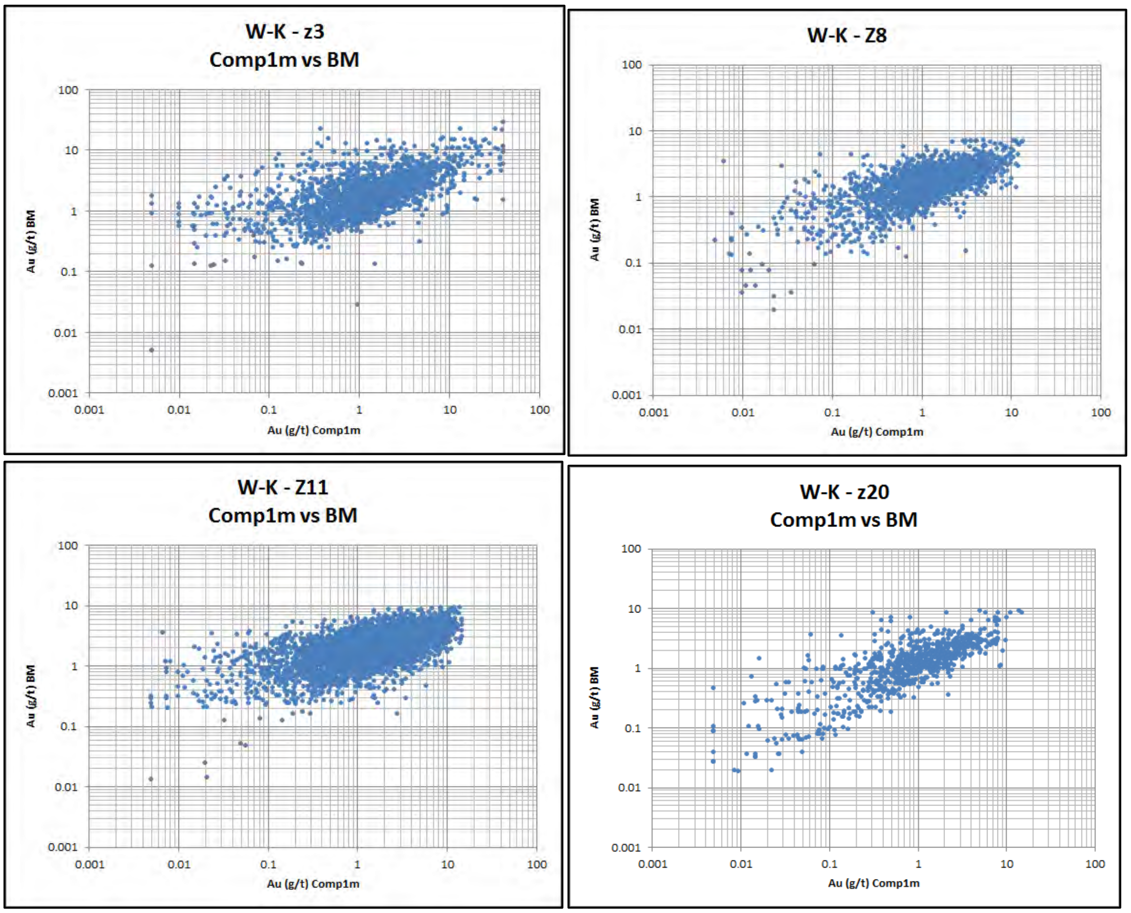
To validate the interpolated sub-block grade data, the average composite grade of any given zone is compared with the estimated block grade (after reconstituting the parent block size from the sub-blocks) for those composites that are contained within that block. Correlation statistics are shown in Table 14.7.

Table 14.7
Block Grade Validation in the Main Zones of Wona-Kona and Siou

Deposit	Zone	Number of Composites	Average Composite Grade (g/t Au)	Average Block Model Grade (g/t Au)	Correlation Coefficient
Wona	3	1,895	2.64	2.54	0.569
	8	2,113	1.82	1.81	0.618
	11	6,878	2.31	2.27	0.590
	20	831	1.50	1.52	0.670
Siou	9	6,252	3.28	2.54	0.497
	25	8,575	4.41	4.69	0.668
	55	1,245	4.32	2.92	0.432
	56	1,846	3.50	2.24	0.559
	57	896	1.95	1.06	0.378

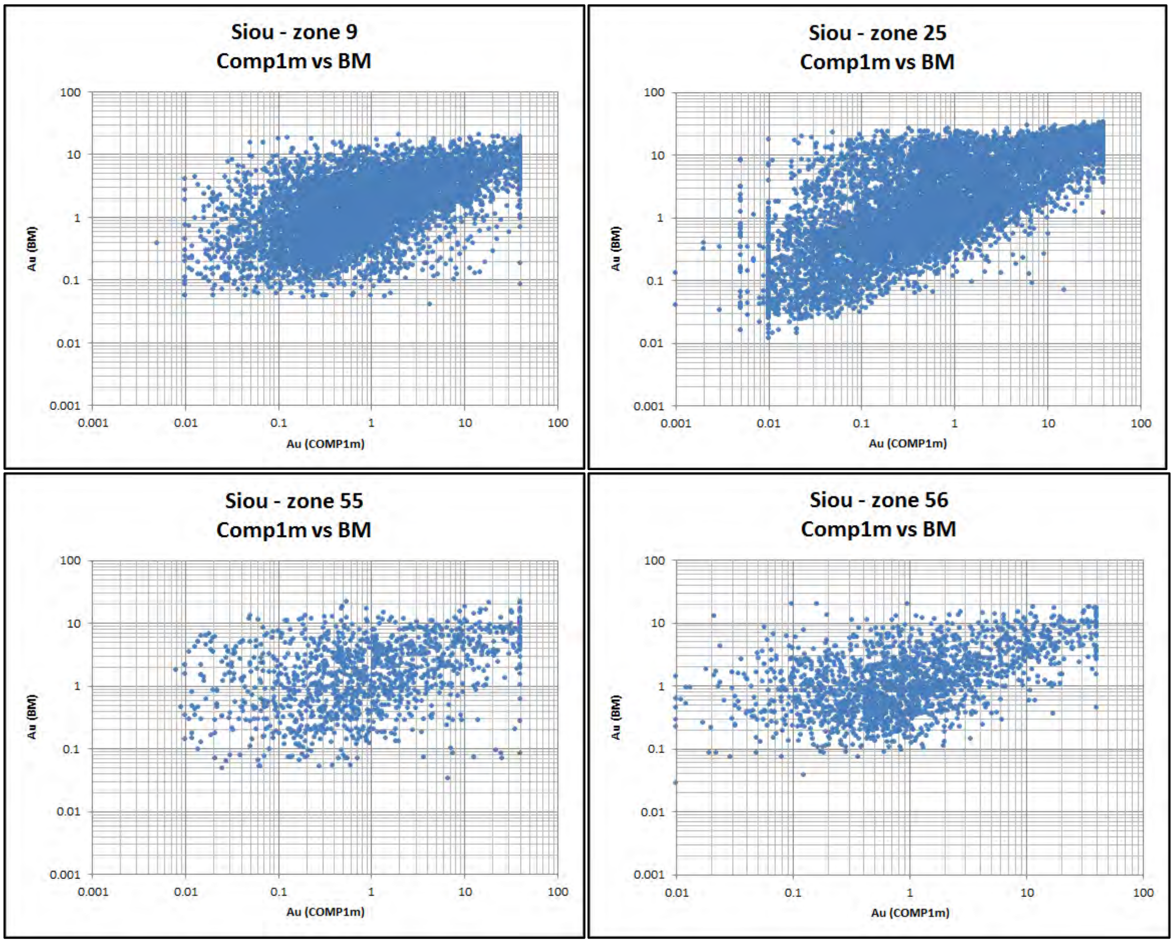
Correlation plots are shown in Figure 14.28 and Figure 14.29. For Wona, the correlation coefficient varies around 0.6 with the average composite grades showing a good match with the average estimated block grade at the same location. At Siou, the correlation coefficient varies between 0.38 to 0.67, with appreciable smoothing in the block grade estimates.

Figure 14.28
Block Grade Validation in the Main Zones of Wona-Kona



Note: Each plot compares the grade of a composite with the estimated grade of the block of the same zone that contains the composite.

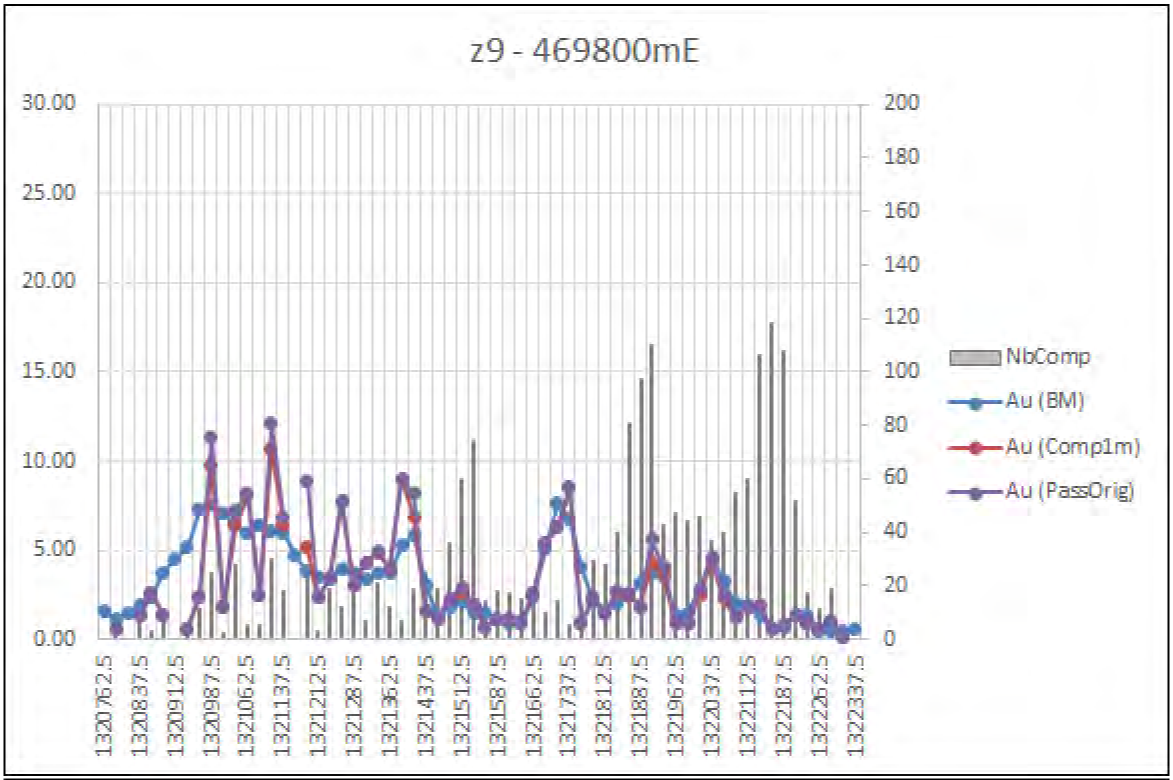
Figure 14.29
Block Grade Validation in the Main Zones at Siou



Note: Each plot compares the grade of a composite with the estimated grade of the block of the same zone that contains the composite.

Selected trend plots along 100 m wide corridors in the X and Y directions are presented in Figure 14.30 and Figure 14.31 for Zone 9. Ordinary kriging gold estimates are compared to top-cut composites and raw samples.

Figure 14.30
Grade Trend Plot Along X at Siou for Zone 9



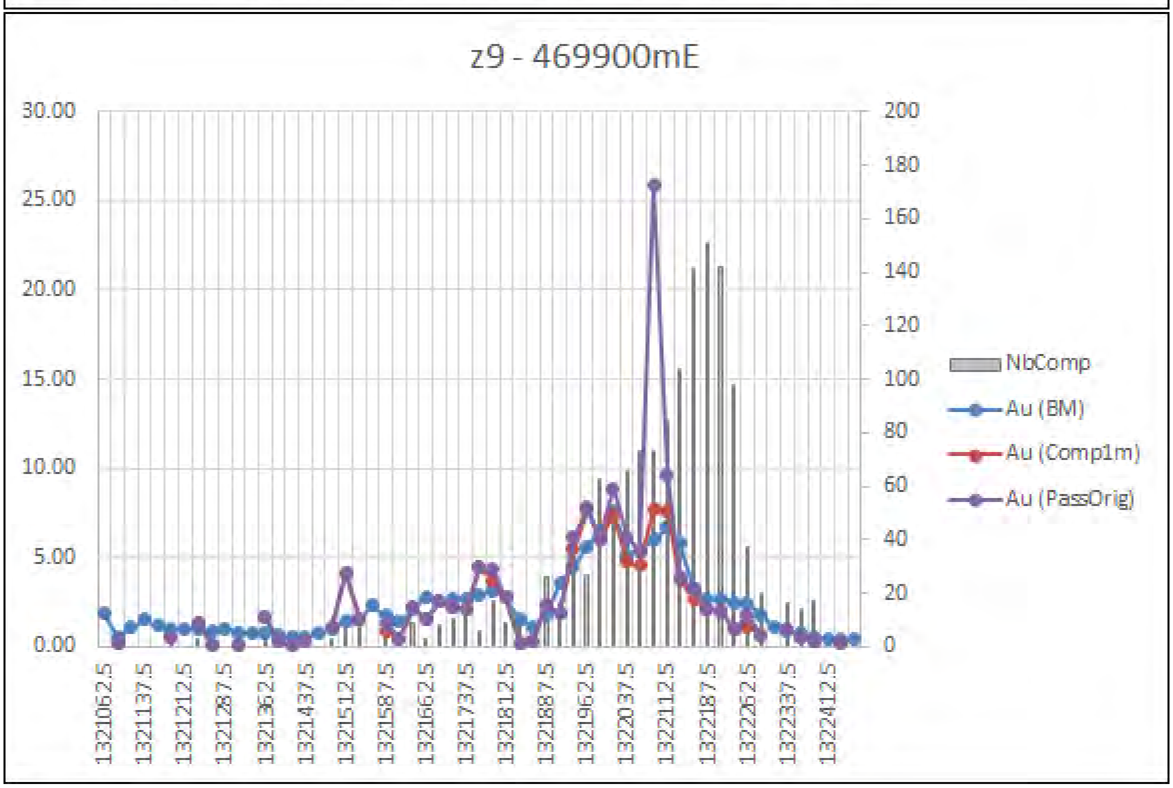
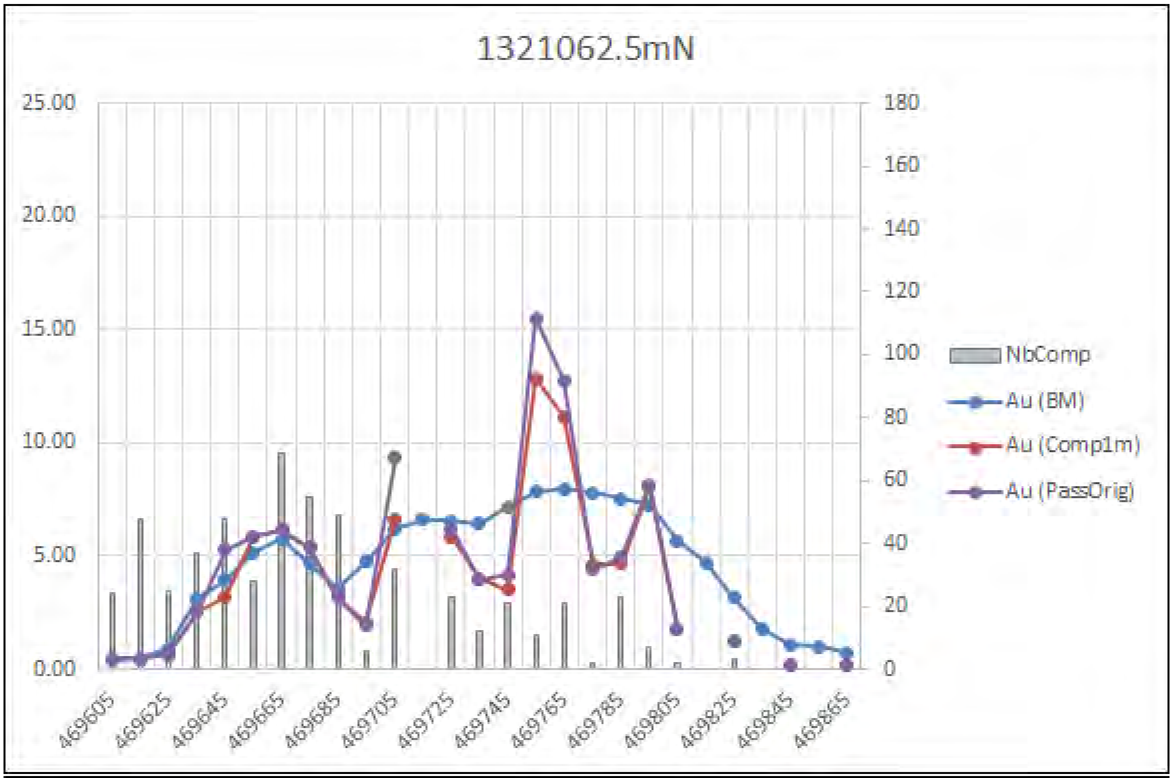
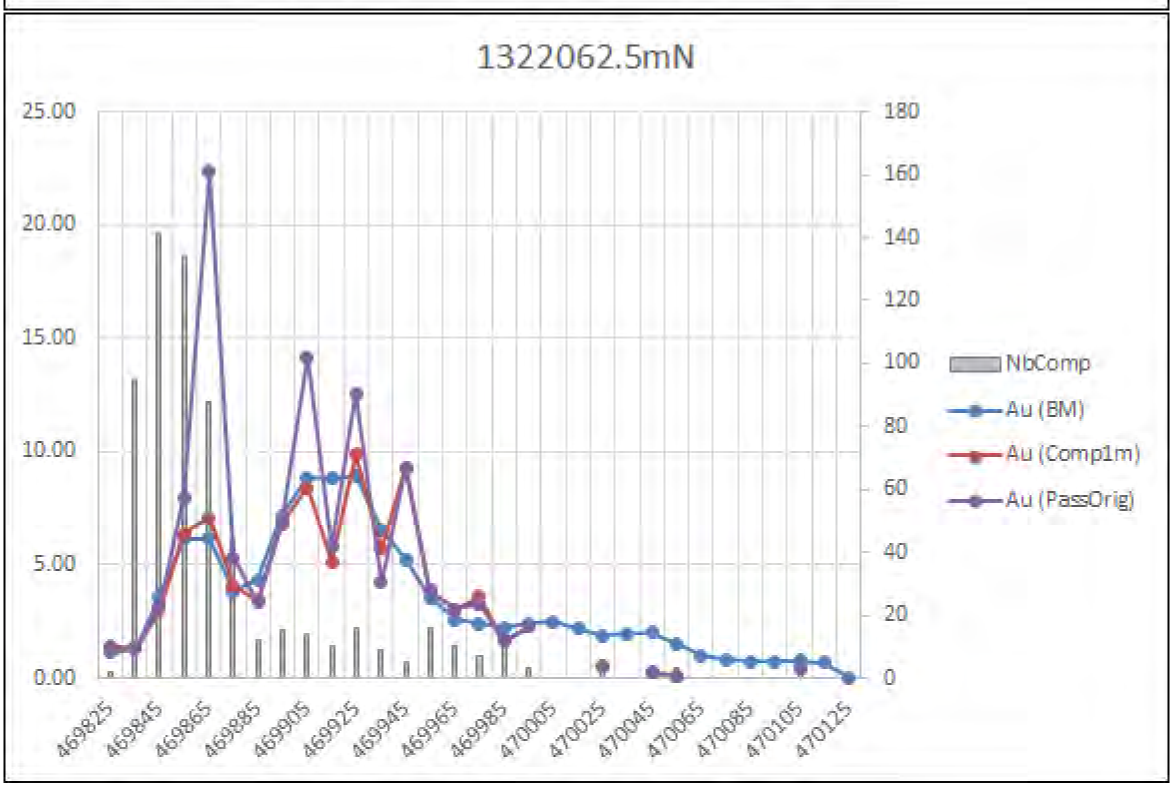


Figure 14.31
Grade Trend Plot Along Y at Siou for Zone 9





14.7 RESOURCE CLASSIFICATION

As block grade is interpolated, resources in each block are automatically classified based on the interpolation run number (SVOL). On most deposits, blocks estimated in the first run (SVOL=1) are given the measured category and correspond to blocks surrounded by composites of intercepts on a 25 m by 25 m grid within the same mineralized envelope. Blocks estimated in the second run (SVOL=2) are given the indicated category corresponding to a complete 50 m by 50 m grid of intercepts. Blocks estimated in the last run (SVOL=3) are in the inferred category.

Strictly for in-house use to facilitate mine planning and grade control, the following parameters are applied: at Wona-Kona, "a second level of indicated resources (SVOL=3; indicated2)" was added where blocks are estimated from intercepts composites on an incomplete 50 m by 50 m grid. At Siou, "two sub-categories of measured resources (SVOL=1&2; measured1 and 2)" were created to allow for tighter grid spaced grade control RC drilling. In those two deposits, blocks interpolated in a fourth run (SVOL=4) are classified as inferred (see top of Figure 14.32 to Figure 14.34). At Maoula, the estimated blocks are all classified in the inferred category.

Classifying resources automatically can introduce some undesired effects, such as having a mixture of blocks of indicated and inferred category on the same bench or section which may be problematic when defining reserves. Generating "rims" of indicated and inferred resources from isolated intercepts, is also undesirable for mine planning. Thus, an automatic classification should only be used as a framework for a final classification.

The subsequent manual classification is based on the density of hole intercepts in any given zone. Re-grouped intercepts for each zone are first compiled on long section maps with polygons of influence around each intercept. Polygon dimensions are defined according the density of hole intercepts. For intercepts on a complete and regular 25 m grid, polygons have a long radius of 17.5 m (i.e., half the diagonal of a 25 m by 5 m mesh). Measured resources are defined by the outline drawn around all contiguous polygons of that size. For intercepts on a 50 m by 50 m mesh, polygons have a maximum radius of 35 m and indicated resources are defined by the outline drawn around all contiguous polygons of that size.

A manual classification was applied on most of the zones of the Wona-Kona, Siou, Yama and Yaho resource models. At Wona-Kona (see bottom of Figure 14.32), the outline of indicated resources is drawn around contiguous polygons with a maximum radius of 35 m to 40 m.

For Siou, resource classification boundaries were manually reclassified for Zones 9, 25, 55, 56 and 57. For each zone, polygons of influence around intercepts were outlined on one vertical long section map based on the density of intercepts and the original automatic classification. A set of outlines was first interpreted for the area drilled on the 12.5 m by 12.5 m grid pattern, extended 200 m on each side of the long section, and meshed together to create a solid. Blocks within this solid were categorized as measured (SVOLCM=1). A second set of outlines was drawn over the area drilled on a 25 m by 25 m grid pattern. Blocks within that solid were also categorized as measured (SVOLCM=2). Note that SEMAFO uses two envelopes for grade control purposes, but this distinction is not made in the final mineral resource statement. A third set of outlines was drawn over the 50 m by 50 m drilled area. Blocks within that solid were categorized as indicated (SVOLCM=3). The remaining blocks of the resource model were classified as inferred. The results of this smoothed classification are shown at the bottom of Figure 14.33 and Figure 14.34 for Zones 25 and 9, respectively.

Figure 14.32
Block Resource Automated (top) and Smoothed Final (bottom) Classification in Zone 11 of Wona-Kona

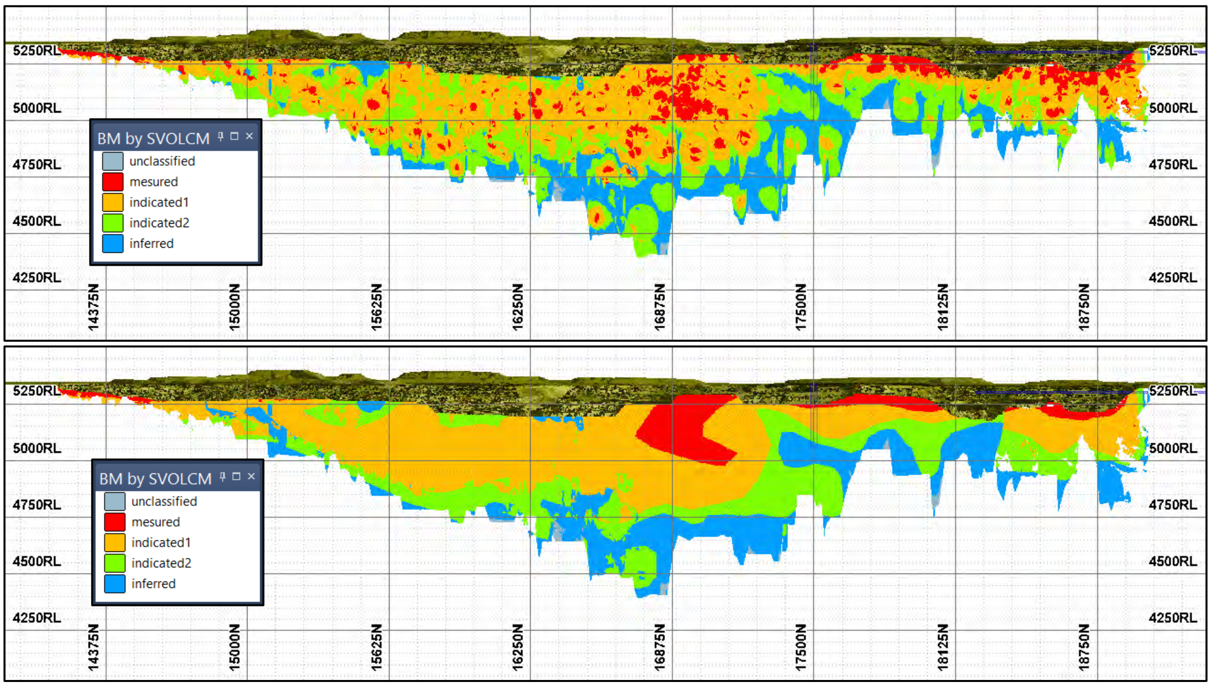


Figure 14.33
Block Resource Automated (top) and Smoothed Final (bottom) Classification in Zone 25 of Siou

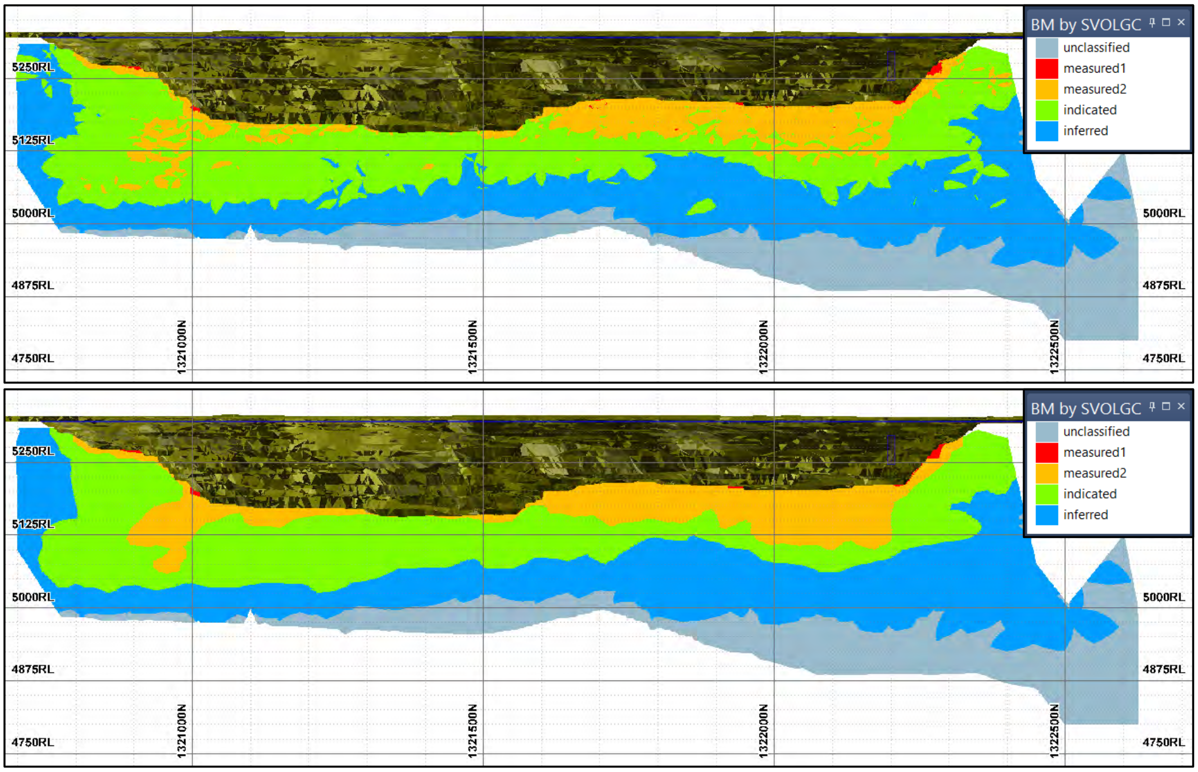
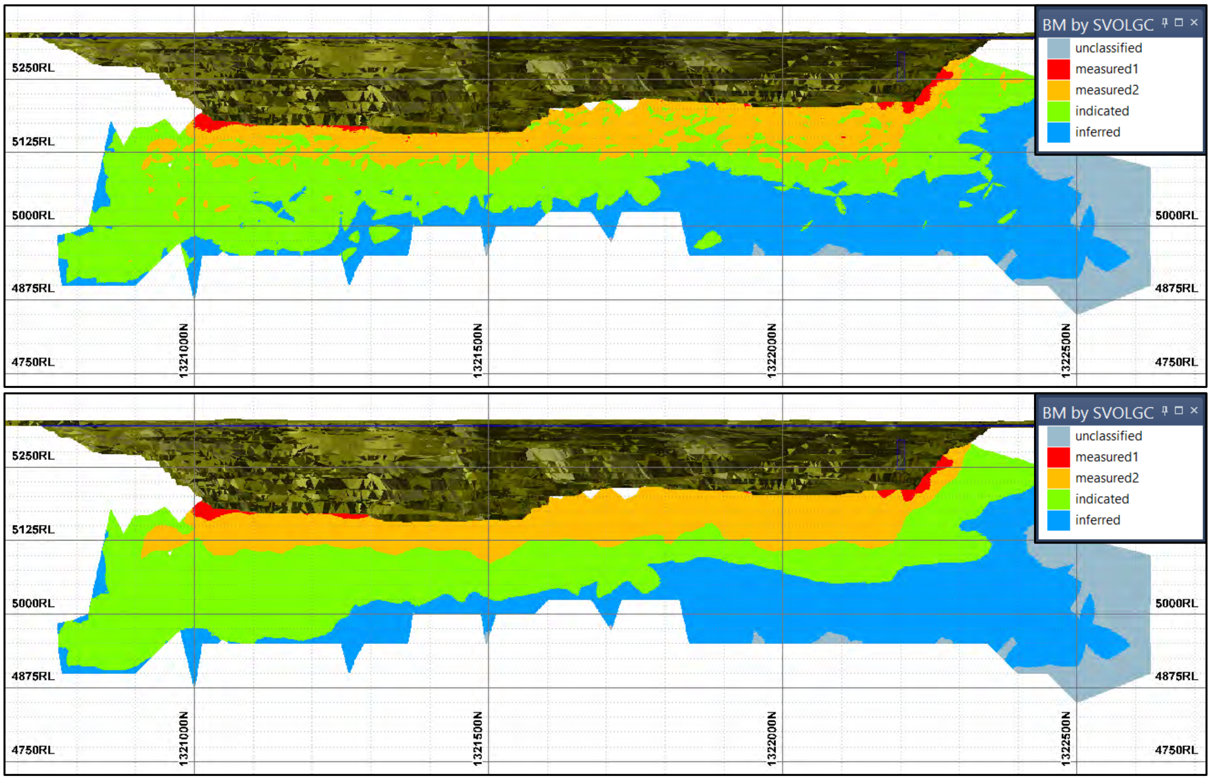


Figure 14.34
Block Resource Automated (top) and Smoothed Final (bottom) Classification in Zone 9 of Siou



14.8 MINERAL RESOURCE ESTIMATES

To produce the final resource estimates, all mineralized material is first classified by mineralization type and category from the block models. The mineral inventory is that portion of mineralized material above a 0.5 g/t Au cut-off grade applied to individual sub-blocks grade estimates.

Resources are that part of the mineral inventory that reflect a "reasonable prospect of economic extraction" of such resources as defined by the CIM Definition Standards for Mineral Resources and Mineral Reserves. This requirement implies that the quantity and grade estimates meet certain economic thresholds and that the mineral resources are reported at an appropriate cut-off grade.

In the upper portion of deposits, the conceptual limit of economical extraction is an optimized pit shell with reasonable technical (maximum pit slopes, gold recovery) and economical (gold price, unit mining and processing costs) parameters. Unlike pit design shells for reserves, those for resources include the inferred blocks of the mineral inventory.

The optimized pit shells parameters are listed in Table 14.8 with the following comments:

- Maximum pit slope angle, mining recovery, dilution, royalties and sale costs are those of the reserves (see Section 15.0).
- Unit mining and processing costs used are outlined in Table 14.8.
- Unit costs for mining waste include an additional transportation cost to the waste pad. Unit costs for milling ore include general and administration (G&A) costs and the cost of transportation to the mill at Wona.
- Gold recoveries are those of the reserves for the saprolite/oxide and the saprock/transition horizons for all deposits. For the bedrock/sulphide portion, gold recovery has been set at 81% for Wona-Kona (SGS METMIN Report dated June 2010 (SGS South Africa, 2010d)), 96% for Siou (SGS METMIN Report dated December, 2012 (SGS South Africa, 2012c)) and 48% for Yaho (HRL Testing report, 2012 (HRL, 2012)). Recoveries are set to 19% to 29% for Nyafé, Fofina, F67, Fobiri and Maoula with the assumption that sulphide mineralization is considered refractory and cannot be recovered economically with the current CIL process.
- Gold price is USD 1,400/oz, i.e., a premium of USD 200/oz over the USD 1,200/oz used for reserve estimation. (See Section 15.0).

Table 14.8
Parameters for Resource Pit Optimization

Zone/Parameter	Wona-Kona	Siou	Yama	Nyafé	F67	Fofina	Yaho	Fobiri	Maoula
Max. Slope Angle OXIDE	34°	38º/31°	36°	36°	36°	36°	36°	36°	36°
Max. Slope Angle TRANSITIONAL	34°	45°	36°			36°	36°	36°	36°
Max. Slope Angle SULPHIDE	52°	50º/42°	52°	52°	52°	52°	52°	52°	52°
Cost Rss: Mining Ore OX (USD/t)	1.20	1.28	1.26	1.60	3.60	1.07	2.15	3.60	1.62
Cost Rss: Mining Ore TR (USD/t)	2.00	2.06	2.20	2.58		1.60	2.15	4.05	1.64
Cost Rss: Mining Ore SU (USD/t)	2.26	2.27	2.50	2.84	4.42	1.88	2.65	4.42	1.99
Cost Rss: Mining Waste OX (USD/t)	0.80	1.06	1.33	1.33	0.98	1.13	2.08	0.98	1.51
Cost Rss: Mining Waste TR (USD/t)	1.90	1.90	2.37			1.79	2.08	1.47	1.53
Cost Rss: Mining Waste SU (USD/t)	2.06	2.06	2.57	2.57	1.88	1.91	2.57	1.88	1.94
Mining Dilution (avg.) (%)	10	15	15	15	15	15	10	10	15
Mining Metal Recovery (%)	97.5	97.5	97.5	97.5	97.5	97.5	97.5	97.5	97.5
Processing Metal Recovery OX (%)	94	96	95	87	87	92	87	84	87
Processing Metal Recovery TR (%)	87	96	92			74	84	71	84
Processing Metal Recovery SU (%)	81	96	91	29	29	26	48	19	48
Rehabilitation (USD/t)	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Cost Rss: Milling Ore OX (USD/t)	12.77	15.74	20.02	19.68	14.33	14.04	13.60	14.33	17.01
Cost Rss: Milling Ore TR (USD/t)	15.93	18.39	23.37			17.16	17.93	16.62	19.21
Cost Rss: Milling Ore SU (USD/t)	16.90	19.34	24.52	24.18	18.15	18.51	24.63	18.15	21.53
Underground Cut-off Grade (g/t Au)	>2	See text	-	>5	>5	>2.5	>3	>5	>5

Notes Milling cost of ore includes G&A and transportation. At Siou, wall slope angle differs from west side (sediments) to east side (altered granite).

For the year-end 2017 resource estimates reported herein, historical pit optimized shells using a gold price of USD 1,400/oz have been retained but the costs have been based on actual recent experience. Thus, resources for Siou, Yama, Nyafé, F67, Fofina, Fobiri, Yaho, and Maoula are made of blocks of the mineral inventory within the generated shells and above a fixed cut-off grade recalculated with the updated costs. For Wona-Kona, in-pit resources are made of blocks of the mineral inventory within the former reserve pit design at USD 1,300/oz.

Below the optimized pit shell, an underground mining cut-off grade of 2 g/t Au for Wona-Kona, 2.5 g/t Au for Fofina, 3 g/t Au for Yaho and 5 g/t Au for the other deposits is applied to individual blocks. These cut-off grades are appropriate since they consider the mill recovery for sulphides. For Siou, technical and economical parameters for underground extraction are those of the reserves (described in Section 15.0) except for the gold price which is set at USD 1,400/oz. A cut-off grade of 2.3 g/t Au for long hole stopping and 2.7 g/t Au for cut and fill stopping was applied to blocks of the indicated category bordering the reserves. Additionally, a 2 g/t Au cut-off grade was applied to the inferred resources below the optimized pit shell.

The final resource estimates listed in Table 14.9 are that part of the mineral inventory made of 1) resources within the optimized pit shells above the marginal cut-off grades and 2) resources below the optimized pit shell, except for Wona-Kona (USD 1,300/oz pit design), at an underground mining cut-off grade. For deposits with declared reserves (i.e., Wona-Kona, Nyafé, Fofina and Siou), resources are comprised of the above resources but exclude the Measured and Indicated resources contained within the final pit design shells of the reserves, except for those blocks within the reserves pit shells that are 1) Measured plus Indicated blocks below the cut-off grades of the reserves but above the above marginal cut-off grades of the resources and 2) all Inferred sub-blocks above that same marginal cut-off grade. All Maoula resources are in the Inferred category.

Mineral resources are made up of 1) blocks of the mineral inventory above the marginal cut-off grades and within the optimized resource pit shell but outside the final pit design shell of reserves, if any; 2) Measured plus Indicated blocks within reserve pit shell below the cut-off of reserves but above the above marginal cut-off grades of the resources; 3) Inferred blocks within reserve pit shell, if any, and with a grade above the marginal cut-off; and 4) blocks of the mineral inventory above an underground cut-off grade below the optimized resource pit shell.

Table 14.9
Mana Estimated Resources, Exclusive of Reserves, as at 31 December, 2017

Deposits	Measured			Indicated			Total Resources		
	Tonnage	Grade (g/t Au)	Ounces	Tonnage	Grade (g/t Au)	Ounces	Tonnage	Grade (g/t Au)	Ounces
Wona-Kona	1,331,000	2.05	87,800	21,623,000	2.55	1,775,600	**22,954,000**	**2.52**	**1,863,400**
Nyafé	286,000	3.94	36,300	223,000	5.97	42,700	**509,000**	**4.83**	**79,000**
Fofina	293,000	4.25	40,000	253,000	4.45	36,100	**546,000**	**4.34**	**76,100**
Yaho	5,738,000	0.91	168,500	11,636,000	0.88	330,800	**17,374,000**	**0.89**	**499,300**

Deposits	Measured			Indicated			Total Resources		
	Tonnage	Grade (g/t Au)	Ounces	Tonnage	Grade (g/t Au)	Ounces	Tonnage	Grade (g/t Au)	Ounces
Filon 67	26,000	2.72	2,300	9,000	3.59	1,000	**35,000**	**2.93**	**3,300**
Fobiri	469,000	1.80	27,100	114,000	1.52	5,600	**583,000**	**1.74**	**32,700**
Siou Open Pit	67,000	0.63	1,400	56,000	0.65	1,200	**123,000**	**0.66**	**2,600**
Siou Underground	513,000	3.23	53,200	787,000	3.25	82,300	**1,300,000**	**3.24**	**135,500**
Yama	0		0	99,000	1.56	4,900	**99,000**	**1.54**	**4,900**
Total Mana	**8,723,000**	**1.49**	**416,600**	**34,800,000**	**2.04**	**2,280,200**	**43,523,000**	**1.93**	**2,696,800**

Deposits	Inferred		
	Tonnage	Grade (g/t Au)	Ounces
Wona-Kona	3,466,000	2.96	329,600
Nyafé	151,000	5.87	28,400
Fofina	67,000	4.20	9,100
Yaho	223,000	0.78	5,600
Filon 67	6,000	6.32	1,100
Fobiri	578,000	1.39	25,800
Maoula	2,628,000	1.62	137,100
Siou	2,093,000	3.86	259,900
Yama	58,000	1.33	2,500
Total Mana	**9,270,000**	**2.68**	**799,100**

Notes:

1. 2014 CIM Definition Standards were followed for mineral resources.
2. The mineral resource has been estimated using a gold price of USD 1,400/oz.
3. High-grade assays have been capped.
4. The mineral resource was estimated using a block model. Three dimensional wireframes were generated using geological information. A combination of OK and ID^3 estimation methods were used to interpolate grades into blocks of varying dimensions depending on geology and spatial distribution of sampling.
5. Mineral resources that are not mineral reserves do not have demonstrated economic viability. There is currently insufficient exploration to define the inferred resources as indicated or measured resources.

Mineral resources were estimated by François Thibert M.Sc. geo., Directeur, Groupe Estimation Ressources et Réserves, Afrique de l'Ouest, of SEMAFO under the supervision of Michel Crevier, P.Geo., MScA, Vice President, Exploration and Mine Geology and SEMAFO's QP. The estimates were reviewed by Charley Murahwi, M.Sc., P.Geo., FAusIMM, Senior Geologist with Micon who is the QP responsible for the estimate.

15.0 MINERAL RESERVE ESTIMATES

The Mana Mineral Reserves at the end of December, 2017 were estimated within open pits for the Wona-Kona, Nyafé and Fofina deposits, and within a combined open pit and underground mine for Siou.

The optimized pit shells consider only the measured and indicated resources categories. Table 15.1 lists the parameters used in the definition of those optimized pit shells for reserves with the following comments:

- Maximum pit slope angles between 34º and 36° for saprolite/saprock and 52° for bedrock for Wona, Fofina, Nyafé and Yama pit shells; for Siou, a slope angle of 37° was set for saprolite, 38º to 41° for the altered granodiorite, 45° in the saprock, and 42º to 50° in bedrock. Those parameters follow recommendations that can be found in various Golder reports.
- Unit costs for mining waste include an additional transportation cost to the waste pad. Unit costs for milling ore include G&A costs and a transportation cost to the mill at Wona.
- Gold recoveries for Wona-Kona are taken from the 2010 study (Met-Chem, 2011). Siou gold recovery is 96%, irrespective of the alteration facies (see SGS 2012d). Gold recoveries in bedrock are 29% and 26% at Nyafé and Fofina, respectively. They correspond to average recoveries from metallurgical samples taken at various locations in the fresh portion of the deposits. The impact is quite noticeable on bedrock ore resources.
- For Wona-Kona, Fofina, Nyafé and Yama, the resources are composed of blocks of measured and indicated within historical pit optimized shells using a gold price of USD 1,100/oz but above fixed cut-off grades recalculated with actual costs and a gold price of USD 1,200/oz. For Siou, a pit shell limited to the South and optimized to the North was applied using a gold price of USD 1,200/oz.

Table 15.1
Parameters for Reserve Pit Optimization

Zone/Parameter	Wona-Kona	Siou	Fofina	Nyafé	Yama
Max. Slope Angle OXIDE	34°	38°/31°	36°	36°	36°
Max. Slope Angle TRANSITIONAL	34°	45°	36°		36°
Max. Slope Angle SULPHIDE	52°	50°/42°	52°	52°	52°
Cost Rsv: Mining Ore OX (USD/t)	1.50	1.60	1.34	1.60	1.26
Cost Rsv: Mining Ore TR (USD/t)	2.50	2.58	2.00	2.58	2.20
Cost Rsv: Mining Ore SU (USD/t)	2.83	2.84	2.35	2.84	2.50
Cost Rsv: Mining Waste OX (USD/t)	1.00	1.33	1.41	1.33	1.33
Cost Rsv: Mining Waste TR (USD/t)	2.37	2.37	2.24	2.37	2.37
Cost Rsv: Mining Waste SU (USD/t)	2.57	2.57	2.39	2.57	2.57
Mining Dilution (avg.) (%)	10	15	15	15	15
Mining Metal Recovery (%)	97.5	97.5	97.5	97.5	97.5
Processing Metal Recovery OX (%)	94	96	92	87	95
Processing Metal Recovery TR (%)	87	96	74		92

Zone/Parameter	Wona-Kona	Siou	Fofina	Nyafé	Yama
Processing Metal Recovery SU (%)	81	96	26	29	91
Rehabilitation (USD/t)	0.10	0.10	0.10	0.10	0.10
Cost Rsv: Milling Ore OX (USD/t)	15.96	19.68	17.55	19.68	20.02
Cost Rsv: Milling Ore TR (USD/t)	19.91	22.99	21.45	22.99	23.37
Cost Rsv: Milling Ore SU (USD/t)	21.13	24.18	23.14	24.18	24.52

Note: Wona-Kona slope angles in oxide and transitional material are shallower in accordance with Golder recommendations.

The optimized pit shells have been converted into final pit designs with the addition of a ramp and a minimum width in the bottom bench of 9.9 m at Wona-Kona and 7.5 m for the other deposits. The width of the ramp is 11 m (single way) and 18 m (two-way) and its maximum slope is 10%. The wall angle and safety berm parameters have been included in Section 16.0.

In Nyafé, the optimized pit shell is similar to that at the end of 2010 to retain the final pit shell design from the end of 2010 for the 2017 reserves. Resources in all of those shells have been converted to reserves by adding the mine dilution and recovery factors mentioned in Section 16.0.

For underground mining at Siou, an estimated in-situ cut-off grade of 2.6 g/t Au for long hole stopping and 3.0 g/t Au for cut and fill stoping was applied to the Datamine Mineable Stope Optimizer (MSO) reserves to delineate and select mining stopes. The methodology is summarized below, and details of the conversion process are provided in the next section:

- The stope designs considered only Measured and Indicated mineral resources.
- Maximum mining depth was determined by assessment of costs.
- Geotechnical assessment was undertaken by Golder and included stope dimension, ground support and pillar dimension.
- Mining shapes, applied on the resource model are designed as wireframes using Datamine MSO; wireframes provide tonnes per stope, stope number, and a weighted average grade considering internal and external dilution.
- Long hole stope dimensions vary from 5 m to 24 m in the X direction, 20 m in Y and 25 m in Z; cut and fill stope dimension vary from 4 m to 100 m in X, 10 m in Y and 4.5 m in Z. A minimum waste pillar of 10 m is kept between lenses. An external dilution of 0.5 m was added for long hole stoping and 0.25 m for cut and fill stoping. A minimum dip of 50º is considered for long hole stopes.
- Two lenses may be mined independently only if there is a minimum 10 m waste pillar between them. If there is insufficient pillar material, they are either combined in a single stope or only the economic portion is mined.
- Mine recovery (such as for sills) and other dilution as per mine design are reported in Section 16.0.
- Gold price of USD 1,200/oz.

The Mineral Reserve Statement as of December 31, 2017, is presented in Table 15.2. Open pit reserves at Siou are limited to the northern part of the pit with some remaining reserves in the South that will be mined with the crown pillar. Underground reserves extend in the southern portion of the deposit.

Table 15.2
Mana Estimated Reserves at 31 December, 2017

Deposits	Proven Reserves			Probable Reserves			Total Reserves			Stripping Ratio (Waste/Ore)
	Tonnage	Grade (g/t Au)	Ounces	Tonnage	Grade (g/t Au)	Ounces	Tonnage	Grade (g/t Au)	Ounces	
Wona-Kona	6,062,000	2.33	453,500	6,280,000	2.22	448,900	12,342,000	2.27	902,400	10.52
Nyafé	265,000	5.81	49,600	6,000	3.96	700	271,000	5.77	50,300	12.41
Fofina	33,000	4.66	4,900	3,000	3.94	300	36,000	4.49	5,200	2.95
Siou Open Pit	1,400,000	3.78	170,200	179,000	1.92	11,000	1,579,000	3.57	181,200	17.76
Siou Underground	1,047,000	5.10	171,600	1,988 000	5.38	344,200	3,035,000	5.29	515,800	-
Yama	-	-	-	651,000	1.75	36,600	651,000	1.75	36,600	12.62
ROM Pad	317,000	1.84	18,800	-	-	-	317,000	1.84	18,800	-
Total Mana	**9 124 000**	**2.96**	**868,600**	**9,107,000**	**2.88**	**841,700**	**18,231,000**	**2.92**	**1,710,300**	**11.40**

Notes:
1. All figures have been rounded to reflect the relative accuracy of the estimates.
2. Metal price of USD 1,200 per ounce gold.
3. Strip ratios include both operating and capitalized costs.

Mineral reserves were estimated by François Thibert M.Sc. geo., Directeur, Groupe Estimation Ressources et Réserves, Afrique de l'Ouest, of SEMAFO under the supervision of Michel Crevier, P.Geo., MScA, Vice President, Exploration and Mine Geology and SEMAFO's QP. The estimates were reviewed by EurIng Bruce Pilcher, CEng, FIMMM, FAusIMM(CP), Senior Mining Engineer with Micon who is the QP responsible for the estimate.

15.1 RECONCILIATION

A reconciliation of the resource block model to actual production has been carried out annually between 2014 and 2017. Gold ounces from the block model are before dilution (i.e., resources used for the reserves basis) and are compared with gold ounces outlined by grade control (GC) sampling and adjusted to mill-feed (before recovery). Table 15.3 presents the results of that reconciliation.

Resource block model contained ounces and mill-feed ounces showed a good overall correlation. Note that since early 2017, RC drilling has replaced former channel sampling as the elected grade control method at Mana, with the objective of enabling better mine planning.

Table 15.3
2014 to 2017 Reconciliation Compilation

Deposit	Resource block model (undiluted)*			GC outline reconciled to mill*			Variance		
	t	g/t	kg	t	g/t	kg	t	g/t	kg
Variance 2014 Reserves vs Reconciled Production									
Wona	850,462	2.19	1,861	774,666	2.38	1,845	-8.9%	8.7%	-0.9%
Kona	302,235	2.46	742	290,297	3.08	894	-3.9%	25.2%	20.5%
Siou	447,282	7.53	3,366	462,417	6.78	3,135	3.4%	-10.0%	-6.9%
Fofina	382,312	5.06	1,934	373,888	6.26	2,339	-2.2%	23.7%	20.9%
Grand total	**1,982,291**	**3.99**	**7,903**	**1,901,268**	**4.32**	**8,213**	**-4.09%**	**8.35%**	**3.92%**
Variance 2015 Reserves vs Reconciled Production									
Wona	172,728	2.22	383	169,688	2.32	393	-1.8%	4.5%	2.6%
Kona	551,231	2.40	1,324	619,591	2.60	1,609	12.4%	8.3%	21.5%
Siou	359,910	9.28	3,339	305,759	9.33	2,854	-15.0%	0.5%	-14.5%
Fofina	1,018,731	3.11	3,167	925,525	3.59	3,322	-9.1%	15.4%	4.9%
Grand total	**2,102,600**	**3.91**	**8,213**	**2,020,563**	**4.05**	**8,178**	**-3.90%**	**3.62%**	**-0.43%**
Variance 2016 Reserves vs Reconciled Production									
Siou	1,094,845	4.81	5,271	1,114,234	4.64	5,175	1.8%	-3.5%	-1.8%
Fofina	748,315	3.09	2,313	677,268	3.42	2,313	-9.5%	10.7%	0.0%
Grand total	**1,843,160**	**4.11**	**7,584**	**1,791,502**	**4.18**	**7,488**	**-2.80%**	**1.58%**	**-1.27%**
Variance 2017 Reserves vs Reconciled Production									
Wona (Pillar)	296,973	1.81	538	369,717	1.63	601	24.5%	-9.9%	11.7%
Siou	1,107,350	5.21	5,766	1,411,334	3.84	5,425	27.5%	-26.3%	-5.9%
Fofina	148,012	3.58	530	158,384	2.78	440	7.0%	-22.3%	-17.0%
Grand total	**1,552,335**	**4.40**	**6,834**	**1,939,435**	**3.33**	**6,466**	**24.94%**	**-24.27%**	**-5.38%**
Consolidated Variance 2014-15-16-17 Reserves vs Reconciled Production									
Wona-Kona	2,173,629	2.23	4,848	2,223,959	2.40	5,342	2.3%	7.7%	10.2%
Siou	3,009,387	5.90	17,742	3,293,744	5.04	16,589	9.4%	-14.6%	-6.5%
Fofina	2,297,370	3.46	7,944	2,135,065	3.94	8,414	-7.1%	14.0%	5.9%
Grand total	**7,480,386**	**4.08**	**30,534**	**7,652,768**	**3.97**	**30,345**	**2.30%**	**-2.86%**	**-0.62%**

* Before mining dilution

16.0 MINING METHODS

16.1 INTRODUCTION

Two mining methods will be employed to recover the ore identified in the reserve estimation at Mana. Open pit mining will continue to be used at Wona-Kona and part of the Siou ore zone. Following identification of the ore at depth, underground mining will be employed in the southern part of the Siou deposit. Although output from Fofina and Nyafé is relatively low, they are also mined by open pit methods.

16.2 OPEN PIT MINING

16.2.1 Introduction

In determining the optimal economic shape of the open pits in three dimensions, pit optimization was conducted using Datamine's NPV Scheduler software based on the Lerchs-Grossman algorithm.

Open pit mine production at Mana averages approximately 7,500 t/d of ore, mainly from the Wona and Siou pits, that can be blended with ore from other open pit sources up to a maximum of 8,000 t/d for processing in the mill. Ore in the Wona and Siou pits represents 76% of the estimated mineral reserves as at 31 December, 2017.

The Kona pit has been mined out and backfilled. References to Wona-Kona, therefore, are to the existing Wona pit.

The optimal pit shells were produced with the Lerchs-Grossman algorithm (optimization phase) in order to guide the pit designs. The pit design process consists of designing ramp accesses to the bottom of the pit using geotechnical recommendations to guide bench geometry.

The dimensions of the designed pits are shown in Table 16.1. Length is north-south and width is east-west.

Based on current reserves, the open pit mine life is eight years, with an average of 37 Mt/y material (ore plus waste) to be moved during the next three years.

Grade control is undertaken by RC drilling along sections and at locations selected by site geologists.

Table 16.1
Dimensions of the Designed Pits

Pits	Length (km)	Width (km)	Depth (m)
Nyafé Sud	0.38	0.22	85
Wona-Kona	3.62	0.70	310
Fofina	0.88	0.55	130
Siou	1.80	0.80	253
Yama	0.46	0.32	125

Considering the large volume of stripping material at the south of Siou Phase 4, (stripping ratio over 32), SEMAFO assessed the possibility of an underground mine below the open pit Phase 2. (See Figure 16.4, below for illustration of phases).

16.2.2 Geotechnical Assessment

Geotechnical pit slope designs were completed by Golder Associates (Golder) in 2016 and provided recommendations for all of the pits. These parameters are regularly updated on the basis of field mapping and production data and practices.

16.2.2.1 Siou Pit

Table 16.2 and Table 16.3 summarize the technical parameters presented in Golder's studies.

Table 16.2
Siou Pit, Slope Design Recommendations for Fully Drained Saprolite and Laterite
(Factor of Safety = 1.2)

Geotechnical Unit	Pit Sector	Operating Practice	Bench Height (m)	Bench Face Angle	Slope Height (m)	Catch Bench Width (m)	Design Inter-ramp Angle (º)
Laterite	East and West Wall	No Blasting Graded to provide drainage for Laterite	10	½H:1V (63º)	10	8.0	
Metasediment-derived Saprolite	West Wall	No Blasting Fully Depressurized Excavate bench faces along foliation	10	½H:1V[1] (63º) or Along Foliation	< 20	5.0	45
					20 to 30	6.9	41
					30 to 40	7.8	37
					40 to 50	8.8	36
					50 to 60	9.8	34
					60 to 70	10.4	33
					70 to 80	11.0	32
					80 to 90	11.0	32
					90 to 100	11.6	31
Granitoid-derived Saprolite	East Wall	No Blasting Fully Depressurized	5	½H:1V (63º)	< 20	4.6	35
					20 to 30	5.2	33
					30 to 50	5.8	31
					50 to 70	6.1	30
					70 to 100	6.5	29

Note: [1] Maximum recommended bench face angle, bench faces should be excavated and scaled along foliation.

Table 16.3
Siou Pit, Slope Design Recommendations for Saprock and Bedrock

Geotechnical Unit	Pit Sector	Operating Practice	Bench Height (m)	Bench Face Angle	Slope Height (m)	Catch Bench Width (m)	Design Inter-ramp Angle (º)
Saprock	All	Controlled Blasting Fully Depressurized Slopes	10	½H:1V (63º)	All	5	45
Foliated Footwall Metasediments	West Wall	Controlled Blasting (Pre-split) to Develop Bench Face Cleanly Along Foliation Double Benching	20	60º or Along Foliation	All	6	49
Granitoid and Metavolcanic Bedrock	East Wall	Controlled Blasting (Pre-split) Double Benching with Excellent Scaling	20	68º (average achieved bench face angle)	All	8.5	50

Note: Typical bench face angle based on foliation orientation, bench faces should be scaled back to foliation.

In light of mining experience and, in particular, the appearance of an intrusive structure at the north of the pit, these parameters were reviewed by Golder in 2017 and the results presented in a memorandum issued on 28 June, 2017 (Golder, 2017). Golder made several recommendations for slope designs in bedrock, of which the more conservative are highlighted in Table 16.4.

Table 16.4
Siou Pit, Slope Design Recommendations for Bedrock

Geotechnical Unit	Pit Sector	Operating Practice	Bench Height (metres)	Bench Face Angle	Catch Bench Width (metres)	Design Inter-ramp Angle (degrees)
Igneous Rock (Granitoid)	East Wall Slope DDR = 240 to 300 degrees	Controlled Blasting (Pre-split) Double Benching with Excellent Scaling	20	48 (Average achieved bench face angle)	8.5	37
Igneous Rock (Granitoid)	East Wall Slope DDR = 180 to 240 and 300 to 360 degrees	Controlled Blasting (Pre-split) Double Benching with Excellent Scaling	20	68 (Average achieved bench face angle)	8.5	50
Mafic Volcanic	East Wall Slope DDR = 180 to 360	Controlled Blasting (Pre-split) Double Benching with Excellent Scaling	20	68 (Average achieved bench face angle)	8.5	50

Note: DDR = Average dip direction.

16.2.2.2 Wona-Kona Pit

Since the Kona pit has been mined out and backfilled, geotechnical parameters are presented for the Wona pit, as shown in Table 16.5 and Table 16.6.

Table 16.5
Wona Pit, Slope Design Recommendation for Fully Drained Saprolite
(Factor of Safety = 1.2)

Geotechnical Unit	Pit Sector	Operating Practice	Bench Height (m)	Bench Face Angle	Slope Height (m)	Catch Bench Width (m)	Design Inter-ramp Angle (º)
Saprolite	All	No Blasting Fully Depressurized	10	½H:1V (63º)	< 20	5.0	45
					20 to 30	6.9	41
					30 to 40	7.8	37
					40 to 50	8.8	36
					50 to 60	9.8	34
					60 to 70	10.4	33
					70 to 80	11.0	32
					80 to 90	11.0	32
					90 to 100	11.6	31

Table 16.6
Wona Pit, Slope Design Recommendation in Saprock and Bedrock

Geotechnical Unit	Pit Sector	Operating Practice	Bench Height (m)	Bench Face Angle	Catch Bench Width (m)	Design Inter-ramp Angle (º)
Saprock	All	Controlled Blasting, Fully Depressurized Slopes	10	½H:1V (63º)	5.0	45
Competent and Massive Bedrock	All	Excellent pre-split and controlled blasting and bench face scaling	10	75º	4.5	54
			20	75º	9.2	54
Incompetent Bedrock (Graphitic Zones)	All		10	65º (Achieved bench face angle)	6.5 (or as appropriate)	42 (assumes 6.5 m wide catch bench)

16.2.2.3 Fofina Pit

The Fofina pit is almost completed. Geotechnical parameters are presented in Table 16.7.

Table 16.7
Fofina Pit, Slope Design Recommendations

Geotechnical Unit	Pit Sector	Operating Practice	Bench Height (m)	Bench Face Angle	Slope Height (m)	Catch Bench Width (m)	Design Inter-ramp Angle (º)
Saprolite	All	No Blasting Fully Depressurized	10	½H:1V (63º)	< 20	5.0	45
					20 to 30	6.9	41
					30 to 40	7.8	37
					40 to 50	8.8	36
					50 to 60	9.8	34
					60 to 70	10.4	33
					70 to 80	11.0	32
					80 to 90	11.0	32
					90 to 100	11.6	31
Saprock	All	Controlled Blasting, Fully Depressurized Slopes	10	½H:1V (63º)	All	5	45
Bedrock	All	Double Benching with Excellent Scaling and operator Training	20	68º (Average achieved bench face angle)	All	8.5	50

Note: See Figure 8 for delineation of bench face angle, inter-ramp angle, bench height and catch bench width.

The design parameters for the Wona and Fofina pits are the same. Details are presented in Table 16.8.

Table 16.8
Wona and Fofina Pit Design Parameters

Material	Bench Height (m)	Bench Face Angle	Catch Bench Width (m)	Inter-ramp Slope Angle (º)
Saprolite	10	65º	5.5	45
Bedrock	10	75º	4.5	54

16.2.3 Open Pit Production Rate

Overall, the total mine production rate for the coming three years is expected to average 37 Mt material moved annually. With current reserves, the life of the open pits is eight years.

16.2.3.1 Mine Dilution

Mine dilution is 10% in the Wona pit; it is estimated at 15% in all the other pits. The mining recovery rate in all pits is estimated at 97.50%. Both mining dilution and mining recovery are based on data collected on regular basis from since 2008.

In addition, in order to reduce the dilution and ore loss due to blasting, two new practices have been inserted in the mining for the ore blasts which are:

- Blast Movement Technologies (BMT) to be able to follow the movement after blast.
- Use of electronic detonators for a better displacement control.

16.2.3.2 Mining Equipment Fleet

The total material to be moved over the eight-year life of all open pits is 184.8 Mt including 15.2 Mt of ore. At Siou, the remaining material to be moved is 29.6 Mt, including 1.60 Mt of ore.

SEMAFO owns the majority of the mining fleet but it also uses contractors' services and rental equipment. The current fleet includes:

- Owner's equipment:
    - 2 Excavators CAT 6018 of 10 m^3 bucket capacity.
    - 8 Excavators PC1250SP-8R of 6.5 m^3 bucket capacity.
    - 14 90-t Komatsu HD785-7 trucks.
    - 25 65-t HD605-7R/ HD465-7EO/CAT775F trucks.
    - 6 Atlas Copco drill rigs: 2 ROC F9-11; 2 T45; 2 DTH
    - Ancillary equipment: 2 motor graders, 5 dozers, 3 wheel-loaders, 1 wheel-dozer and 3 water trucks (each 50 m capacity).
- Rental/contractor equipment:
    - 2 Excavators: CAT 6015 and CAT 390F (backup).
    - 8 CAT 777 D trucks.
    - 2 Atlas Copco DTH D60 drill rigs.
    - 2 Atlas Copco T50 drill rigs.
    - Ancillary equipment: grader, dozer, loader.

The fleet averages has the capacity to move about 120,000 t/d of material moved, or 40 Mt/y.

16.2.4 Mine Production Schedule

The mine production schedule was developed to feed the mill at a nominal rate of 7,000 t/d. Figure 16.1 and Figure 16.2 below present the annual extraction schedule for the open pit operation.

Figure 16.1
Open Pit Ore by Year and by Pit

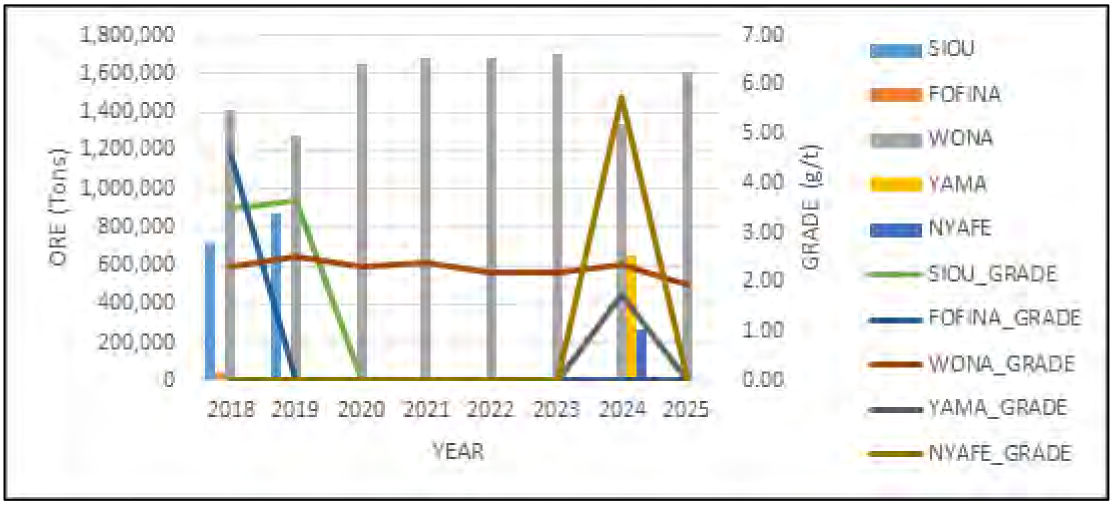
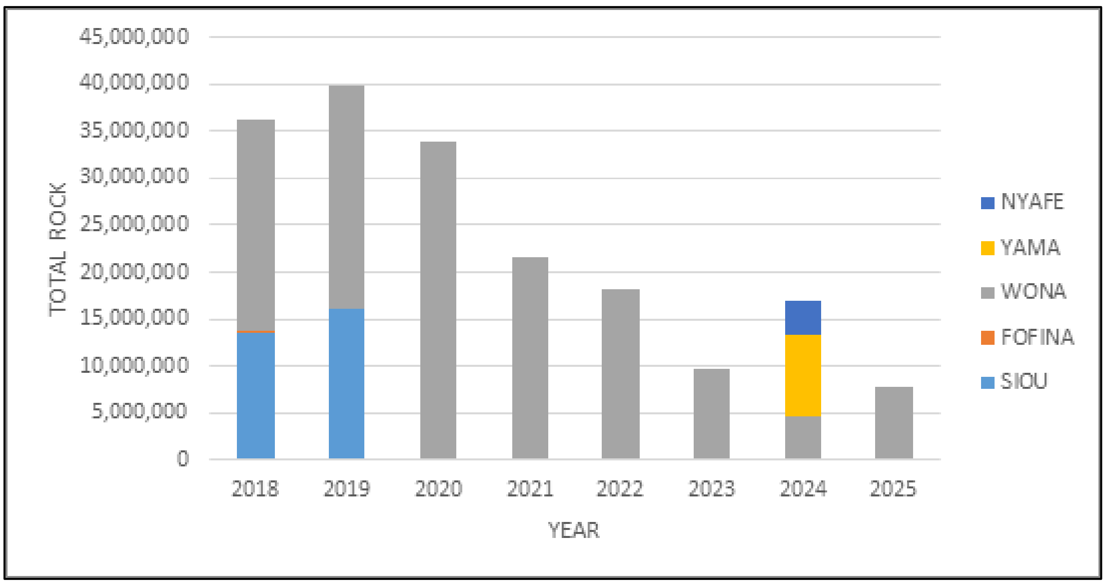


Figure 16.2
Total Open Pit Production by Year



16.3 TRANSITION FROM OPEN PIT TO UNDERGROUND MINING AT SIOU

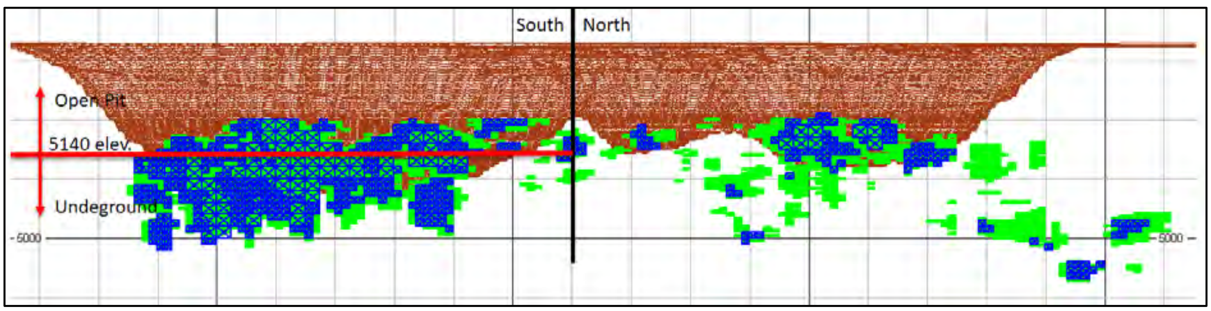
An initial assessment of the transition elevation between the open pit and an underground mine at Siou was undertaken in an in-house preliminary economic evaluation completed in 2015.

The method used to evaluate the transition elevation is based on the value of a series of slices at every 20 m of the ore zone going downwards. For each 20 m slice, an ore value was calculated based on comparison of the open pit and underground mining costs to recover the same 20 m slice. This method results in the optimum value of the ore zone without taking in consideration timing and scheduling.

At the time of the preliminary study, the information at depth was scattered, but showed good potential to justify more exploration. The Siou zone was divided into two subzones to ensure that results for the south zone would not influence the north zone since the Datamine Mineable Stope Optimizer (MSO) results for cut and fill and long hole were more scattered.

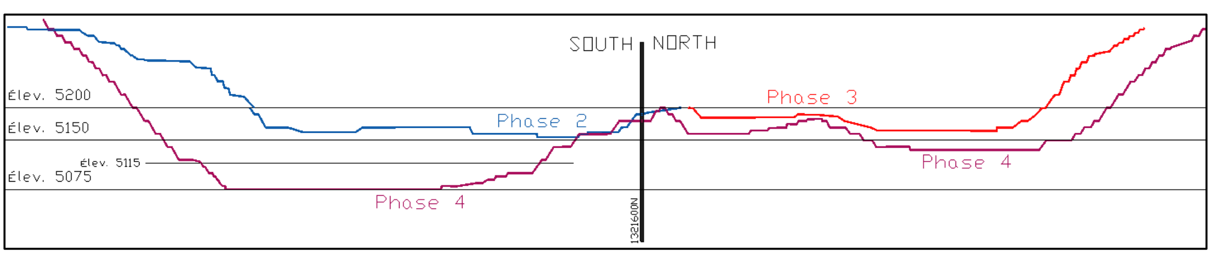
Figure 16.3 shows the results of this evaluation (MSO longhole stope results are shown in blue and cut and fill stopes in green). For the south subzone, the transition elevation is at 5,140 shown with a red line on Figure 16.3. For the north subzone, below elevation 5,140, there is insufficient mineralization identified to date to justify recovering it. This red line represents the limit between the ore highest value with an open pit and an underground mine, without taking in consideration the scheduling.

Figure 16.3
Longitudinal View of Siou Open Pit Shell and MSO Stopes



The Siou open pit was designed originally with four phases/pushbacks going down to elevation 5,075 without considering the underground potential. There is no Phase 3 in the south subzone. In spring, 2017, the slope angle was revised by Golder which increased the stripping ratio for the Phase 4 pit. It was decided, therefore, to review the value of all Phase 4 ore mined by open pit (see Figure 16.4) and compare it with the value by underground methods based on the reserves and 2017 exploration results.

Figure 16.4
Siou, Reserve Evaluation in Phase 4 Open Pit



As a result of this evaluation of production scheduling, life of mine and ore value, SEMAFO will use open pit mining in Phase 4 of the north subzone and will switch to underground mining in the south subzone from Phase 2. This will provide flexibility to recover ore below the south subzone Phase 4 open pit. This mineralization was identified with the 2017 exploration program, see Golder, 2017. The analysis indicates that underground operations eliminate the need to mine 62 Mt of open pit waste rock.

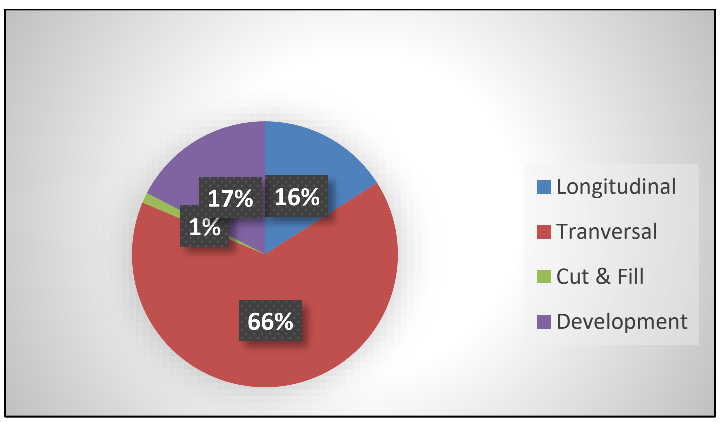
16.4 UNDERGROUND MINING – SIOU

16.4.1 Underground Mining Method

Two underground mining methods will be used at Siou: long hole (longitudinal retreat and transversal) and cut and fill mining. These were selected because of the inclination of mineralized lenses and ore (stockwork) thickness. Long hole mining will be used when a stope can be mined economically above a dip of 50º degrees and cut and fill below 50º. Most of the areas where the Siou orebody is located in the hanging wall will be mined cut and fill.

Figure 16.5 shows the ore tonnage breakdown depending on the mining method; long hole longitudinal retreat, long hole transversal, cut and fill, and development.

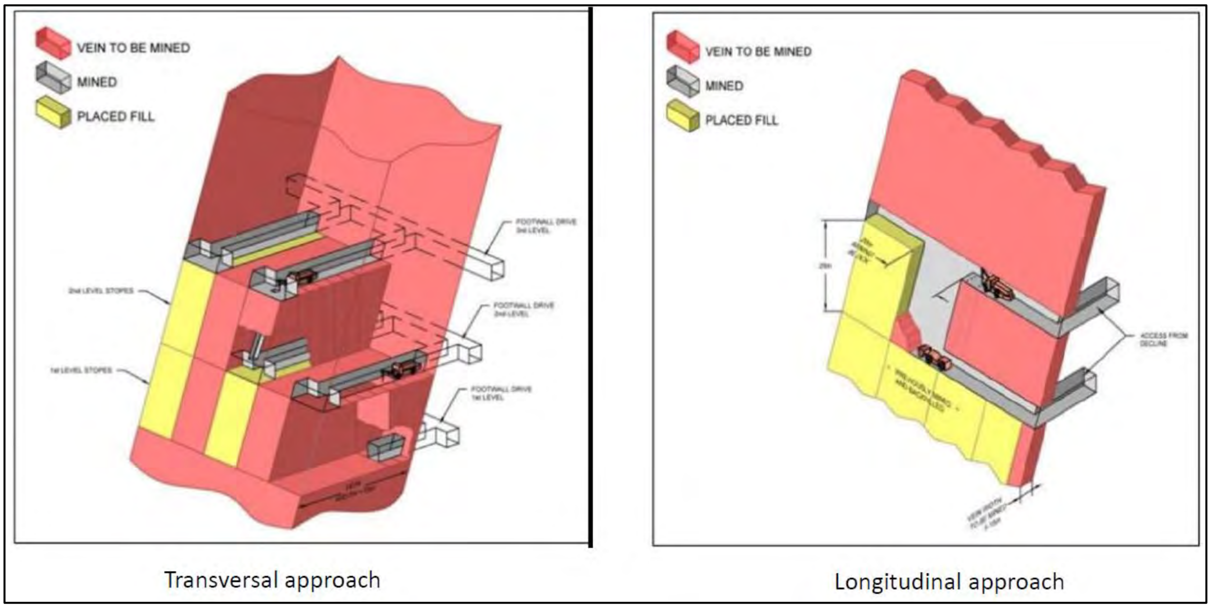
Figure 16.5
Siou Underground Ore Tonnage Breakdown by Mining Method



16.4.1.1 Long Hole Mining

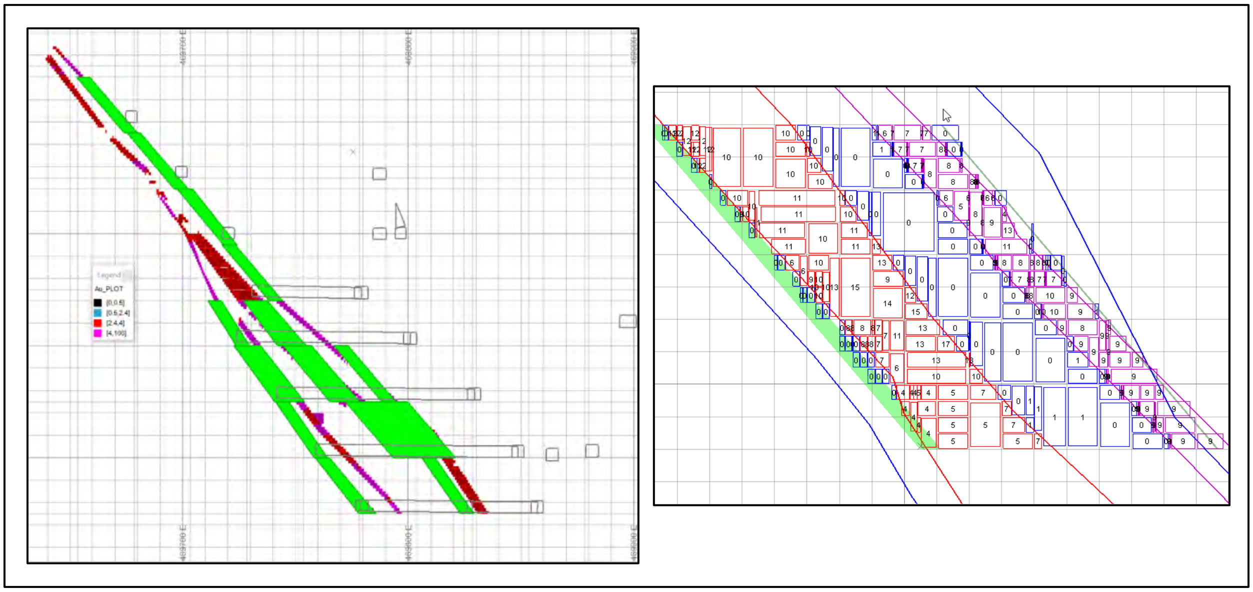
Two different approaches will be used in long hole mining, depending on the width of the ore zone. Where stopes are wider than 10 m, a transversal approach will be used; where they are narrower, a longitudinal approach will be used. The longitudinal approach will be used mainly at the extremities of the ore zone (see Figure 16.6).

Figure 16.6
Siou Underground Long Hole Mining Methods



The long hole stope delineation was done using MSO on the geological block model. The geotechnical recommendations on stope dimensions were used as the input parameters (see Section 16.4.2). Footwall and hanging wall dilution of 0.5 m was added to the stope tonnage and grade (Golder 2017). The grade of the diluting material depends on the block model. In the case of the footwall lenses (stockwork), the MSO shows that the stope can be designed to recover up to two lenses at once. In other areas, the software has highlighted only the best lens for recovery where there is insufficient pillar material between two lenses to mine safely or the width is not sufficient to mine independently. Figure 16.7 shows a cross section representing the recovery of the mineralized zone. In the left-hand diagram, the green shows the stoping areas, the red and magenta, the mineralization left in place because of lack thickness or pillar width between the two potential stopes. The right-hand diagram shows the recovery of two mineralized lenses within the same stope in the stockwork. The MSO calculation has estimated that the overall dilution for the long hole stope is 41.5%.

Figure 16.7
Recovery of the Mineralization Zone



Consolidated backfill and loose rock will be used to ensure safe ore recovery. Cemented rock fill at 4% cement will fill the primary stopes of the transversal stoping to ensure stability, and secondary stopes will be backfilled with loose rock. For the longitudinal stope, only a wedge close to the next stope will be backfilled with cemented rock fill, the rest will be loose rock.

For the longitudinal retreat, drives will be developed at the bottom and top of the stope. Mine geologists will align the development to follow the ore, map the heading and collect samples to confirm the stope with geological model.

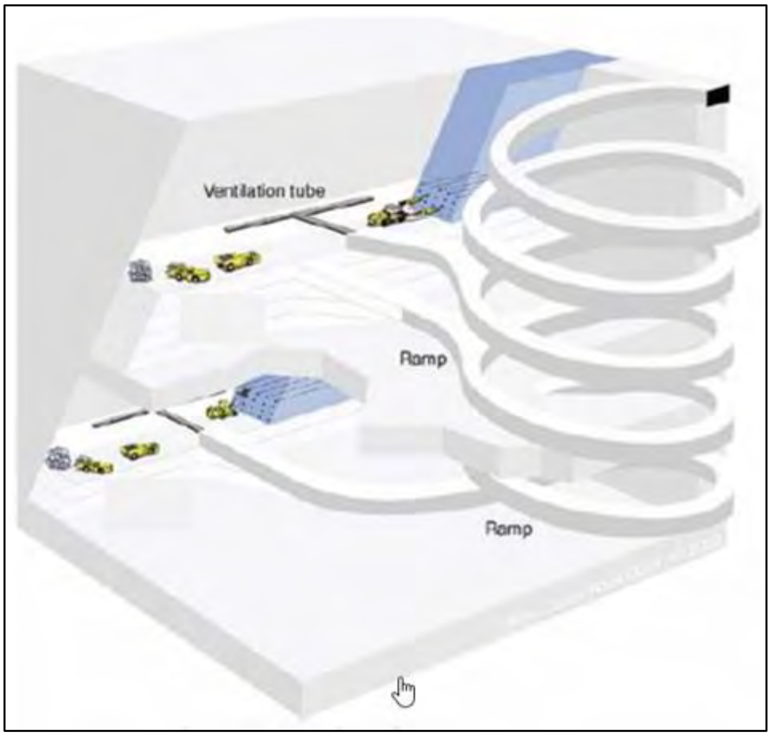
In the transversal approach, the surveyors will align the development. Mine geologists will map and sample the heading to gain knowledge on the ore zone and to corroborate the geological model. The stope will be designed according to the mapping results and geological model.

The ground support will be undertaken according the geotechnical recommendation. Small diameter hole drills will do production drilling. A drop raise will be excavated to create a free face and a void for production blasting.

16.4.1.2 Cut and Fill Mining

Stope delineation for cut and fill mining was also performed using the MSO from Datamine. The minimum mining size has been set to 4.5 m by 4.5 m. In this case, 0.2 m of dilution from the wall was used to evaluate the tonnage and grade of the cut. An overall dilution for the cut and fill stope was estimated with the MSO calculation at 37.9%. Saprolite, which has a yellowish colour, will be used for backfill to easily distinguish broken ore and the backfill material. Figure 16.8 shows a cut and fill general mining method schematic.

Figure 16.8
Siou Underground Cut and Fill Mining Method



From Atlas Copco.

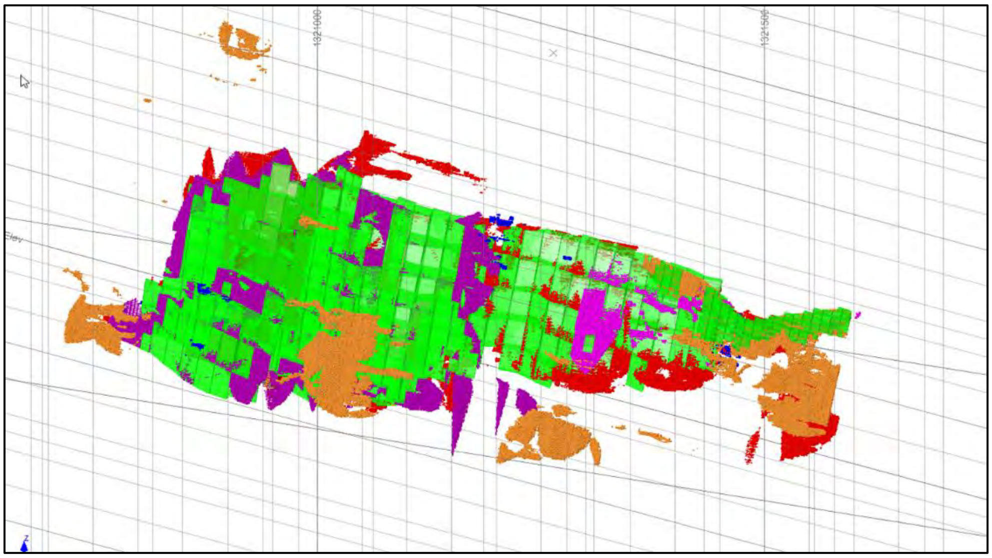
Pivot ramps will be driven from the main access ramp. There will be five 4.5 m cuts per access and the production drilling will be done by jumbo. The ore will be hauled in a loading station located in the ramp, in front of the stope access. The air to ventilate the heading will be brought in the stope by fan and vent bag from the main ramp.

16.4.1.3 Mining Recovery

Figure 16.9 shows the stoping (in light green) and the mineralization left in place. The MSO or the mining plan did not recover all the identified mineralization because of either grade, thickness or location with the infrastructure.

The MSO recovery, before the mining plan, was estimated at 81.0% but the MSO recovery of the mining plan is increased to 90.3% by excluding the isolated areas that have been discarded.

Figure 16.9
Identified Mineralization versus MSO Stoping



16.4.2 Underground Geotechnical Analysis

Golder was retained to perform the geotechnical analysis of the underground project at Siou. This includes stope dimension, ground support and pillar dimension (Golder 2017).

The geotechnical investigation occurred in the second and third quarter of 2017 while doing the exploration drilling. The rock is qualified as Good to Very Good according to the Q' index for the four geological units present at Siou.

To summarize the design criteria:

- Crown pillar: above the long hole stope
    - 10 m crown pillar for a 15 m wide span.
    - 15 m crown pillar for a 20 m wide span.
    - 18 m crown pillar for a 25 m wide span.
- Crown pillar: above cut and fill
    - 10 m crown pillar for a span smaller than 12 m.
    - 5 m crown pillar for a span of 6 m.

Recovery of the crown pillar will likely impact the stability of the east wall. It is suggested that recovery of the crown pillar takes place at the end of the mine life. Table 16.9 summarizes the recommended long hole stope dimensions.

Table 16.9
Recommended Stope Geometries

Stoping Method	Q'	Strike (m)	Height (m)	Span (m)	Cable Bolting
Transverse	Geomean	20	30	30	Cable bolting not likely required. If unstable hanging walls are experienced, consider cable bolting with 2.0 m to 2.5 m spacing.
	Q' = 4	10	30	30	Cable bolting not likely required. If unstable hanging walls are experienced, consider cable bolting with 2.0 m to 2.5 m spacing.
		20	30	30	Cable bolts recommended in the HW and back with 2.0 m toe spacing.
Longitudinal	Geomean	20	30	12	No
		20	30	20	Can be developed with cable bolts.
	Q' = 4	10	30	12	No

Golder, 2017.

In the case of parallel stoping, a 10 m pillar will be required between the stope. The footwall stope will be mined first. For the ground support, refer to Table 16.10.

Table 16.10
Recommended Ground Support

Ramp	Back	2.4 m fully resin grouted rebar or Swellex with corrosion protection on a 1.2 m by 1.2 m spacing with galvanized #6-gauge welded wire mesh.
	Walls	1.8 m galvanized split sets on a 1.2 m by 1.2 m spacing with galvanized #6-gauge welded wire mesh.
Transverse stope accesses	Back	1.8 m fully resin grouted rebar on a 1.2 m by 1.2 m spacing with #6-gauge welded wire mesh.
	Brow	Three rows of 2.4 m fully bonded rebar on a 1.2 m by 1.2 m spacing with #6-gauge welded wire mesh.
	Walls	1.5 m split sets on a 1.2 m by 1.2 m spacing with #6-gauge welded wire mesh.
Cut and fill and longitudinal stope accesses (6 m wide)	Back	2.4 m resin grouted rebar or Swellex on a 1.2 m x 1.2 m spacing with #6-gauge welded wire mesh.
	Walls	1.5 m split sets on a 1.2 m x 1.2 m spacing with #6-gauge welded wire mesh.
Cut and fill and longitudinal stope accesses (up to 12 m wide)	Back	4 m Super Swellex (PM24) bolts or 5 m cable bolts on a 1.2 m x 1.2 m spacing located in the centre of the back span, complemented by 4 m Swellex PM12 on a 1.2 m x 1.2 m spacing on the remaining of the back and shoulder. Bolts installed with #6-gauge welded wire mesh.
	Walls	1.5 m split sets on a 1.2 m by 1.2 m spacing with #6-gauge welded wire mesh.
Intersections (effective span up to 9 m)	Back	3.0 m resin grouted rebar or Swellex (PM12) on a 1.2 m by 1.2 m spacing with #6-gauge welded wire mesh. Extend to a minimum of 2 bolting lines (or rings) before and beyond all intersection sides.
	Walls	1.5 m split sets on a 1.2 m by 1.2 m spacing with #6-gauge welded wire mesh. Install 2 evenly spaced rows of #0-gauge welded wire mesh strapping, extending at least 3 m into each drift if corners are experiencing heavy blast damage.

Golder, 2017.

16.4.3 Hydrogeological Analysis

Golder was also retained to investigate the hydrogeology. While undertaking the geotechnical investigation, data were also obtained on the potential ground water inflow (Golder 2017). Under a steady state condition and at the end of the excavation, a total inflow of about 700 m^3/d is estimated for the underground mine.

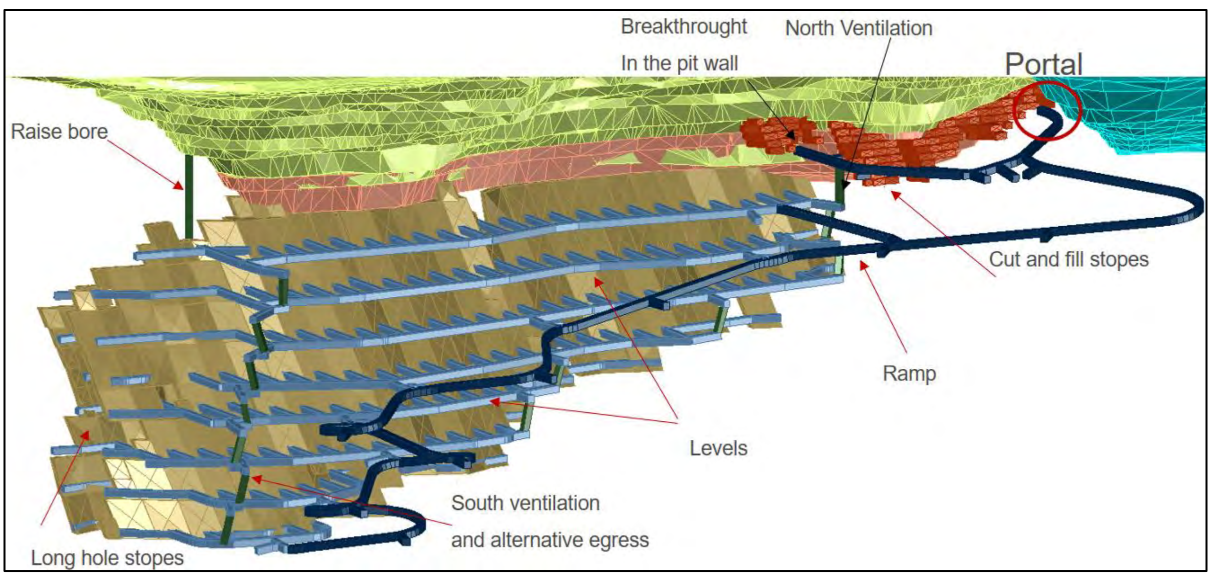
16.4.4 Underground Mine Design

The mine design and planning was based on the Siou geological model MSO results. The production rate will be 2,000 t/d using a contract miner. Stope dimensions were based on the geotechnical analysis. However, it was decided to use 25 m intervals between levels instead of 30 m, as recommended. This is to reduce the possibility of excessive deviation on a 50º stope inclination.

A ramp will give access to the underground mine via a single portal. Its dimension will be 5.5 m by 5.5 m and it will be driven at -14% gradient with a conventional mechanized jumbo drill. There will be mucking bays to allow the development to continue whilst truck loading. In the future, the bay will be used as a by-pass to facilitate the circulation in the ramp.

The main ramp will start at the 5,200 elevation at the bottom of the pit, near the middle of the Siou open pit excavation. This will allow the ramp to start while mining in the north of the open pit is still active. This location also allows recovery of the crown pillar (pit floor) in a safe manner. The ultimate dimensions of the underground operation will be 600 m along strike by 200 m deep. Figure 16.10 shows an isometric view of the mine design.

Figure 16.10
Siou Isometric View of Underground Mine Design



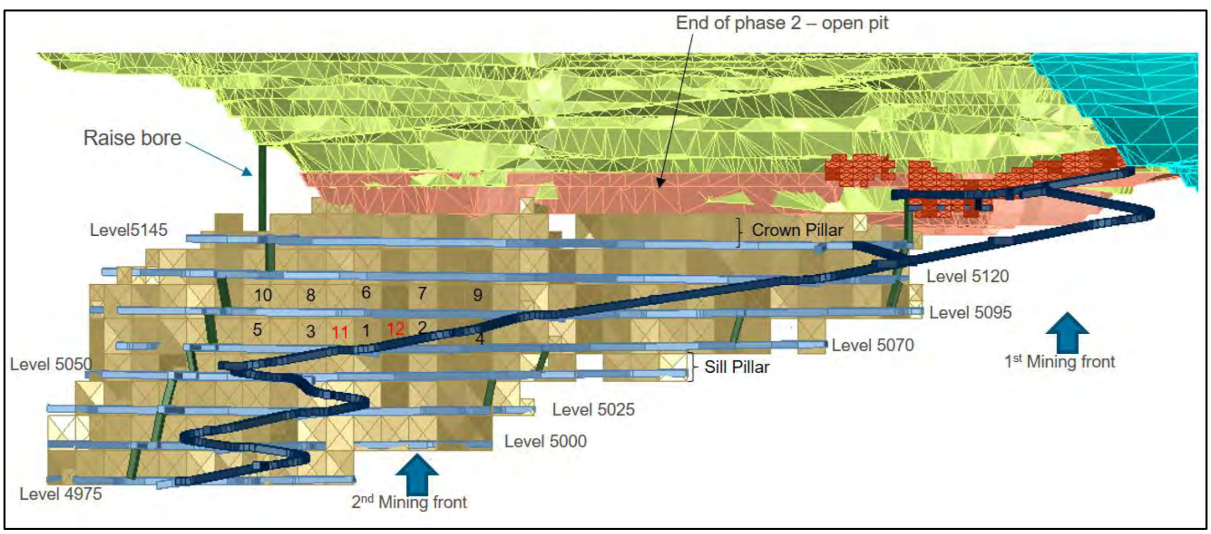
SEMAFO, 2017.

All ramps and levels will be excavated at 5.5 m by 5.5 m while the level stope accesses and ore development will be 5.0 m by 5.0 m. The raise dimension is established at 4.5 m by 4.5 m and will be drilled with an in-the-hole hammer (ITH) drill and excavated by the drop raise technique. A raise borer will be used to connect the underground with the surface at the south end. Ground support will be installed in the raises to allow a manway installation. This manway will be used as alternative egress from the mine in case of emergency. The ore zone (stockwork) will be developed mainly with the transverse method but at the extremities, the development will be longitudinal as the lenses are generally thinner.

A crown pillar between the open pit and the underground will be left in place and be recovered at the end of the mine life. This pillar will separate the underground and the surface mine to ensure stability while mining underground.

Figure 16.11 shows a high level underground mining sequence. The development will start with the access ramp and priority will be given to drive a breakthrough into the pit wall to facilitate the ventilation for the north ventilation raise, the development of the decline and the 5145 level for raise bore location. The first production will be above the 5070 level. Mining will commence with primary stopes and will follow with the secondary stopes. Figure 16.11 illustrates an example of the sequence with the primary stopes numbered in black and the secondary in red. The decline development will continue down to the 4975 level. A 20 m sill pillar will separate the second mining front from the first mining front and will be recovered with the upper pillar at the end, with a recovery of 75%. Towards the end of the mine life, 65% of the crown pillar will also be recovered.

Figure 16.11
Underground Mining Sequence



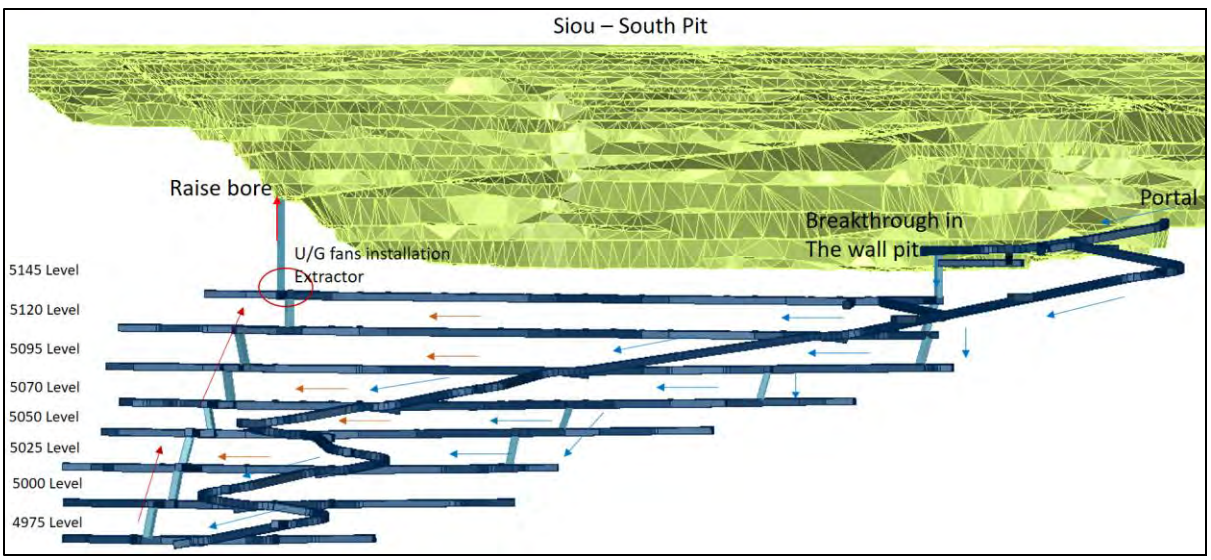
SEMAFO, 2017.

16.4.5 Underground Mine Services

16.4.5.1 Mine Ventilation

The fresh air quantity requirement has been established following Canadian ventilation standards. The required airflow was calculated with the full network excavated and all equipment. Utilization percentages were taken into consideration assuming that not all equipment will be used in the same time in the mine. A total air flow of 250 m^3/s for low sulphide fuel would normally be required during the peak production when the mine is fully developed. However, with the high sulphide fuel that is available in Burkina Faso, the required flow is 390 m^3/s. Fans will be installed in the ventilation access to the raise bore and will draw the air from the main portal and the north ventilation raise, then through the workings and out using the south raise bore as the exhaust. Vent doors will be installed at the level raise access to control the required flow on the level. Vent walls will be also required as the mine expands its network to control the air flow towards the working area. Figure 16.12 shows the main ventilation network at Siou. Auxiliary fans will be used to bring the fresh air to the working faces.

Figure 16.12
Ventilation Network

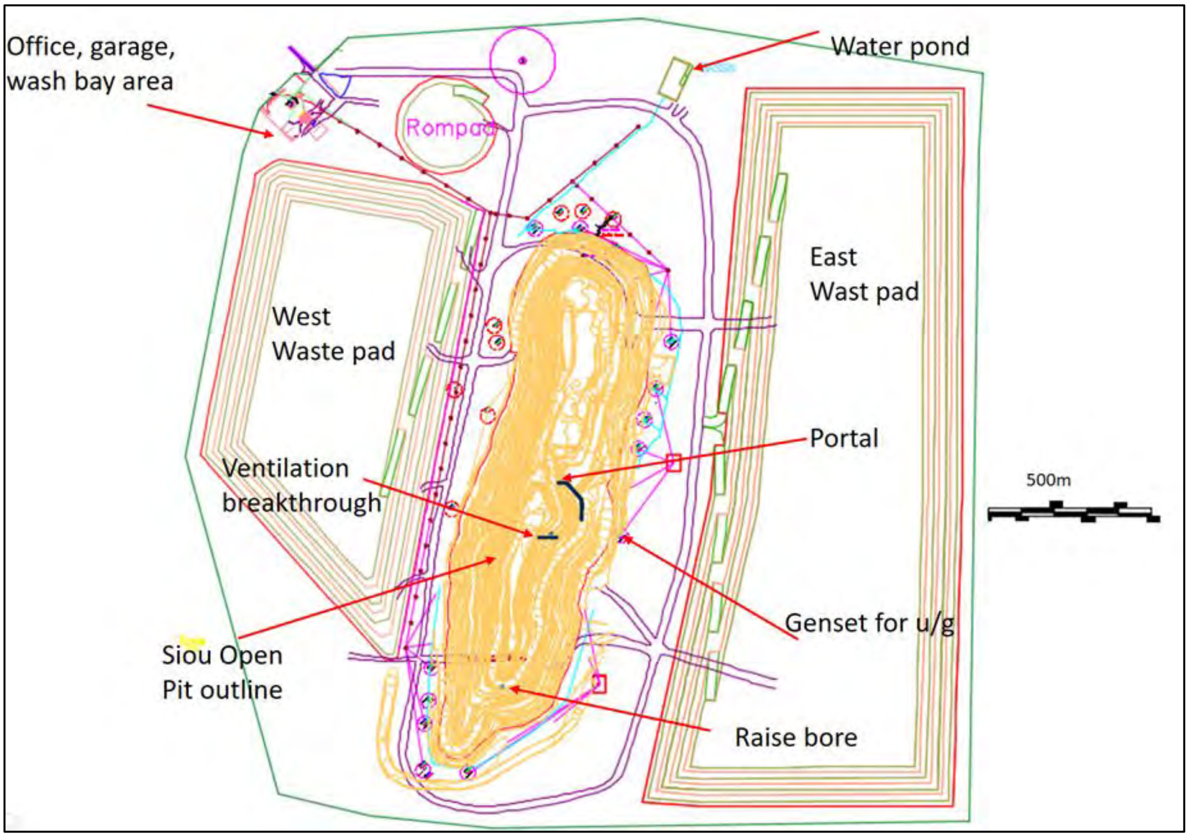


SEMAFO, 2017.

16.4.5.2 Water Supply

At the beginning of the Siou open pit, wells were drilled around the pit to lower the water table during surface mining. This water is still pumped into a pond on surface and will be used to supply the underground mine. The pond will be also used to collect the water from the underground mine dewatering. The location of the pond is shown in Figure 16.13, surface facilities plan view.

Figure 16.13
Surface Facilities Plan View



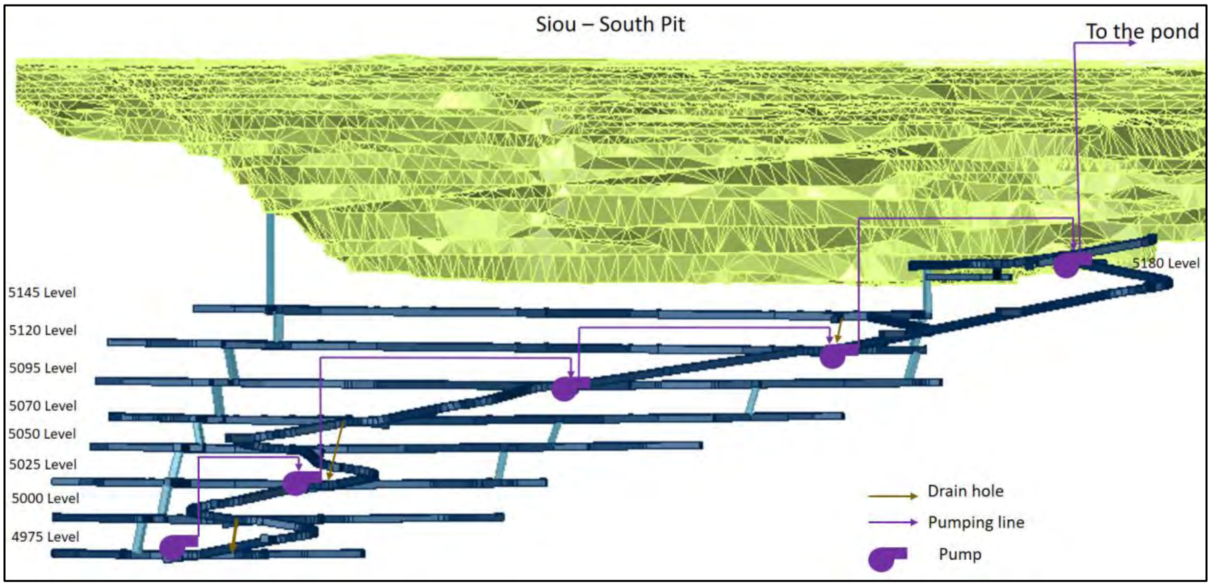
SEMAFO, 2017.

16.4.5.3 Dewatering

The dewatering by the wells located around the pit will still be required after surface mining has finished. It will help to keep the water table down and reduce the quantity of water to be pumped out from the underground mine. According to the hydrogeology, when fully excavated, there will an expected inflow of 700 m^3/d.

Small sumps will be excavated at the entrance of each working level to collect the water. Where possible, holes will be drilled to drain the water to the level below. On levels 4975, 5025, 5095 and 5120 pumps will be installed to bring the water up to level 5180 in stages. On the 5180 level, larger dirty and clear water sumps will be developed. There will be a drain in the dirty sump to allow decanted water (clear) to pass to the clear water sump which will be pumped out to the surface pond. Figure 16.14 shows the pumping layout.

Figure 16.14
Pumping Layout



SEMAFO, 2017.

16.4.5.4 Electrical Distribution

The electrical power will be generated by an 11 kVA generator set; the first genset will be installed on surface to start the development. A cable will be run from the pit down to a substation and then into the main ramp. As the mine expands and the demand for electrical power increases, other gensets will be installed underground. At the peak demand, it is anticipated that four gensets will be required.

16.4.5.5 Compressed Air

A compressor will be installed at the pit bottom adjacent to the portal. One 160 kW electrical compressor will service the mining area. The compressed air network in the mine will be used mainly for drilling and explosive loading.

16.4.5.6 Mine Communications

A leaky feeder system will be installed underground. This will allow effective communication between all underground personnel and surface installations.

16.4.5.7 Mine Facilities

The main facilities for the underground development will be on surface, as shown in Figure 16.13. This includes office, warehouse and maintenance facilities such as wash bay and workshop. There will be a fuel station and an area to store used oil which will be collected and disposed by the fuel company. A cement batch plant will be installed by the contractor for cement needs such as backfill, concrete floor or shotcrete.

The existing ROM pad from the open pit will be used to store the ore from underground. This ore is transported by a contractor to the mill.

16.4.6 Underground Mine Operation

The underground mine will be operated by an underground mining contractor as a turnkey project. The contractor will be in charge of all mining aspects including mobile, fixed equipment and the maintenance, mine services and facilities. The contractor will also put in place the safety practice and working procedure in conjunction with SEMAFO.

The underground mine will work on two 12-h shifts per day. There will be two hours between the shifts to allow for shift handovers and the ventilation to clear the blast fume.

16.4.6.1 Drilling

There will be different drilling units depending of the work needed to be done. Jumbo drills will be used for drifting and for cut-fill mining. These units will also be used to drill holes for the appropriate ground support.

For the long hole production drilling, an electro-hydraulic rig will be used. An ITH will drill a slot raise with the V30 and ventilation raise.

16.4.6.2 Blasting

Explosives storage is located near the Wona open pit. Explosives will be transported from there to the underground mine each day depending of the quantities needed. There will be separate powder and detonator magazines excavated underground to securely store one day's supply. Any excess explosives and detonators not used during the day will be returned to the underground magazines.

An explosive transport vehicle will deliver the explosive and accessories at the headings.

During the mine development there will only be a couple of faces active and blasting can occur at any time during the day. However, procedures will need to be in place to ensure that the development operation is carried out safely. When the mine is in full production, blasting will only occur at the end of the shift using the proper procedures.

16.4.6.3 Ground Support

The ground support will be installed according to the geotechnical analysis. A shotcrete machine will be also available if the need occurs. The cable bolts holes will be drilled with a top hammer drill.

The SEMAFO mine engineering department will inspect the mine to ensure that the ground support is completed according to the specifications. If other unstable ground conditions occur, the situation will be evaluated in conjunction with the contractor to ensure the excavation stability and the safety of the operation is maintained.

16.4.6.4 Mucking and Hauling

Scooptrams with a 9 yd^3 bucket will be used to muck the development faces and the stopes.

Low profile underground trucks with a 60-t nominal capacity will haul the broken material to surface via the decline. The ore will be hauled from underground to the ROM pad and then transported to the mill at the Wona site.

The waste development rock will be hauled out of the underground mine and stored temporarily in the pit bottom. Whilst on surface, the trucks will be used to transport waste material around the bottom of the pit for backfill purposes.

16.4.6.5 Backfill

Two types of backfill will be used depending of the mining method. Loose rock fill will be used in the cut and fill stope and cemented rock in long hole stopes. Saprolite is the preferred material to backfill the cut and fill stopes. This fine material has a different colour from the ore and it will be easier to identify the ore from the backfill while mucking. This will minimize the backfill dilution in a cut and fill stope.

In the transverse long hole stopes, the whole void of the primary stope will be filled with 4% cemented rockfill and the secondary stopes will only be filled with waste rock. In the longitudinal retreat long hole stopes, only the wall adjacent to the following stope will be filled with 4% cemented rockfill to create a wedge in half of the stope; the rest of the stope will be filled with waste rock.

A batch plant will be installed on surface to make the cement for backfill and shotcrete needs. The cement will be transported underground with a cement truck.

16.4.7 Equipment

Table 16.11 shows the list of equipment required for the project at peak production.

Table 16.11
Fixed and Mobile Equipment

Equipment	Main Activity	Number
Jumbo drill DD421-60C or similar	Development	4
Cablebolter	Production	1
Longhole drill DL420-15C or similar	Production	1
ITH & V30 or similar	Production (slot raise)	1
Scooptram R2900G or similar	Production/Development	4
Truck TH663 or similar	Production/Development	5
Cement truck – Tranmixer or similar	Production	2
Explosive vehicle. – Charmec 1614B	Production/Development	2
Grader – Cat 12H or similar	Road bed maintenance	1
Service truck	Maintenance	1
Surface Loader –IT L120F or similar	Service	4
Store truck –4X4	Service	1
Bus	Employees transportation	2
Pickup t/backs	Supervision/Engineering/Geology	12
Twin Cab – 4x4	Light vehicle	4
Troop Carrier	Employee transportation	2
Batch Plant	Production	1

16.4.8 Personnel

The total workforce required per year is shown on Figure 16.15. Years 1 and 7 are not full years (see Table 16.12 for a summary of the work force).

Figure 16.15
Total Workforce

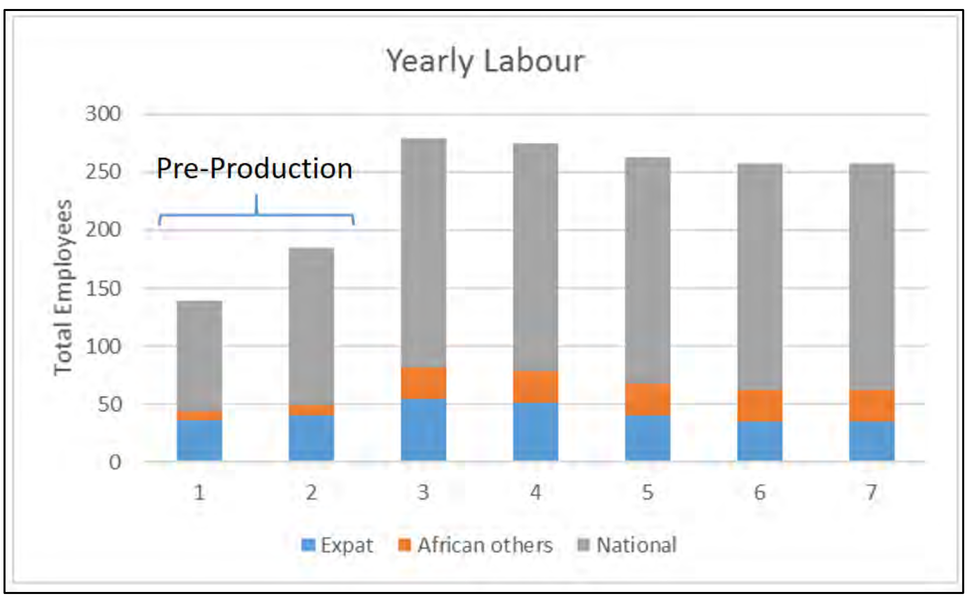


Table 16.12
Mana Mining Operation, Summary of Work Force Requirements

Personnel Numbers	Contractor/ Owner	Expatriate/ National	Y1	Y2	Y3	Y4	Y5	Y6	Y7
Mining Staff									
Site Manager	Contractor	E	1	1	1	1	1	1	1
Alternate Site Manager	Contractor	E	1	1	1	1	1	1	1
Mine Foreman	Contractor	E	2	2	2	2	2	2	2
Mining Engineers	Contractor	E	1	1	2	2	2	2	2
Supervisor	Contractor	E	3	3	3	3	3	3	3
Safety Training Coord. Mine Rescue	Contractor	E	4	4	4	4	4	4	4
Jumbo Operator Trainer	Contractor	E	4	5	8	8	8	5	4
LHD Operator Trainer	Contractor	E	3	3	6	6	6	3	3
Surveyor	Contractor	E	2	2	2	2	2	2	2
Production Trainer	Contractor	E	-	-	2	2	2	2	2
Procurement Supervisor	Contractor	E	2	2	2	2	2	2	2
General Underground Trainer	Contractor	E	3	5	5	5	1	1	1
Mine Engineer	Owner	E	2	2	3	3	3	3	3
Surveyor	Owner	N	2	2	4	4	4	4	4
Ventilation Technician	Owner	N	1	1	1	1	1	1	1
Rock Mechanic Technician	Owner	N	1	1	1	1	1	1	1
Sub Total			**32**	**35**	**47**	**47**	**43**	**39**	**36**
Maintenance Staff									
Maintenance Foreman	Contractor	E	2	2	2	2	2	2	2
Underground fitter trainer	Contractor	E	3	6	9	9	9	6	6
Underground Electrician trainer	Contractor	E	3	3	3	3	3	3	3
Auto-electrician	Contractor	E	3	3	3	3	3	3	3
Sub Total			**11**	**14**	**17**	**17**	**17**	**14**	**14**
Mining Operation									
Shift Boss	Contractor	N	-	-	3	3	3	3	3
Cable Bolter Operator	Contractor	N	-	-	4	4	4	4	4
Long Hole Driller	Contractor	N	-	-	3	3	1	1	1
Scooptram Operator	Contractor	N	-	-	6	6	6	6	6
Scooptram Operator	Contractor	N	-	4	4	4	4	4	4
Batcher	Contractor	N	-	4	4	4	4	4	4
Agitator Truck Batcher	Contractor	N	-	-	4	4	4	4	4
Charge Up Operator	Contractor	N	8	8	16	16	16	16	16
Truck Driver	Contractor	N	8	8	16	16	16	16	16
Service Crew	Contractor	N	6	12	24	24	24	24	24
Grader Operator	Contractor	N	1	2	4	4	4	4	4
Storeman	Contractor	N	4	4	8	8	8	8	8
ITH Driller	Contractor	N	-	1	1	1	1	1	1
Bit Sharpener	Contractor	N	4	4	8	8	8	8	8
Nipper	Contractor	N	4	4	8	8	8	8	8
Cap Lamp Attendant	Contractor	N	4	4	4	4	4	4	4
Magazine Keeper	Contractor	N	4	4	4	4	4	4	4
Cleaners	Contractor	N	6	6	6	6	6	6	6
Drivers	Contractor	N	1	1	1	1	1	1	1
HR officer	Contractor	N	1	1	1	1	1	1	1

Personnel Numbers	Contractor/ Owner	Expatriate/ National	Y1	Y2	Y3	Y4	Y5	Y6	Y7
Administration Staff	Contractor	N	2	4	6	6	6	6	6
Mining Engineers	Contractor	N	2	2	4	4	4	4	4
Translators	Contractor	N	4	4	8	8	8	8	8
Surveyor	Contractor	N	2	2	2	2	2	2	2
OHS Coordinators	Contractor	N	2	4	4	4	4	4	4
General Labour	Contractor	N	8	8	12	12	12	12	12
Sub Total			**71**	**91**	**165**	**165**	**165**	**165**	**165**
Geology									
Geologist	Owner	E	2	2	2	2	2	2	2
Geomatician	Owner	E	1	1	1	1	1	1	1
Geologist	Owner	N	2	4	4	4	4	4	4
Geomatician	Owner	N	1	2	2	2	2	2	2
Sampler	Owner	N	4	6	6	6	6	6	6
ROM Pad Dispatcher	Owner	N	-	2	2	2	2	2	2
Sub Total			**10**	**17**	**17**	**17**	**17**	**17**	**17**
Maintenance									
Shift Fitter U/G	Contractor	N	4	4	8	8	8	8	8
Worksop Fitter Surface	Contractor	N	4	8	8	8	8	8	8
Boiler Maker	Contractor	N	2	2	2	2	2	2	2
Trade Assistant/Service Man	Contractor	N	2	2	4	4	4	4	4
Auto Electrician	Contractor	N	-	4	4	4	4	4	4
Power House	Contractor	N	4	4	4	4	4	4	4
Light Vehicle Fitter	Contractor	N	1	2	2	2	2	2	2
Apprentice 4^{th} Year	Contractor	N	4	4	4	4	4	4	4
Maintenance Planner	Contractor	N	4	4	4	4	4	4	4
Electrician	Contractor	N	4	4	4	4	4	4	4
Subtotal			**29**	**38**	**44**	**44**	**44**	**44**	**44**
Total Personnel			**153**	**195**	**290**	**290**	**286**	**279**	**176**

16.4.9 Underground Production Schedule

The Siou underground ore mining rate will be 2,000 t/day. The material will be extracted from the long-hole stopes, the cut and fill stopes and development headings depending on the availability, accessibility and scheduling.

To achieve this rate, there will be a ramp up in ore production while developing the mine. The pre-production schedule has been established to ensure sufficient advanced development to sustain the nominal production rate. There will be approximately 1.5 years of pre-production prior to going to full production and some development ore will be produced during this time.

Table 16.13 shows the annual schedule of the project where the 2,000 t/d of ore will be achieved after 1.5 years of development. The life of mine is expected to be 5.75 years.

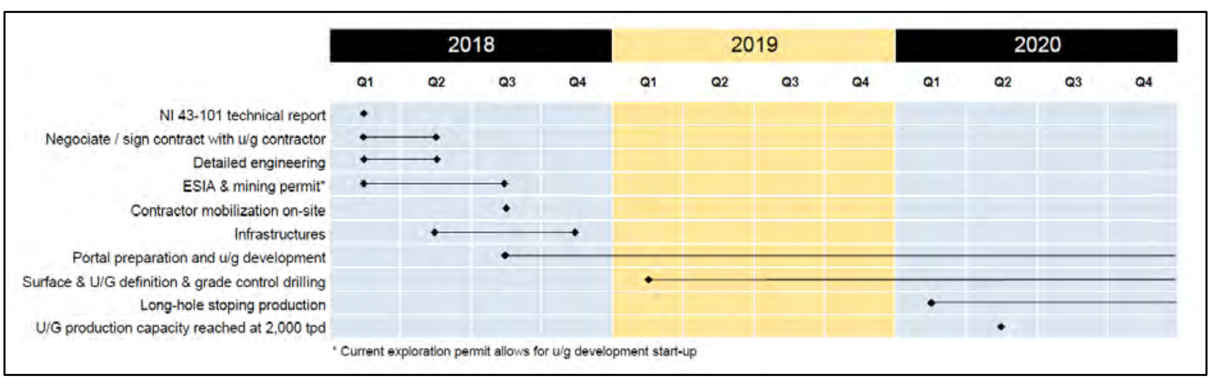
Table 16.13
Underground Production Schedule

Description	Unit	Year -1.5	Year -1	Year 1	Year 2	Year 3	Year 4	Year 5	Total
	Months	5	12	12	12	12	12	3.55	
Worked days		150	350	350	350	350	350	350	
Development									
Operation									
Ore	m		345	2,671	2,287	2,191			7,494
Cut and Fill Equivalent	m	231	807						1,038
Waste	m	90	496	1,839	1,047	1,031			4,503
Total Operation	m	321	1,648	4,510	3,334	3,222	-	-	13,035
Capital									
Raise Bore	m		71						71
Service/Vent Raise	m		66	39	63				168
Drift	m		1,996	898	642				3,536
Ramp	m	850	617	578	195				2,240
Total Capital	m	850	2,750	1,515	900				6,015
Total Development	**m**	**1,171**	**4,398**	**6,025**	**4,234**	**3,222**			**19,050**
Production									
Long Hole Stope	t			467,030	543,910	550,630	705,000	204,000	2,470,570
Grade	g/t Au			5.80	4.55	5.27	5.35	4.93	5.28
Cut and Fill Stope	t	13,000	25,000						38,000
Grade	g/t Au	5.23	5.23						5.23
Development	t		27,000	186,970	160,090	153,370	-	-	527,430
Grade	g/t Au		5.23	5.14	5.38	5.60	-	-	5.35
Total Production	**t**	**13,000**	**52,000**	**654,000**	**704,000**	**704,000**	**705,000**	**204,000**	**3,036,000**
Grade	**g/t Au**	**5.23**	**5.23**	**5.61**	**4.97**	**5.34**	**5.35**	**4.93**	**5.29**

SEMAFO envisages underground production at Siou reaching capacity in the second quarter of 2020, with the main development activities shown in Figure 16.16. Detailed engineering will take place through the first half of 2018. It is expected that the mining contractor will be mobilized in the third quarter of 2018, with portal preparation and underground development initiated immediately.

Work on the ESIA and permitting requirements will proceed through the third quarter.

Figure 16.16
Siou Underground Development Timeline



16.4.10 Recommendations

The level of this study is prefeasibility. There are still points that need further development and investigation:

- Sizing and location of the main underground ventilation fans.
- Specifications for mine dewatering pumps.
- Review of surface water collection pond and well capacity for mining water supply.
- Surface layout and installations (generator set, office, workshop, etc.)
- Final decision on portal location and pit floor layout.
- Relationship and interaction between the surface and underground operations.
- Establish detailed block sequencing and adjust development schedules and advances.
- Develop a ground control management plan.
- Develop stope design procedures to incorporate all sampling.
- Planning and implementation of definition drilling and grade control programs and procedures in order to maintain dilution and mining losses at acceptable levels.

17.0 RECOVERY METHODS

17.1 INTRODUCTION

Gold from the Mana deposit is recovered by a state of the art metallurgical plant which was constructed in 2008 with a nominal capacity of 4,000 t/d. This process plant has subsequently been through various expansion stages over the years to reach the current throughput capacity of up to 7,200 t/d for bedrock (sulphide) ore and 8,000 t/d using blended ore (saprolite/bedrock).

Over the past 10 years (2008-2017), the Mana plant processed a total of 22,790,647 t of ore coming from various satellite pits (Wona, Kona, Nyafé, Siou, Fofina) with an average grade of 2.8 g/t Au and an overall recovery of 90.8% which produced 1,863,186 oz of gold. The operational results correlate very well with the laboratory tests performed over the years for different ore types and for all mineralization types including oxides and sulphides. The annual process plant production statistics for 2014 to 2017 are summarized in Table 17.1. These results correlate well with the laboratory tests where recoveries above 95% were expected for all mineralization types including oxides and sulphides (See Section 13).

Table 17.1
Summary of Consolidated Annual Production

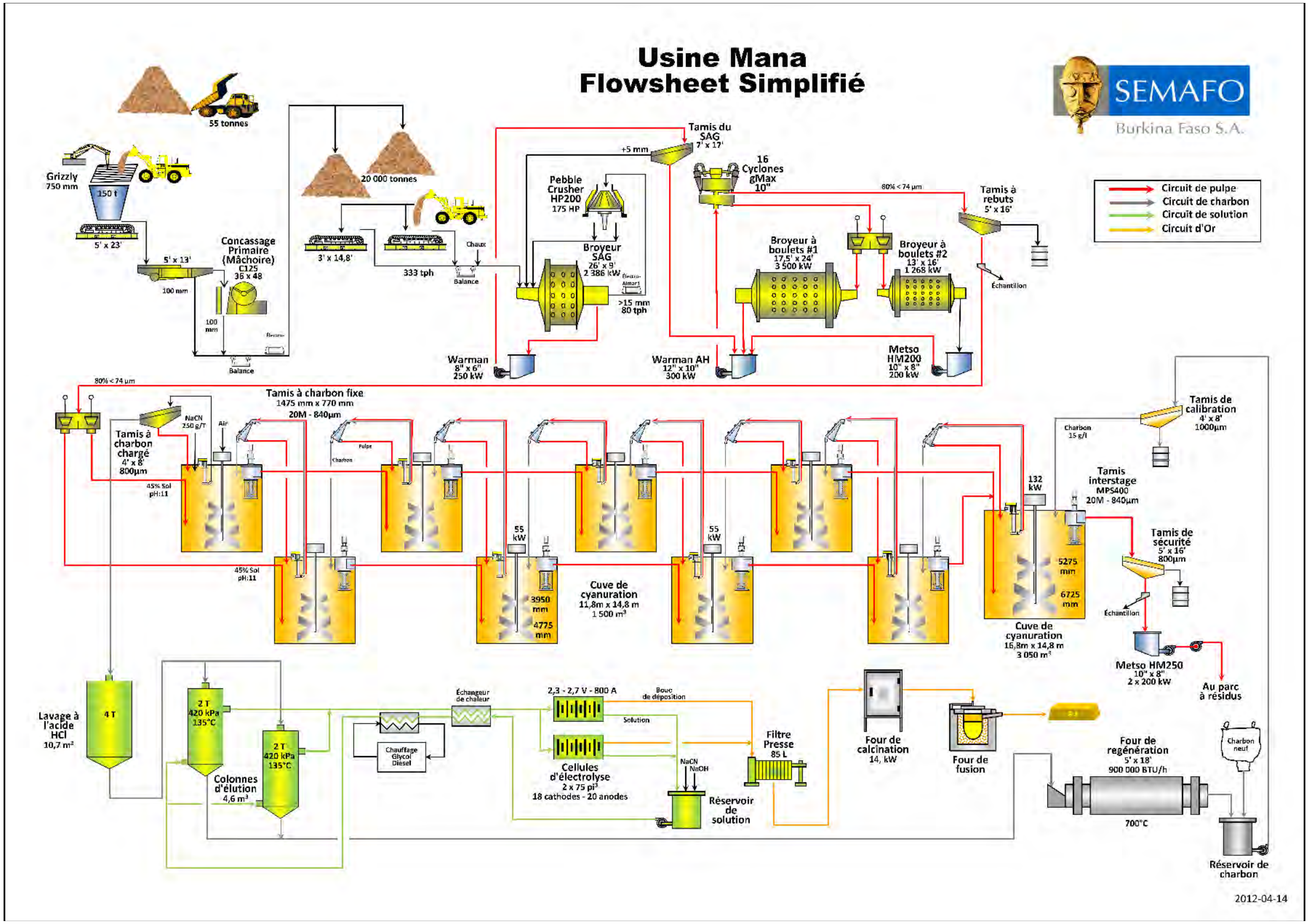
Year	Tonnes (t)	Grades (g/t Au)	Recovery (%)	Gold (kg Au)	Gold (oz Au)
2014	2,754,400	2.90	91.0	7,988	234,300
2015	2,399,100	3.63	91.0	8,709	255,900
2016	2,753,300	2.88	94.0	7,930	240,200
2017	2,739,900	2.46	95.0	6,740	206,400
Total	**10,646,700**	**2.95**	**92.9**	**31,366**	**936 800**

17.1.1 Selected Process Flowsheet

The Mana flowsheet comprises a standard SABC comminution circuit, CIL circuit, Zadra elution circuit and tailings disposal. The process flow diagram is provided in Figure 17.1.

The comminution circuit consists of an open primary jaw crusher circuit followed by SAG and ball mills. The SAG mill operates in closed circuit with a pebble crusher and the product from the SAG is also screened classified prior to feeding the ball mills. The ball mill product is in closed circuit with hydrocyclones to produce a product P_{80} of 74 µm. Product from the grinding circuit is leached through a CIL circuit with a retention time of ±28 hours depending on throughput. Loaded carbon from the CIL is stripped through a pressurized Zadra system. The pregnant solution from the Zadra circuit is pumped to the gold room where electrowinning and smelting of the electrowon sludge occur in order to produce a gold doré. Slurry tails from the CIL circuit are pumped to the tailings storage facility (TSF) and surnagent water is recycled back to the mill. No gravity circuit or thickeners are included in the existing flowsheet.

Figure 17.1
Overall Process Flow Diagram



There will be no changes in processing as a result of the change of mining method from open pit to underground mining. Therefore, the key process design criteria have not changed since 2012 when ore from the Siou pit was introduced to the process plant. The key plant process design criteria are summarized in Table 17.2.

Table 17.2
Key Process Design Criteria

Criterion	Units	Values
Annual Processing Rate (nominal)	t/y	2.69 Mt
Operating days/year	d/y	336
Daily Processing Rate	t/d	8,000
Design Ore Grade	g/t Au	variable
Ore Specific Gravity		2.8
Crushing		
Crusher Rate - Nominal	wet t/h	400-500
Crusher Operating Time	h/d	17.0
Crusher Availability	%	70.0
Grinding		
Grinding Feed Rate	t/d	8,000
Mill Availability	%	92.0
Feed Rate to Grinding - Design	t/h	333
Ball Mill Discharge P_{80}	µm	74
Cyanide Leaching and CIL		
Feed rate to Cyanide Leaching - Nominal	dry t/h	333
Leach Slurry Density	% solids	50
Leach Slurry Flow rate	m^3/h	450
Leach Residence Time	h	24-28
Number of Leach Tanks		9
Cyanide Concentration	g/L	125-180
Design Gold Soluble Loss	mg/L	0.015

The projected annual mine plan, including estimated metallurgical recoveries for each deposit is summarized in Table 17.3. This table shows the projection of the Siou mine underground production, based on reserves at 31 December, 2017. A plant metallurgical gold recovery of 96.0% has been projected for the underground mineralization.

Table 17.3
Summary of Projected Mine Annual Production from Each Deposit

Deposit	2018[1]	2019	2020	2021	2022	2023	2024	2025	Total
Siou OP tonnes	711,180	867,369							1,578,549
g/t Au	3.50	3.63							3.57
Recovery	96.00%	96.00%							
Ounces	76,734	97,212							173,945
Siou UG tonnes		65,240	653,660	703,765	703,893	704,689	204,242		3,035,489
g/t Au		5.23	5.61	4.97	5.34	5.35	4.92		5.29
Recovery		96%	96%	96%	96%	96%	96%		
Ounces		10,531	113,206	107,953	116,055	116,450	31,041		495,237
Yama OP tonnes							650,535		650,535
g/t Au							1.75		1.75

Deposit	2018[1]	2019	2020	2021	2022	2023	2024	2025	Total
Recovery							93%		
Ounces							33,913		33,913
Fofina OP tonnes	35,514								35,514
g/t Au	4.61								4.61
Recovery	57.80%								
Ounces	2,620								2,620
Nayafé OP tonnes							271,014		271,014
g/t Au							5.77		5.77
Recovery							39%		
Ounces							18,465		18,465
Wona-Kona OP tonnes	1,410,991	1,276,866	1,645,966	1,683,170	1,683,419	1,698,488	1,337,116	1,605,831	12,341,847
Au g/t	2.31	2.53	2.31	2.40	2.20	2.20	2.35	1.97	2.27
Recovery	81.08%	81.08%	81.08%	81.08%	81.09%	81.09%	81.08%	81.10%	
Ounces	85,050	84,047	99,234	105,305	96,553	97,418	81,786	82,371	731,764
Total tonnes	**2,157,685**	**2,209,475**	**2,299,626**	**2,386,935**	**2,387,312**	**2,403,177**	**2,462,907**	**1,605,831**	**17,912,948**
g/t Au	**2.74**	**3.04**	**3.25**	**3.16**	**3.13**	**3.12**	**2.78**	**1.97**	**2.94**
Recovery	**86.5%**	**88.8%**	**88.4%**	**88.0%**	**88.6%**	**88.6%**	**75.1%**	**81.1%**	**86.1%**
Ounces	**164,403**	**191,790**	**212,441**	**213,258**	**212,608**	**213,868**	**165,205**	**82,371**	**1,455,945**

[1] Production numbers for 2018 excludes processing of rompad material.

17.2 PROCESS AND PLANT DESCRIPTION

17.2.1 Crushing

ROM ore is loaded by a WA600 front end loader onto a static grizzly screen to handle slabby material. A rock breaker reduces the oversize material that remains on the grizzly (625 by 665 mm). Fine material drops into a 150-t capacity ROM bin. The ore is then extracted from the bin by a primary apron feeder (1,524 mm by 7,000 mm) and fed to a vibrating scalper screen (1,500 mm by 4,000 mm) to further separate the fines. Coarse material from this screen feeds directly into a 36 in by 48 in (950 mm by 1,250 mm) single toggle jaw crusher. The crusher produces a product with a size P_{80} of 100 mm, at a rate of 400-500 wet t/h and typically operates for 17 h/d. This schedule allows for regular maintenance to occur on a daily basis to the crushing plant.

The jaw crusher handles ROM ore with a maximum lump size of 665 mm. Fines from the scalper discharge directly onto the conveyor belt. Primary crushed material discharges onto a 48-in conveyor belt and is weighed by a scale to maintain a constant throughput to the crushing plant. A magnet located at the head pulley of the conveyor removes any trash steel. Ore is then transferred onto a mobile stacker conveyor which stockpiles around 25,000 t to 30,000 t of crushed ore. Stockpiled ore is withdrawn by two apron feeders in parallel (4,500 mm by 900 mm each) and drops onto the mill feed conveyor. Each apron feeder can handle about 200 t/h of crushed ore. Ore is weighed again to control and maintain steady throughput into the grinding circuit. Hydrated lime is added directly from a dry lime system onto the mill feed conveyor belt for CIL circuit pH control which is maintained at pH 10.5.

17.2.2 Grinding and Classification

The grinding circuit includes a primary semi autogenous grinding (SAG) mill in closed circuit with a vibrating screen and a pebble crusher. The 7.92-m diameter by 2.74 m Allis Chalmers SAG mill is equipped with 2,387 kW variable speed motor and operates between 10-15% ball charges depending on ore hardness. Variable speed control provides additional flexibility for processing of various ore types. The discharge from the SAG mill is split between fine and coarse material. Coarse material (>15 mm) is crushed in closed circuit by a pebble crusher (200 HP) and returns to the SAG mill for further grinding. Fine material (<15 mm) is pumped to the vibrating screen (2.1 m by 5.2 m). The material is classified by the screen with 9.5 mm by 3.2 mm slotted aperture panels. Oversize material returns to the SAG mill for further grinding while undersize material reports to the secondary ball mill discharge pump box. The circulating load for the SAG mill is around 50-60% (fine+coarse) and product size P_{80} is around 1,200-3,500 µm depending on throughput.

Secondary grinding is accomplished by two overflow discharge ball mills. One is a 5.3-m diameter by 7.0 m Outotec mill equipped with a 3,500 kW variable speed motor. Variable speed control of that mill provides great flexibility for processing various ore types. The second mill consists of a 3.96-m diameter by 4.88 m Allis Chalmers mill with a 1,120 kW synchronous motor. The mills operate in in closed circuit with a cluster of 16 in by 10 in GMAX Krebs classifying hydrocyclones. Nine to 12 cyclones are usually operating while four remain as spare units. Cyclone underflow reports back to the two ball mills through a splitter box while cyclone overflow at 50% w/w solids gravitates to a trash vibrating screen ahead of the leach circuit. Circulating load for the mills is typically around 250-350% and the final product P_{80} is targeted at 74 µm.

17.2.3 Leach and Adsorption Circuit

Cyclone overflow gravitates to a trash vibrating screen (Simplicity 1,524 mm by 3,658 mm) ahead of the leach tanks. Trash screen oversize feeds a holding tank and is then transferred to the tailings pump box. Underflow reports to a Heath & Sherwood automatic sampler and then flows to the CIL tanks. The CIL circuit consists of nine tanks in series. The first eight tanks have a live capacity of 1,588 m^3 each. The last tank has a live capacity of 3,182 m^3. The tanks are sized to provide 24 to 28-h residence time depending on throughput. Carbon concentration in the tanks is maintained between 12-15 g/L to maintain a target solution tail gold tenor below 0.015 mg/L. A cyanide distribution system composed of one mixing tank and one holding tank prepares a 10% sodium cyanide (NaCN) solution. The solution can be pumped either to the grinding circuit or CIL tanks as required. The cyanide concentration is maintained around 125-180 ppm depending on ore types and is controlled using a continuous cyanide analyzer to optimize consumption into the leaching tanks. Oxygen is supplied by blowing air into the tanks at up to 2,000 m^3/h. Hydrogen peroxide is also available if a higher dissolved oxygen (DO) level is required in the CIL tanks. Each tank is fitted with mechanically swept wedge wire screen to retain the carbon. All tanks are fitted with bypass facilities to allow any tank to be removed from service for agitator or screen maintenance.

Carbon enters the circuit at CIL tank No. 9 and advances counter-current to the slurry flow. The carbon is retained by a screen and gravitates into tank No. 8 while the slurry flows to tank No. 9. This counter-current process is repeated until the carbon eventually reaches tank No. 1. A recessed impeller pump is then used to transfer slurry and loaded carbon to the loaded carbon screen (Simplicity 1,219 mm by 2,438 mm) mounted above the carbon elution and stripping plant. The loaded carbon, reporting as screen oversize, gravitates to the acid wash column and the screen undersize slurry returns to CIL tank No. 1. Discharge from the last tank is directed to the tailings pump box via a vibrating carbon safety screen (Simplicity 1,524 mm by 3,658 mm) which is designed to recover any carbon leaking from the last CIL leaching tank. Carbon recovered on the safety screen is directed to the CIL spillage sumps and pumped back to the CIL tanks. Tailings going through the screen are directed to a Heath & Sherwood automatic sampler for tail assays and then flow to the tailings pump box.

17.2.4 Elution and Gold Room Operation

The stripping and gold room areas operate 7 d/w. The following operations are carried out in the elution and gold room areas:

- Acid wash of carbon.
- Stripping of gold from loaded carbon using the pressurized Zadra method.
- Electrowinning of gold from pregnant solution.
- Smelting of electrowon sludge.

17.2.4.1 Carbon Acid Wash

Loaded carbon is received into a 4 t (8 m^3) acid wash tank. A 3-5% hydrochloric acid (HCl) solution is prepared and circulates in an up-flow manner through the carbon bed for approximately 3 h. The acid solution is then neutralized with caustic and the carbon rinsed (3-bed volumes) with fresh water. Acid wash is necessary to remove carbonate scale that builds on the activated carbon during the adsorption process which fouls the carbon adsorption properties. Acid washed loaded carbon is then pumped from the acid tank to the two elution columns.

17.2.4.2 Carbon Stripping – Zadra Elution Circuit

Fresh stripped solution is prepared prior to stripping each new batch of carbon. Sodium hydroxide and cyanide solution are pumped into the strip solution tank and mixed with raw water to the required concentrations of cyanide (0.15% w/v) and caustic soda (2.0% w/v) at pH >12.0. The pressurized Zadra strip utilizes 30-36 bed volumes of a circulated 130°C solution at a pressure of 400 kPa to strip the carbon. The barren strip solution is indirectly heated via a diesel-fired hot glycol (33% w/v) heater and pumped in an up-flow manner through the carbon inside the 2-t strip column. The pregnant strip solution exiting the top of the column is routed to the electrowinning cells, where the precious metals are electrochemically precipitated into a sludge form at the cathodes. The strip solution is then routed back to the solution storage tank. The strip solution recirculates continuously for 8-12 h until the gold level of the strip solution reaches 2-8 g/t Au. At that stage, the barren carbon level is less than 80 g Au/t carbon. Once the first column is being stripped, automatic valves are switched to start a new batch on the second 2 t carbon loaded column. Approximately 4 t of loaded carbon is stripped every day.

17.2.4.3 Carbon Regeneration

After completion of the elution process, the barren carbon is transferred from the elution column to a dewatering screen prior to entering the feed hopper of the carbon regeneration kiln. The kiln can regenerate approximately 150 kg/h of barren carbon. As the carbon is contaminated with organic species, the organics foul the carbon and cause the gold and silver adsorption rate to slow and decrease the metal loading capacity of the carbon. This is corrected by heating the carbon to 625°C in a low oxygen atmosphere which burns the organics from the carbon. The carbon is held at this temperature for about 15 min to allow regeneration to occur. Barren carbon is then stored in a holding tank prior to being pumped to a single deck carbon sizing screen (Simplicity 1,219 mm by 2,438 mm) above CIL column No. 9. The carbon sizing screen is fitted with a 0.8 mm square aperture polyurethane deck. Oversize carbon reports to CIL tanks and the fine carbon is stored, filtered and bagged ready to be shipped to recover residual gold left in the fines.

17.2.4.4 Electrowinning and Gold Room

The two 75 ft^3 electrowinning cells supplied by Summit Valley are designed to treat approximately 12.0 m^3/h of pregnant solution each. Individual cell electrical power is supplied by a local rectifier with the range of 2.7-3.3 V and 800 A output. Fumes generated during electrowinning are removed via a local exhaust system. Gold is recovered as sludge from the stainless-steel mesh cathodes. Sludge is washed from the cathodes with high pressure washer and pumped into a holding tank prior to feeding a 85-L Siemens press-filter. Gold is then recovered as a filter cake and dried in an electrical calcine oven. The dried gold cake is then smelted with fluxes in a diesel-fired furnace to produce doré bars. Fumes generated during the smelting are recovered and processed through a wet dust collector to recover fine particles and followed by an exhaust fan to remove heat and fumes.

17.2.5 Reagents

The reagent mixing and dosing systems have not changed over the years. The major reagents utilized within the process plant include:

- Quick lime (CaO) for pH control.
- Sodium cyanide (NaCN) for gold dissolution and desorption.
- Caustic soda (NaOH) for neutralization and desorption.
- Hydrochloric acid (HCl) for carbon acid washing.

- Antiscalant to reduce fouling in the process water distribution, carbon wash and stripping circuit.
- Fluxes for smelting charge preparation.

Average reagent consumption in 2017 is summarized in Table 17.4

Table 17.4
2017 Mana Operation Major Reagent Consumption

Reagent	Format	Annual Consumption (t)	Annual Consumption (kg/t)
Cyanide	1,000 kg bags	1,164	0.430
Hydrated Lime	800 kg bags	2,450	0.890
Steel ball 35-40 mm	900 kg drums	3,150	1.150
Steel ball 100-125 mm	900 kg drums	1,464	0.530
Carbon	550 kg bags	64	0.023
Caustic Soda	25 kg bags	200	0.073
Hydrochloric Acid	290/1,185 kg containers	389	0.142

17.3 TAILINGS DISPOSAL AND WATER MANAGEMENT

Tailings disposal is discussed in more detail in Section 18.9.

Tailings from the production process are pumped with variable speed pumps to the Yona TSF. The TSF is naturally protected by thick layers of underlay clay and no effluent percolates through its clay core embankments. The TSF is presently divided into two equal sections to allow embankment lifts on one section while the other section is in service. Tailings are deposited into the facility using the single discharge point method, which is moved periodically to allow even distribution of the tailings slurry. Supernatant water is directed by gravity through a central basin. Water pumps on a floating barge pump the recycled water back to the process water tank located near the process plant facility. Approximately 50-60% of the mill process water requirement is recovered from the TSF. The remaining raw water necessary for the process plant is collected from a network of underground wells.

Surface runoff water is collected and held in the Wona Dam which has a capacity of approximately 3.8 Mm^3. The construction of a 58 km pipeline between the Mouhoun River and Wona Dam was completed in September, 2012 and has been fully operational since December, 2012.

18.0 PROJECT INFRASTRUCTURE

18.1 OVERALL SITE LAYOUT

The overall Mana site (shown in Figure 18.1) includes the open pit mines, waste rock dumps, process plant, tailings storage facility (TSF), water storage/supply dam, five water runoff basins, sediment ponds, storage areas, buildings, power plant, bulk fuel storage, accommodation camp and main access road.

Different areas are fenced to provide security and prevent animal access. Each open pit is fenced. Road access into the fenced areas is via manned security checkpoints. Within the fence surrounding the Wona pit, security fencing surrounds the accommodation camp, process plant/administration building/garage and annex services, and general site infrastructure.

18.2 ROADS

18.2.1 Site Access

The Mana mine is accessible by road from the capital city of Ouagadougou via Dédougou by a well-maintained bitumen and gravel/laterite roads.

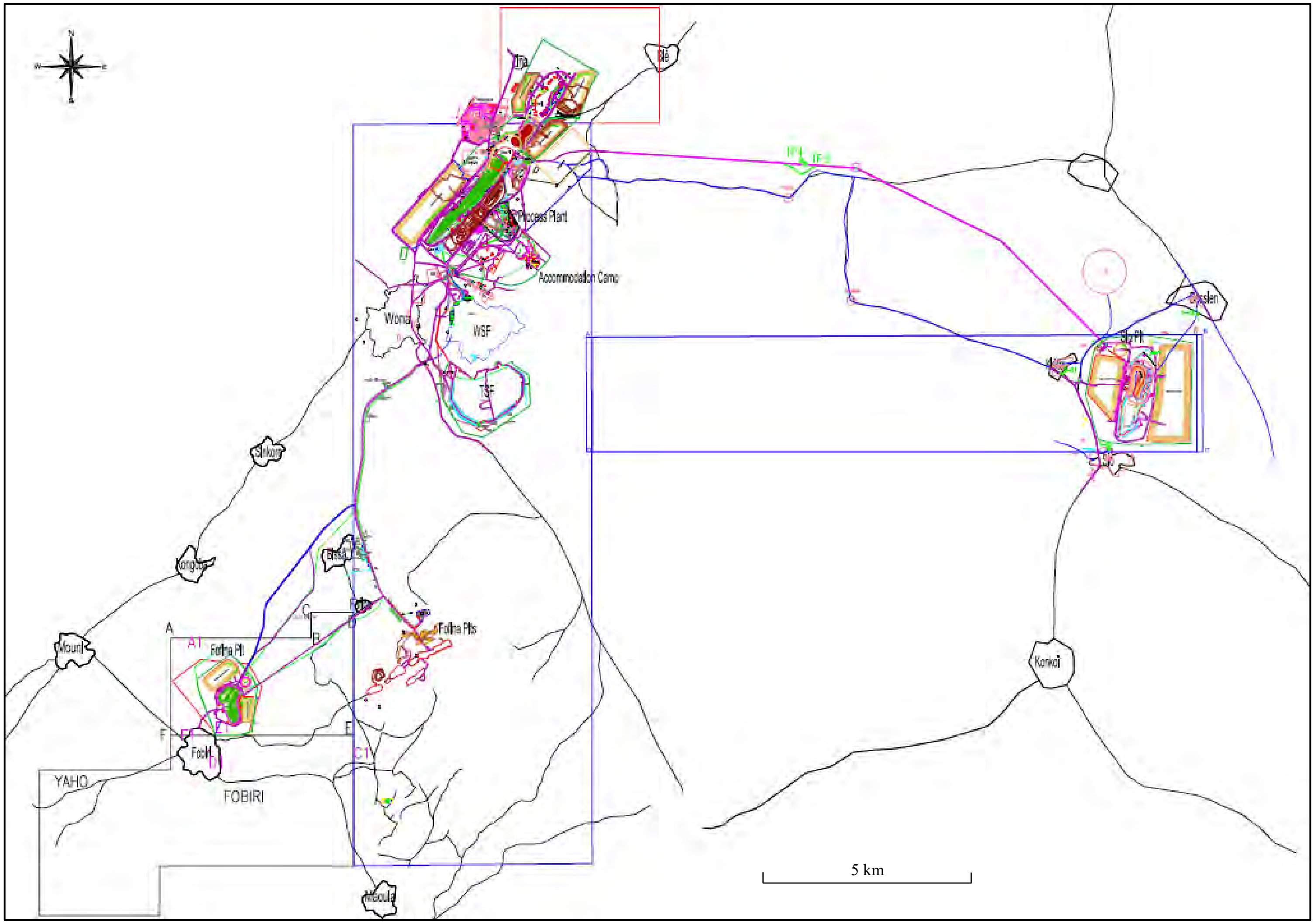
Materials, consumables and personnel are transported to mine site via these access roads.

18.2.2 Site Roads

A network of site gravel and laterite roads provides access between the administration area, process plant facilities, bulk fuel storage, power plant, mine services area, and accommodation camp. See Figure 18.2. These roads are generally 6 m wide and constructed to ensure that storm water sheet flow is achieved across the site, thereby avoiding the need for deep surface drains and culvert crossings within the plant area.

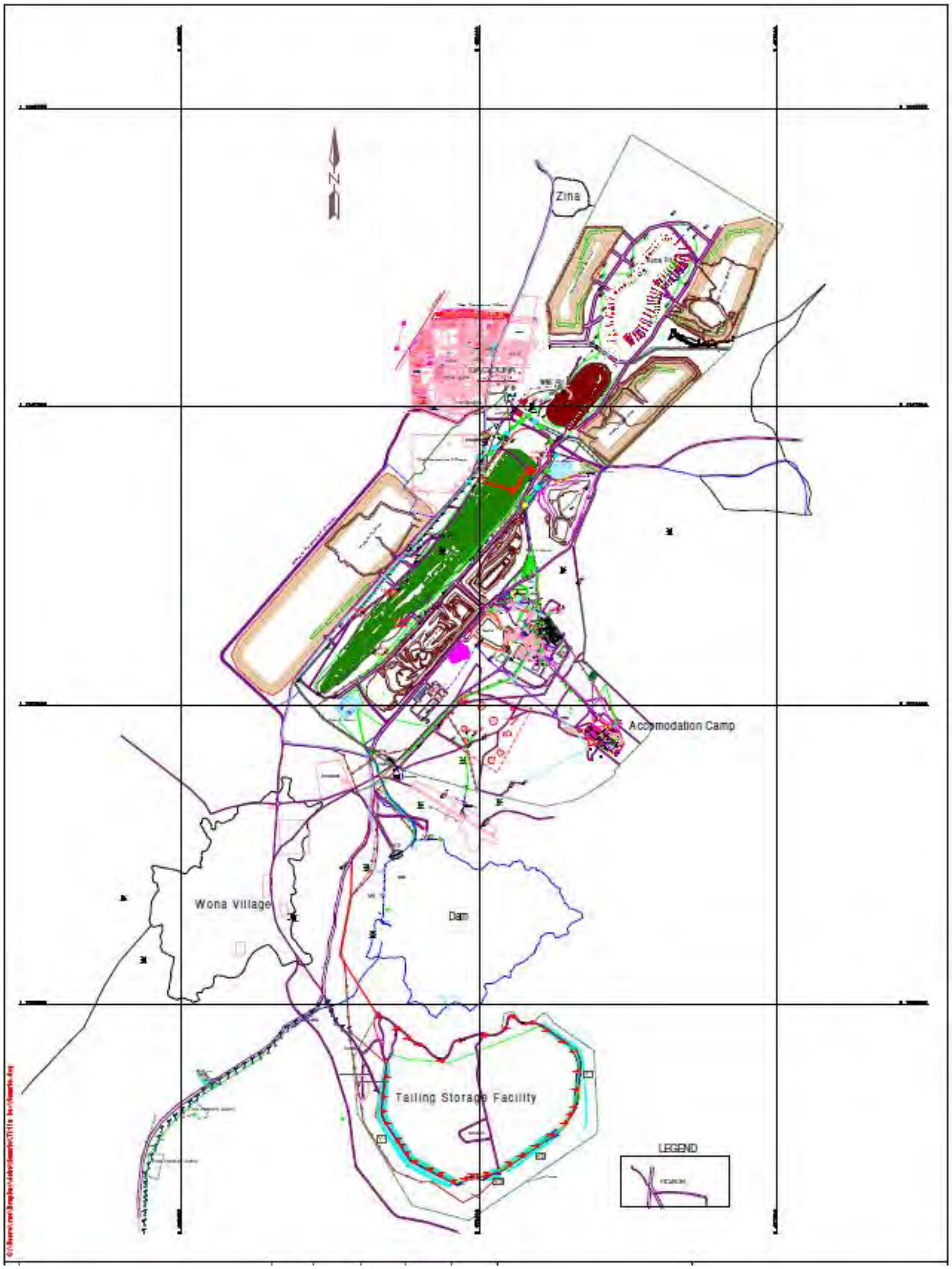
A network of gravel roads provides access between the open pit mining operations and the processing facility and to facilities such as the TSF and the Siou mining operation.

Figure 18.1
Mana Property General Site Layout



SEMAFO, 2017.

Figure 18.2
Mana Property Internal Site Roads



SEMAFO, 2017.

18.3 POWER

18.3.1 Power Supply

Due to the remote location of the Mana site, power is provided by a diesel-fuelled generation station located adjacent to the process plant.

The maximum capacity of the existing power plant is 17.5 MW based on the following units:

- Power plant No.1: Seven 0.9 MW high speed diesel units (Cummins KTA50G3), providing power at 0.4 kV.
- Power plant No.2: Six 1.0 MW high speed diesel units (Cummins KTA50G3), providing power at 6.6 kV.
- Power plant No.3: Four 1.3 MW high speed diesel units (CAT 3516B), providing power at 6.6 kV.

The average running load of the process plant is currently around 7.5-9.5 MW, including the power consumption of the overhead distribution lines.

The SAG and ball mills have the largest demand loads. The SAG mill has a variable speed drive and the ball mill has a fixed speed drive and liquid resistance starters to provide 'soft start' capability to reduce the load surge during start-up and minimize the need for 'spinning reserve' in the power station.

A new electrical substation, identified as MANA, is located near the existing power plants. The new substation has a capacity of 15 MVA and includes a power transformer 33 KV/6.9 KV, 15 MVA.

18.3.2 Electrical Distribution

The electrical distribution system is based on 6.6 kV distribution and 400 V, 50 Hz working voltage.

Power for the process plant is provided via underground cable at 6.6 kV to the process plant transformer. The 6.6 kV supply is stepped down to 400 V, generally at each switch room using separate 6.6 kV/400 V distribution transformers fed from the high voltage distribution board.

Switch rooms house 400 V motor control centres (MCCs), area variable voltage/variable frequency (VVVF) drives, plant control system cabinets, plant lighting transformers and various distribution boards.

Power to support facilities outside the process plant and some mine infrastructure is provided from the main site electrical substation power plant No.1 via overhead 6.6 kV pole lines to various remote facilities including the truck workshop, TSF, water storage dam and accommodation camps.

18.3.3 Electrical Buildings, Transformers and Compounds

There is no specific electrical building for the process plant. Each of the switch rooms is located inside the process building, air-conditioned and sealed to prevent ingress of dust.

All 6.6 kV/400 V power distribution transformers at the process plant site are pad-mounted and installed complete with compound fencing and underground earthing.

18.4 FUEL SUPPLY

An onsite bulk fuel storage facility is located close to the power plant and provides diesel for power generation, mine trucks, light vehicles and users at the process plant.

Three tanks at the bulk fuel storage facility have a maximum capacity equivalent to approximately 26 days of requirements, i.e., 3,518,000 L of diesel fuel.

Day storage tanks are installed at the power plant and in the process plant. Five storage tanks have a total capacity of 110,000 L.

18.5 SEWAGE, WASTE WATER AND SOLID WASTE MANAGEMENT

18.5.1 Sewage and Waste Water

Domestic wastewater and sewage from the site facilities are collected and sent to a wastewater treatment plant based on bacterial action in aerated lagoons. This facility processes an average of 1,500 m^3/m. The water discharged is rigorously monitored and remains in compliance with the discharge standards of Burkina Faso.

Domestic wastewater from workshops and offices is collected and treated in septic tanks at a rate of approximately 9,000 m^3/y.

The industrial wastewater from the Wona and Siou garages and the hydrocarbon depot is treated in self-contained structures with settling separators before being discharged to the environment. All discharge is closely monitored through a sampling and analysis program.

18.5.2 Solid and Hazardous Wastes

All waste is sorted at source and placed in different coloured containers. Material such as food waste uncontaminated packaging, green waste, ordinary industrial waste, is collected in green bins and sent to the landfill site within the TSF.

Recyclable materials (scrap metal, wood, used batteries, plastic packaging) are collected and sent for recycling. Reusable materials, such as empty containers, large woven bags and drums, are made available to employees and recyclers.

Hazardous residual materials comprise used oils and greases, used oil and gas oil filters, empty cyanide containers, lead-contaminated cups and crucibles and laboratory aqueous solutions. Used oils are recovered by the supplier and recycled in its processing centre. Empty cyanide packaging and biomedical wastes are disposed of in approved incinerators. Contaminated waste from the laboratory is disposed of within the landfill in the TSF. Used filters are drained and pressed before being made available to recyclers.

Any spill of hazardous material on site is dealt with immediately in accordance with established procedures which include isolation of the area, excavation of contaminated soil, neutralization of the affected site, on-site disposal and/or neutralization of the soils, and transfer to the tailings facility for final disposal.

18.6 ACCOMMODATION

The accommodation camp is located about 1 km to the north/east of the process plant and provides accommodation for 135 employees including expatriates and national senior and technical staff.

It consists of the following facilities:

- 26 blocks of two single rooms with en-suite bathrooms.
- 19 blocks of four single rooms with en-suite bathrooms.
- Three blocks of two single rooms with en-suite bathrooms for the senior staff.
- One block consisting of a single room with an en-suite bathroom for the mine director.
- Dining/recreation room.
- Fitness centre.
- Laundry.
- Office and storage.

18.7 MINE AND PLANT FACILITIES

18.7.1 General

Site buildings consist of administration offices, workshops, warehouses, laboratory and reagent storage sheds which are constructed of structural steel framing and metal cladding on concrete slabs.

Offices and amenity buildings are concrete block or brick construction.

18.7.2 Main Infrastructure Facilities

The main infrastructure facilities at the Mana operation are:

- Mine and plant warehouses and laydown area.
- Administration buildings.
- Electrical/mechanical/surface works workshop.
- Assay laboratory.
- Mine main garage with truck wash-down facility.
- Power plant with intermediate fuel storage: 110,000 L.
- Fuel storage facility, storage capacity 3,518,000 L.
- Light towers.
- Clinic/health, safety and environmental buildings.
- Accommodation buildings.
- Other ancillary buildings.

The explosive site is a separately fenced area with 24-h security guard and equipped with surveillance cameras. Within the fence, facilities include the following:

- Office.
- Ablutions module.
- Changing room.
- 180-t capacity ammonium nitrate storage shed.
- Chemical gassing shed.
- One pad with five bulk emulsion storage tanks, 30-t each, total capacity 150 t.
- Storage for pentolite boosters, detonators, packaged explosives.
- Safety guard room.
- Spare parts tools storage.
- Flammables store.

18.7.3 Siou Mining Operation

The Siou mining operation is located approximately 16 km east of the processing plant. Certain infrastructure items are located in the Siou sector to minimize transportation and maintenance costs, and to ensure security for mining high grade ore.

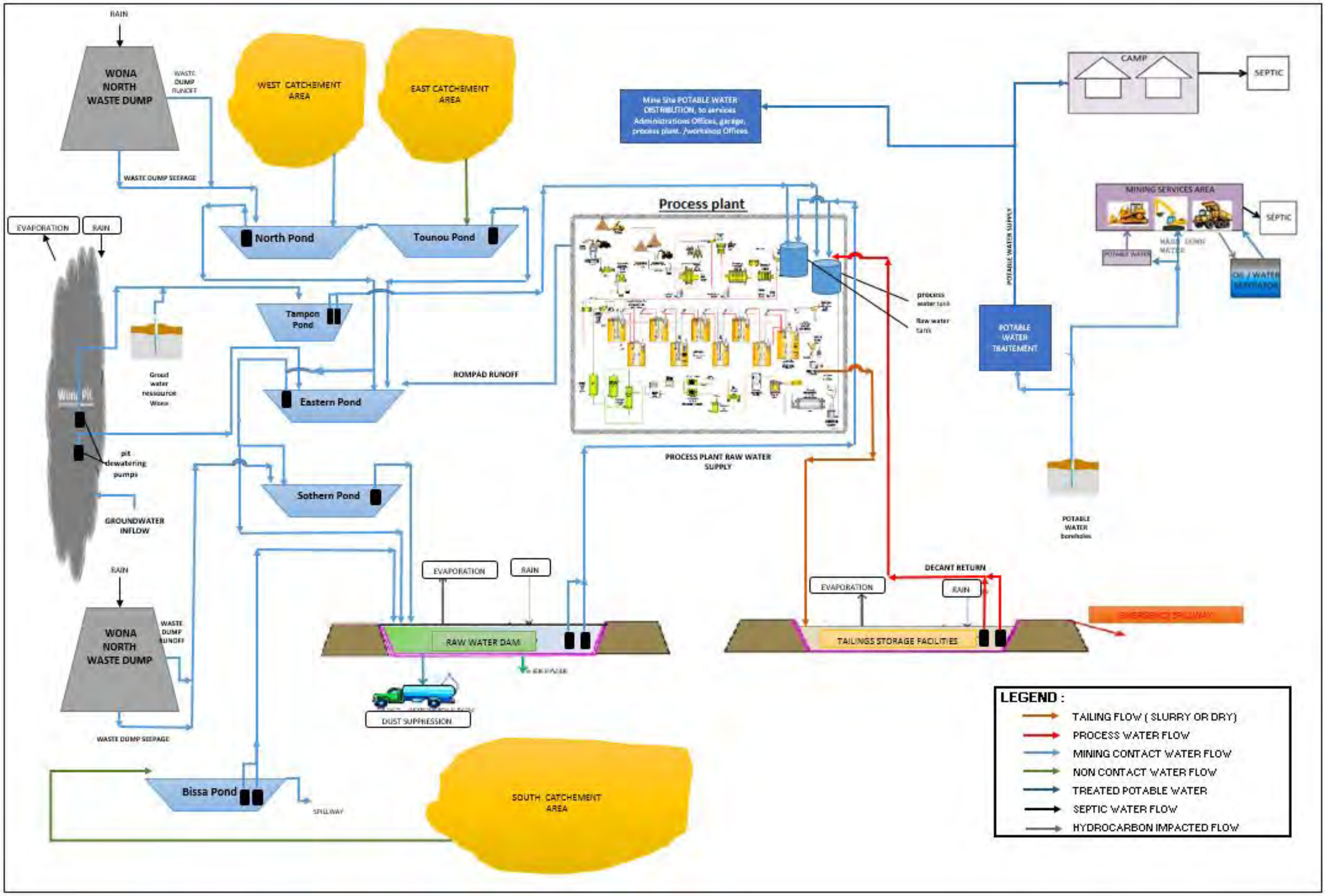
Infrastructure facilities include:

- Rest area and meeting space with capacity for 40 people.
- An office for shift bosses.
- Ablutions facilities and washrooms.
- A pit stop garage for regular maintenance work on machines.
- Two electricity generators with total capacity of 360 kW.
- Fuel storage for up to 110,000 L.
- Fences, access route, gates, security stands.
- Truck balance for ore transported from Siou to the processing plant.
- Light towers.

18.8 WATER SUPPLY INFRASTRUCTURE

Site water supply and infrastructure is illustrated schematically in Figure 18.3.

Figure 18.3
Site Water Supply and Demand



SEMAFO, 2017.

Operational water demand is met from TSF decant, pit dewatering (including precipitation in the pit area), surface runoff and site groundwater which is collected in raw water dams and ponds around the site.

The total plant water demand is between 3.6 and 3.9 Mm^3/y. The water demand for the process plant, equivalent to approximately 1.4 m^3/t processed, is met by recycled process water from the TFS of 1.9 Mm^3/y (approximately 54% annual average recycling rate), pit dewatering, and boreholes, equivalent to 0.72 Mm^3/y and surface water runoff intercepted by five collection basins during raining season. Water is pumped and stored in the water dam and used by the process plant at the raw water equivalent rate of approximately 1.0 Mm^3/y.

The surface water collection network consists of five collection basins located north and south of the treatment plant with a nominal holding capacity of 601,000 m^3, as summarized below:

- Bissa Basin 197,000 m^3.
- North Basin 160,000 m^3.
- East Basin 55,000 m^3.
- South Basin 139,000 m^3.
- Tounou Basin 50,000 m^3.

Seventy percent of surface water (1.9 Mm^3) is recovered every year in the different collection basins around the site with the balance coming from boreholes and pit dewatering.

Ground and surface water demand by source in 2016 and 2017 is shown in Table 18.1.

Table 18.1
Site Groundwater and Surface Water, Annual Production, 2016 and 2017

	2016		2017	
	m^3	% of total	m^3	% of total
Wona pit boreholdes	344,570	12	329,886	11
Wona pit dewatering	370,616	13	524,514	18
North, South, East and Tounou Basins	1,086,877	37	891,400	30
Mouhoun River	0	0	0	0
Bissa Basin	1,092,500	37	1,154,500	39
Potable water boreholes	46,134	2	62,629	2
Total	**2,940,697**	**100**	**2,906,585**	**100**

The site water balance in 2016 and 2017 is summarized in Table 18.2.

Table 18.2
Mana Site Water Balance, 2106 and 2017

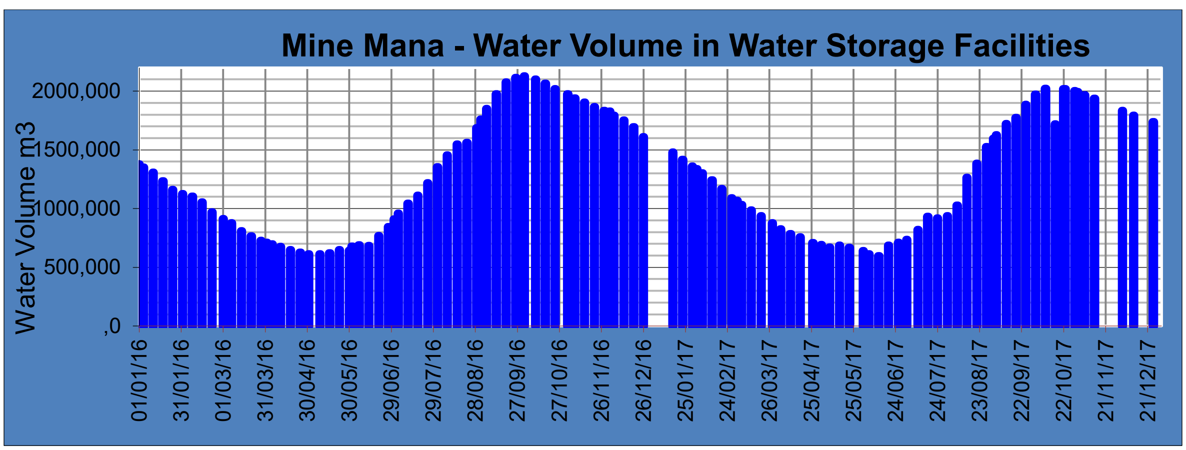
	2016		2017	
	m^3	% of total	m^3	% of total
Total plant consumption, m^3	3,827,498		3,746,362	
Recycled water from TFS, m^3	2,113,117	55	1,989,213	53
Pit dewatering and boreholes, m^3	703,209	18	725,422	19
Water storage facility, m^3	1,011,172	26	1,031,727	28
Ore processed, t	2,753,327		2,735,353	
Ratio m^3/t processed	1.39	100	1.37	100

18.8.1 Raw Water Storage

The water storage dam has a design capacity of 3.6 Mm^3 although the maximum utilization has been 2.1 Mm^3. The dam receives water from surrounding watersheds and the surface water collection ponds.

The variation in storage volume is illustrated in Figure 18.4.

Figure 18.4
Water Storage Facility Volume



18.8.2 Potable Water

Potable water for the Mana site is supplied from underground wells (Dangouna village, Somana, Wona and accommodation camps). An average of 4,000 m^3/m of drinking water is consumed for drinking, bathing, kitchen and laundry usage.

A water quality monitoring program is in place and is in accordance with the regulations in force in Burkina Faso.

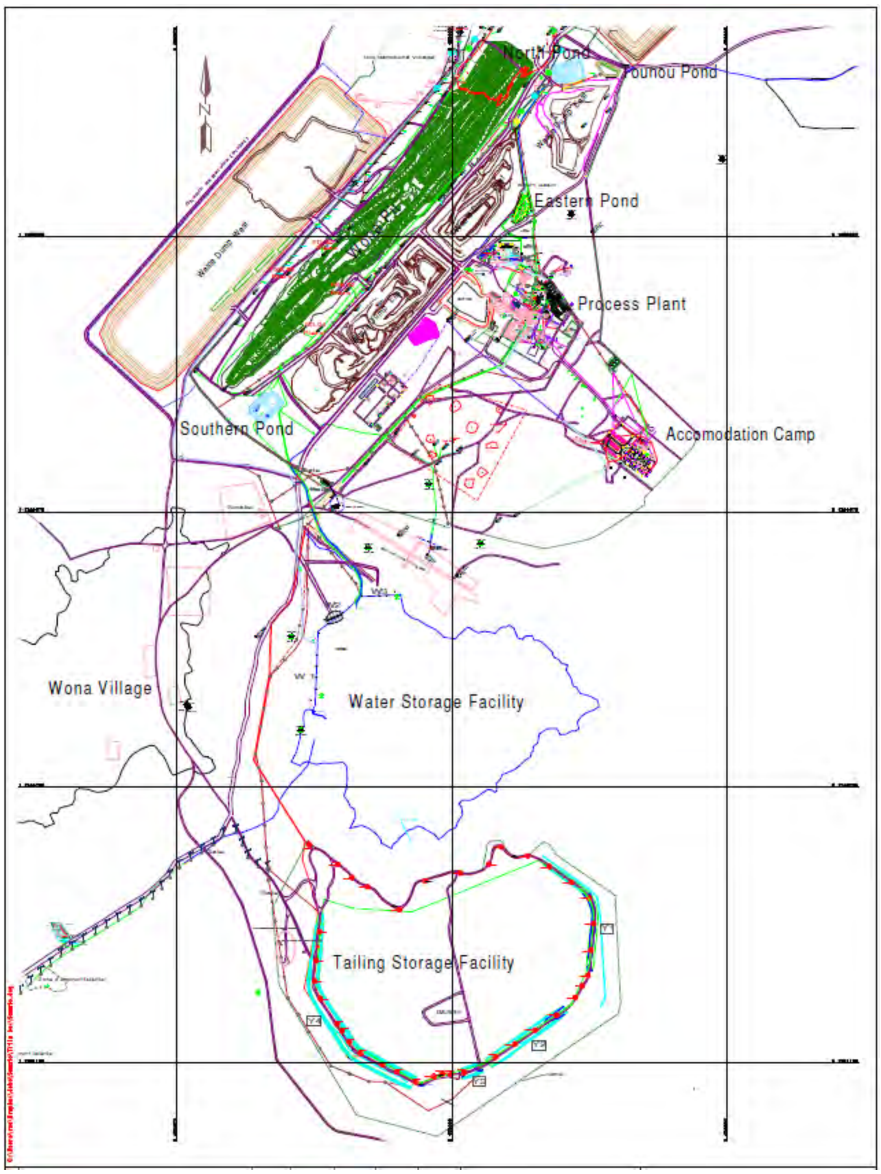
Water distributed to drinking fountains for employees' use is softened, disinfected with chlorine and treated by UV and reverse osmosis. Water delivered to the site facilities is treated with chlorine.

The mine also distributes drinking water to nearby villages.

18.9 TAILINGS STORAGE FACILITY

The location of the TSF is shown in Figure 18.5.

Figure 18.5
Location of Tailings Storage Facility



SEMAFO, 2017.

A TSF with a storage capacity of 41 Mm^3 of tailings generated by the ore processing operations is required for the life of the project at a rate of 2.7 Mt/y. The tailings storage facility design is described in detail in the Tailings Storage Facility and Site Water Management Technical note 613063-3000-4GER-0001 prepared by SNC-Lavalin, 2014 (SNC-Lavalin 2014).

The principal objectives for the design of the TSF are as follow:

- To produce a design in compliance with relevant international regulations, guidelines and standards using best available technology.
- Permanent, secure and total containment of all tailings within an engineered disposal facility.
- Achieve a high density, consolidated tailings mass by employing controlled subaerial deposition of tailings.
- Control, collect and remove free draining liquids from the tailings during operation for recycling as process water to the maximum possible extent.
- Maintain excess storage capacity within the tailings storage facility to contain the design storm allowance.
- Provide an engineered structure to control discharges from the storage due to extreme events greater than the design storm allowance.
- Reduce seepage from the facility during operation and on closure.
- Cost-efficient utilization of available material for embankment construction.
- Rapid, effective and stable rehabilitation.
- Monitoring features for all aspects of the facility and associated works to ensure that performance standards can be measured and achieved.

18.9.1 Facility Design

Tailings are discharged to the tailings pond via a 5 km long HDPE pipeline. The treatment residues of the plant consist of a sludge containing ± 50% water. After settling of the solids, the supernatant water is recycled to the plant. There is no effluent out of the tailings pond. Ten control wells around the TSF monitor groundwater quality and fluctuations in the water table.

The facility is contained by four peripheral laterite embankment dams, named Y1 to Y4, and a hill on the north side, as shown in Figure 18.5, above. It has an area of approximately 130 ha and is divided into two cells, east and west, separated by a median dam. The tailings are deposited alternately in the cells in order to accelerate consolidation and evaporation; during deposition in the east cell, for example, the tailings in the west cell consolidate and dry out and before the capacity of the east cell reached, a dam raise is completed in the west cell.

The tailings have a grain size similar to that of sandy silt, with composition averaging about 58% silt and 32% sand.

A geotechnical investigation was conducted at the TSF site which included drilling, in-situ testing and laboratory testing of the foundation and construction materials. Full details of the geotechnical work are included in the geotechnical investigation report prepared by Groupe Qualitas Inc. (Qualitas, 2013).

The foundation of the peripheral dams consists of an alluvial layer composed of clays and silts with an average thickness of 2.5 m. This is underlain by a layer of red laterite approximately 8 m thick which is underlain in turn by saprolite.

The optimal height of each dam raise was selected using stability analysis for the shear strength of mine tailings. A height of 3 m was selected as being less demanding from the point of view of bearing capacity of mine tailings, more economical and allowing faster construction for deposition alternately in the two cells.

Tailing are deposited by spreading the tailings from the peripheral dams and the north hill so that rainwater and process water flows to the centre of the pond from which it is pumped to the processing plant.

The facility design is illustrated in Figure 18.6 and Figure 18.7.

Figure 18.6
Plan View of Tailings Storage Facility Design

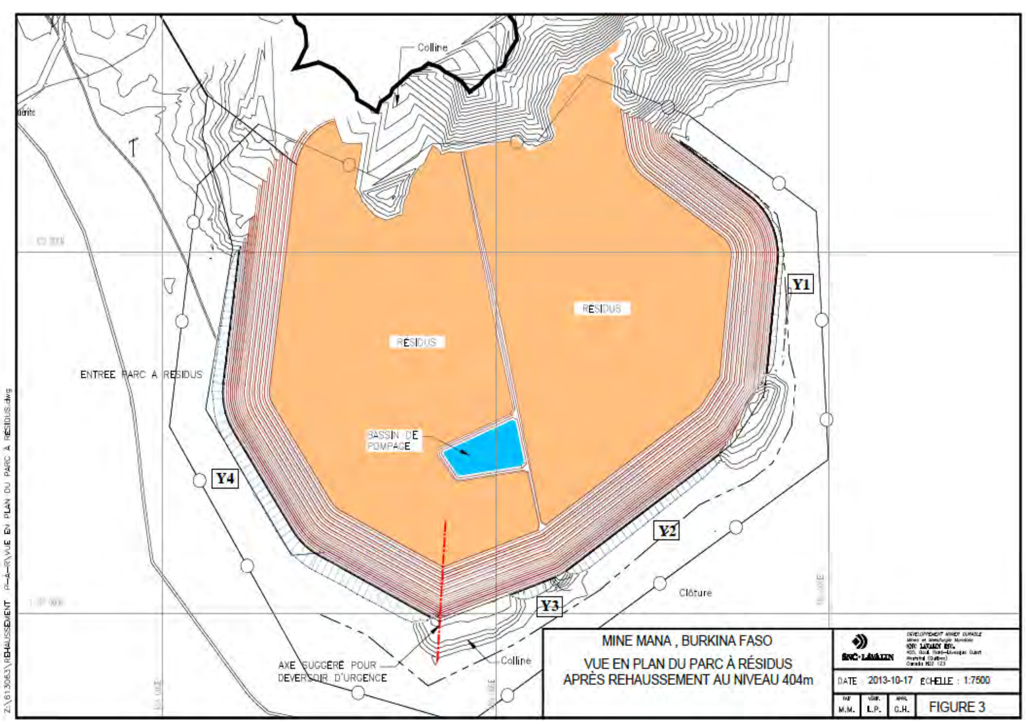
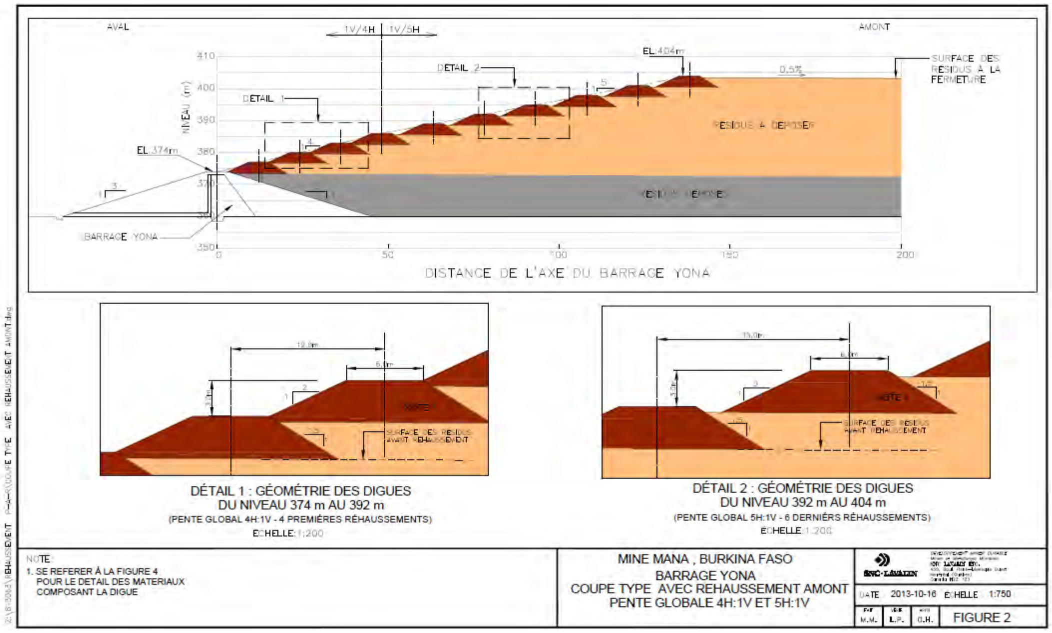


Figure 18.7
Tailings Storage Facility Design



19.0 MARKET STUDIES AND CONTRACTS

19.1 MARKET STUDIES

No market studies have been undertaken for this prefeasibility study. The commercial product is gold doré.

19.2 CONTRACTS

SEMAFO has contracts in place for sale of gold from its producing mine, Mana, in Burkina Faso.

Refining contracts are with well recognized international refineries and sales are made based on spot gold prices. These contracts include fees for transportation of the product from the site, insurance, assaying, refining and an allowance for metal losses during refining.

20.0 ENVIRONMENTAL STUDIES, PERMITTING AND SOCIAL OR COMMUNITY IMPACT

There are no identified environmental or social issues on the Mana property that would materially impact SEMAFO's ability to operate the mining and processing facilities. Figure 20.1 is a general view of the Mana site.

Figure 20.1
General View of Mana Site

Micon, 2017.

20.1 INTRODUCTION

Environmental and social impact assessments (ESIA), environmental and social management plans (ESMP) and resettlement action plans (RAP) define the terms of the environmental management of the Mana mining and processing operations, as well as the compensation for people affected by the developments. The terms of compensation for the people affected by development include the relocation of populations and the amount of financial compensation in accordance with the regulations in place.

Environmental control, implementation of ESMPs and facility response plans (FRP) and the monitoring of extraction and treatment operations are the responsibility of the Environmental Manager for all operations at Mana. A team of technicians and environment operators under his supervision carries out regular environmental controls. Water quality (groundwater, surface water, drinking water, wastewater), air quality, noise and vibration, acid generating potential, waste materials, and the tailings pond are subject to rigorous monitoring in accordance with the regulatory requirements of Burkina Faso and industry best practice. Due to the high impact of the rainy season, special attention is given to monitoring the overall management of the mine's water, including the tailings pond. All water from the tailings pond is recycled to the mill for ore processing. There is no effluent discharge to the environment.

Community development has always been an important part of SEMAFO's business strategy, and the company remains very active in this regard. The Community Relations Department and the SEMAFO Foundation are responsible for implementing social commitments and SEMAFO's social responsibilities. Several initiatives and programs ensure the continued support of the surrounding communities, not only for ongoing operations but also for any future expansion.

20.2 LEGAL FRAMEWORK AND PERMITS

The following description of the regulatory framework for environmental and social management in Burkina Faso is based on Lycopodium, 2016.

20.2.1 Policies and Strategies for Environmental Protection

Since the early 1990s, Burkina Faso has developed numerous policies and strategies for the management of its natural resources. A declaration of mining policy was formulated in 1995 that highlighted the importance of the private sector as an engine of economic development. Other policies relating to environmental protection include the following:

- Strategy for Accelerated Growth and Sustainable Development.
- Government Program for Emerging and Sustainable Development.
- Rural Development Strategy.
- National Policy on Environmental Matters.
- Environmental Plan for Sustainable Development Program.
- National Policy on Rural Land.
- National Action Program for Adaptation to Climate Variability and Change.

20.2.2 Legal Framework

The Burkina Faso legal framework with respect to environmental and social aspects of economic activities is supported by a number of laws and decrees, including:

- Environmental Code.
- Mining Code.
- Forest Code.
- Public Health Code.

- General Local Authorities Code.
- Act on Rural Land Tenure.
- Act on Agrarian and Land Reorganization.
- Law on Water Management.
- Act on Pastoralism.

Other relevant regulations include:

- Decree No. 2007-853/PRES/PM/MCE/MECV/MATD dated 26 December, 2007 on specific environmental regulations for the conduct of mining in Burkina Faso.
- Decree No. 2006-590/PRES/PM/MAHRH/MECV/MRA dated 6 December, 2006 on the protection of aquatic ecosystems.
- Decree No. 2006-588/PRES/PM/MAHRH/MECV/MPAD/MFB/MS dated 6 December, 2006 determining the perimeters of protection for water bodies and streams.
- Decree No. 2001-342/PRES/PM/MEE dated 17 July, 2001 on the scope, content and procedure for Environmental Impact Assessment Study and Environmental Impact Instruction.
- Decree No. 2001-185/PRES/PM/MEE dated 7 May, 2001 on setting standards for discharges of pollutants into the air, water, and soil.

20.2.3 Mining Code

The Mining Code (Law N° 036-2015/CNT pertaining to the Mining Code of Burkina Faso) is administered by the Ministère de l'Énergie, des Mines et des Carrières (MME) and provides the legal framework for the mining industry in the country. The state owns title to all mineral rights and these rights are acquired through a map-based system by direct application to the MME.

The Mining Code guarantees a stable fiscal regime for the life of any mine developed. It guarantees stabilization of the financial and customs regulations and rates during the operational period to reflect the rates in place at the date of signing. The Mining Code also states that no new taxes can be imposed, with the exception of surface tax, mining duties and royalties. However, the title holder may also benefit from any reductions of tax rates during the life of the operating licence.

Adopted in June, 2015 by the National Transitional Council, the new Mining Code complies with the policies of the Economic Community of West African States (ECOWAS) and the community mining policies of the West African Economic and Monetary Union. In particular, the Mining Code establishes the creation of a mining fund for local development to support municipal and regional development plans, to which the mining licence holders will contribute up to 1% of monthly turnover, or the value of extracted products during the month. Like the preceding code, the new code requires mining projects to conduct an Environmental and Social Impact Assessment (ESIA) and to meet the requirements of the Mining Code.

20.2.4 Institutional Framework

The main institutional stakeholders for environmental matters include the following:

- Ministry of Environment, the Green Economy and Climate Change (MEEVCC).
- Ministry of Energy, Mines and Quarries.
- Office of Mines and Geology.
- Chamber of Mines of Burkina Faso.
- National Commission of Mines.
- National Council for the Environment and Sustainable Development.
- National Bureau of Environmental Assessment.
- Technical Committee on Environmental Assessments.
- Other Ministries and Departments involved are:
    - Department of Infrastructures.
    - Ministry of Territorial Administration, Decentralization and Homeland Security.
    - Department of Health.
    - Department of Agriculture and Food Security.
    - Department of Hydraulic Resources and Sanitation.
    - Department of Animal and Fishery Resources.
    - Ministry of Women, National Solidarity and Family.

20.2.5 Required Permits

An amendment to the existing operating permit is required for the development of the Siou underground mine. The application for an amendment to the operating permit requires a feasibility study that must first be accepted by MEEVCC. The feasibility study must include an ESIA, which must include a Resettlement Action Plan (RAP) that has been accepted by all stakeholders. Once in production, a mining permit holder is required to open under his name, a Trust account named “Fund for the preservation and rehabilitation of the mining environment” at the Central Bank of West African States. This account must be funded annually on January 1 by an amount equal to the total rehabilitation budget presented in the ESIA, divided by the number of years of expected production to cover the costs of mine reclamation, closure and rehabilitation.

A mining plan will be filed with the Burkina Faso authorities as a requirement to edit the actual permit to allow underground mining. On site, a full-time team of professionals has been assigned to work on the permitting process and are collaborating with governmental officials in this regard. It is presently allowed to initiate a ramp as an exploration opening.

20.3 BASELINE STUDIES

A number of baseline studies have been conducted in order to fully document the sensitive environmental and social components of the Mana project area.

An initial environmental impact study of the project was completed out before the opening of the mine (Socrège, 2006). Complementary environmental impact studies were carried out for each of the Kona extensions (Socrège, 2012). The initial ESIA was amended to cover a new pit and the establishment of a new waste rock storage facility in the northeast extension of the Wona main pit. It was further amended to cover the Fofina and Siou projects and the second extension of the operating licence. Each of these studies is accompanied by an ESMP and has been the subject of a reasoned opinion on environmental feasibility (government authorization). They also each include a revised Rehabilitation and Closure Plan for the mine, PRF (SNC-Lavalin, PRF Mana 2013 (SNC-Lavalin, 2013) and SNC-Lavalin, PRF Siou and Fofina 2016) (SNC-Lavalin, 2016), (Sapiens, 2013a) and Siou (Sapiens, 2013b).

20.4 SOCIAL AND COMMUNITY ISSUES

Several action plans were made during the evolution of the Mana project starting in 2007 and developed with the different phases of extension of the project, i.e., Wona-northeast, Kona and Fofina-Siou.

In the absence of a national resettlement plan policy, all of these action plans (travel and compensation plan for affected persons) are in line with Operational Policy 4.12 (OP). 4. 12) of the World Bank. The main goal is to ensure that populations who lose their livelihood or part of their property as a result of the Mana project are treated fairly and participate in the indirect benefits of the mining projects

The approach is summarized as follows:

- Field recognition – including meetings with the local communities, government authorities, local elected representatives and community representatives (village chief, customary chiefs, religious authorities and all resource persons (Muslim, Catholic, etc.).
- Analysis of the existing data through the documentary review.
- Development of a methodology and collection of tools (household, farmland, habitat and infrastructure survey sheets, a forest inventory sheet and a maintenance grid). This methodology and the collection tools are validated with the promoter before their application in the field. An assessment of potentially vulnerable people is also carried out.

Socio-economic surveys are used to identify, locate and characterize all affected individuals and properties. Assets that are affected include:

- Farmland owned by individuals with a percentage of women, including farmer/non-farmer, farmer/landowner and landowner/non-farmer.
- Heads of households including widows and young single persons.
- Ancillary infrastructures (such as storage areas, shea ovens, hen houses, manure pits, kitchen and latrines).
- Family cultural and religious property.
- Collective property, infrastructure and equipment belonging to the village and to religious communities.
- Fruit and other trees.

Compensation is paid for affected property, infrastructure and crops based on replacement cost.

20.4.1 Community Engagement and Consultation

Community engagement and consultation is based on the following:

- All damage caused by mine activities, once proven, is compensated for. A consultation framework is held at least once a year in order to discuss the problems and grievances.
- Permanent contact is established between community leaders and SEMAFO management who attend various social events in the villages (customary and religious holidays, death of a resource person, etc.).
- Grievances and disputes are settled amicably where possible.
- All requests for community projects are directed to the Foundation; other emergency issues (drill repairs, donation, support for sacrifices, etc.) are handled by SEMAFO management.

20.4.1.1 SEMAFO Foundation

The SEMAFO Foundation reviews projects proposed by the communities and realizes them according to their relevance, benefits and feasibility.

The Foundation participates in the construction of schools (including provision of latrines, equipment and supplies) and supports income-generating projects and skills development by supporting local crafts and trade training, as well as funding health projects impacting women, including:

- Implementation of school canteens.

- Implementation of multifunctional platforms.
- Production and processing of shea butter.
- Production of sesame seeds.
- Prevention of cervical cancer, and support for obstetric fistula.
- Beekeeping.
- Poultry-raising.
- Sewing centres.

20.5 ACID ROCK DRAINAGE

Assessment of acid rock drainage has been carried out in connection with a number of studies:

- Reminex Feasibility Study (2004) for Mana mining.
- BBA/Micon Feasibility Study (July 2005), for Mana Mining.
- Environmental Impact Assessment, Mana Mine, Socrège (2006).
- Environmental Impact Statement, Siou and Fofina mine, Sapiens (2013).

Regular analyses carried out over the period 2009-2012 on samples from the Wona and Nyafé pits, and in accordance with international standards, demonstrate that the types of materials contained in the existing waste rock can be considered as non-generating, as summarized in Table 20.1. The maximum acid potential ranges from non-existent to low and the potential for neutralization is high. The resulting net neutralization potential (the difference between neutralization potential and maximum acid potential) is also high.

Table 20.1
Summary of Acid Generation Potential Determination Tests (2009-2012)

Type of Material	Number of Samples	Total Sulphur (%)		Sulphide Sulphur (%)		Neutralization Potential/ Acid Generation Potential		Carbonates (%)	
		Maximum	Median	Maximum	Median	Maximum	Median	Maximum	Median
Wona Waste rock	27	0.14	0.005	0.07	0.005	330	23	13.4	0.09
Nyafé Waste rock	10	0.05	0.005	0.005	0.005	62	29	4.58	0.025
Wona Ore	30	1.85	0.05	1.62	0.02	47	14	7.7	0.09
Nyafé Ore	5	0.95	0.005	0.66	0.005	47	18	4.5	0.025
Plant Feed	32	1.44	0.44	1.02	0.125	280	20	7.75	4.2
Tailings/waste rock	**33**	**1.36**	**0.45**	**0.95**	**0.13**	**110**	**15**	**7.3**	**3.6**

20.6 WASTE ROCK STORAGE

20.6.1 Wona and Nyafé Mining Operations

Waste rock is transported to one of the five storage areas located near the open pits with a total capacity of 29.3 Mt. See Table 20.2. The stripping ratio averages 3:1 for the Wona deposit and 16:1 for the Nyafé deposit, for an overall average of 4.2:1.

Table 20.2
Capacity and Dimensions of Different Waste Rock Storage Areas

Area	Capacity (Mt)	Area (ha)	Estimated Height (m)
Wona	19.3	70.2	30
Nyafé North	7.3	10.2	30
Nyafé North-centre	1.1	1.5	30
Nyafé South-centre	1.4	1.9	30
Nyafé South	0.2	0.3	30
Total	**29.3**	**84.1**	**-**

These structures will be built up in layers and the slopes leveled to an average of about 20° to ensure maximum degree of stability and ease of rehabilitation. Perimeter diversion ditches will be installed around each structure to divert runoff water to the environment via a sedimentation basin

Each waste rock storage area will be rehabilitated and revegetated in a progressive manner using topsoil, surface soils or saprolite obtained from quarries or other sites. This material will be accumulated and stored separately. At the end of the operation or on completion of a facility, it will be deposited as a 50 cm thick layer on the surface to be revegetated.

20.6.2 Siou Mining Operation

To ensure physical stability, the Siou project dumps will be constructed in accordance with the practice established for existing waste storage areas (step construction with angles to be respected). The individual lifts will be 15 m high and 15 m wide with the slopes allowed to form naturally as material is unloaded.

20.7 WASTE DISPOSAL AND SANITARY WASTEWATER

Waste and sewage disposal is discussed in Section 18.5 of this report.

The various categories of waste are managed responsibly to limit potential environmental and social impacts. Recyclable materials are collected and sent for recycling. Reusable materials, such as empty containers, large woven bags and drums, are made available to employees and recyclers.

There are established protocols in place for disposal of hazardous wastes and for dealing with any spills.

Sanitary waste water is treated in a bacterial facility.

All discharges to the environment are in accordance with the discharge standards of Burkina Faso.

Since the beginning of operations in 2008, there has been no effluent from the TSF and no contamination of ground water has occurred.

20.8 CLOSURE, DECOMMISSIONING AND RECLAMATION

The mine rehabilitation and closure plan outlines the recommended remediation options, including the stages and costs of implementation. By decree issued by the Council of Ministers (Decree No. 2007-845/PRES/PM/MCE/MEF of 26 December 2007), the government has set up a fund called the Mining Environment Conservation and Rehabilitation Fund, to be used for the restoration of mining sites. Mining companies in the operational phase are required to contribute to this fund through a judicial account opened at a commercial bank in Burkina Faso. The account of SEMAFO stood at USD 7,255,733, as of December 31, 2017 on an annual rehabilitation budget of USD 0.01/t of material mined (ore and waste rock).

The main objectives of the Closure and Rehabilitation Plan are restoration of ecosystems and recovery of land use, including the following:

- Dismantling and removal of plant equipment, machinery and infrastructure.
- Progressive rehabilitation to allow rapid recovery of the vegetation cover and early recovery of the ecosystem.
- Sustainable rehabilitation measures including control of water and wind erosion.
- Design and implementation of a post-closure monitoring program.

All structures that can be used by communities will be maintained, with the exception of the facilities that may constitute a risk to people or the environment.

21.0 CAPITAL AND OPERATING COSTS

This section outlines the capital and operating costs for all mining operations at Mana, including the Wona-Kona pit, the Siou pit and the Siou underground project. All costs are expressed in US dollars.

21.1 MANA OPEN PITS OPERATING COST AND SUSTAINING CAPITAL

For the purpose of this report, the stripping costs are included in the cash operating cost per tonne and in the total mining operation expenses.

Sustaining capital expenditures for the remaining eight-year mine life amount to USD 46.3 million. These amounts take into consideration tailings lifts, major component rebuild, electrical and mechanical tools, liners and various small sustaining capital needs.

The operating costs shown in Table 21.1 are compiled from the Owner's reports. The unit costs presented herein are representative of the historical costs incurred.

The following assumptions were used to forecast open pit operating costs:

- Price of fuel: USD 0.98/L.
- Exchange rate: USD1.07: €1.00.

Table 21.1
Open Pit Operating Costs

Description	Unit	Wona-Kona	Fofina	Siou/Nyafé/Yama
Waste Mining				
Oxides (saprolite)	USD/t	1.00	1.41	1.33
Transitional (saprock)	USD/t	2.37	2.24	2.37
Sulphides (bedrock)	USD/t	2.57	2.39	2.57
Ore Mining				
Oxides (saprolite)	USD/t	2.00	3.76	5.07
Transitional (saprock)	USD/t	3.17	4.41	6.01
Sulphides (bedrock)	USD/t	3.23	4.77	6.31
Processing				
Oxides (saprolite)	USD/t	12.81	12.48	13.56
Transitional (saprock)	USD/t	15.91	15.67	16.20
Sulphides (bedrock)	USD/t	17.17	17.12	17.11
G&A				
Oxides (saprolite)	USD/t	2.65	2.65	2.65
Transitional (saprock)	USD/t	3.33	3.36	3.36
Sulphides (bedrock)	USD/t	3.56	3.60	3.60

21.2 SIOU UNDERGROUND PROJECT CAPITAL COST ESTIMATE

The capital cost estimate includes all the direct and indirect costs and appropriate project estimating contingencies required to bring the Siou underground project into production, as defined by this prefeasibility study.

The estimated pre-production capital cost is USD 51.7 million and the sustaining development capital is USD 16.5 million. This total has been compiled as shown in Table 21.2.

Table 21.2
Siou Underground Project Overall Capital Cost Estimate
(Million USD)

Main Area	Pre-production	Sustaining	Total
Underground Mine	26.5	10.8	37.3
Maintenance and Infrastructure	13.2	2.9	16.1
Technical Services	2.9	0.5	3.4
Administration	1.5	0.2	1.7
Contingency (15%)	6.6	2.2	8.8
Subtotal	50.7	16.5	67.2
Operation Readiness Plan	1.0		1.0
Total	**51.7**	**16.5**	**68.2**

The project initial capital costs are based on a pre-production period from Q3 2018 through Q4 2019. Pre-production represents the period prior to the processing of the first stope ore from the underground mine.

The project sustaining development capital costs and operating costs are for the period from 2020 to 2024.

Operating cost estimates for the project are mostly based on a contract mining approach.

21.2.1 Mine Capital Cost Estimates for Siou Underground Project

The largest portion of the capital cost estimate is attributed to development costs, which have been based on contractor quotations. The capital costs include a contingency of 15%.

Mining capital includes mine access development, pre-production mining costs, contractor mobilization and other mine infrastructure that is comprised of surface facilities and portal collar construction.

Underground mine capital costs are summarized in Table 21.3.

Table 21.3
Underground Mine Capital Costs
(Million USD)

Item	Pre-production		Sustaining					Total
	Y -1.5	Y -1	Y 1	Y 2	Y 3	Y 4	Y 5	
Decline	3.7	2.7	2.5	0.9				9.8
Level		8.1	3.8	2.6				14.5
Access	0.3	1.7						2.0
Ore drive		1.2						1.2
Vertical Development	0.8	0.1	0.1					1.0
Mine Services	3.1	4.8	0.6	0.3				8.8
Total	**7.9**	**18.6**	**7.0**	**3.8**				**37.3**

Mine services sustaining capital for Years 1 and 2 is associated with development waste to be hauled from underground to the surface waste dump.

The development capital has been estimated based on the length of the development, and the contractor's proposed unit cost of development for each of the different development profiles. Contractor's proposed rates were given in US dollars per metre for development. Ventilation raise development was quoted using both production drill and raise bore equipment rates. The quoted rates are shown in Table 21.4.

Table 21.4
Contractor Rates for Development

Item	Contractor Quote (USD/m)
Decline	3,167
Level	2,898
Access	2,482
Ore Drive	2,427
Drop Raise	2,205
Raise Bore	4,500

In addition to the contractor quotation, costs included in Table 21.3 comprise ground support (including bolts and mesh support), electrical cable supplies and hangers, ventilation tubing, communication lines, water lines, and compressed air lines and fittings.

Since individual stope accesses have a relatively short life corresponding to each stoping area, this type of development has been treated as an operating cost, except during the pre-production period when it is capitalized.

Maintenance and infrastructure capital costs are shown in Table 21.5.

Table 21.5
Maintenance and Infrastructure Capital Costs
(Million USD)

Item	Y -1.5	Y -1	Y 1	Y 2	Y 3	Y 4	Y 5	Total
Mobile Equipment	1.3	4.3	1.0	0.6				7.2
Primary Fans		0.15	0.02	0.01				0.2
Power station	0.3	0.7	0.1	0.1				1.1
Light Vehicles	0.6	1.1	0.2	0.1				1.9
Maintenance Supervision	1.1	3.4	0.6	0.3				5.3
Infrastructures	0.1	0.2	0.04	0.02				0.4
Total	**3.4**	**9.8**	**1.9**	**1.0**				**16.1**

The technical services capital cost was estimated as a combination of owner and contractor costs required to establish engineering and geology services. Capitalized technical services costs include material for safety supplies, survey and sampling equipment, plotters, printers, computers, software, and light vehicles. The plotters, printers, computers, and software would be used by engineering and geology, and the bulk of the software cost is for mine planning and geology software for mine design and ore control. Cost provision for external consulting is also included within the engineering budget.

Technical services capital costs are shown in Table 21.6.

Table 21.6
Technical Services Capital Costs
(Million USD)

Item	Y -1.5	Y -1	Y 1	Y 2	Y 3	Y 4	Y 5	Total
Engineering	0.5	1.3	0.2	0.1				2.1
Geology	0.3	0.8	0.1	0.1				1.3
Total	**0.8**	**2.1**	**0.3**	**0.2**				**3.4**

Administration capital includes cost of contractor mine management overheads and the cost for owner mine management material such as computers, cell phones and office supplies.

Administration capital costs are shown in Table 21.7.

Table 21.7
Administration Capital Costs
(Million USD)

Item	Y -1.5	Y -1	Y 1	Y 2	Y 3	Y 4	Y 5	Total
Administration	0.4	1.1	0.1	0.1				1.7

An allowance of USD 1.0 million is allocated to the operational readiness plan. This covers cost items such as contract negotiation, site visits, permitting, Owner recruitment costs, site preparation and detailed engineering services.

21.3 MINE OPERATING COSTS FOR SIOU UNDERGROUND PROJECT

Siou underground mine operating costs are shown in Table 21.8. The cost per tonne is calculated based on ore tonnes milled per year and is shown in Table 21.9. Note that operating costs incurred during pre-production have been estimated in the same manner as described in this section but are included in capital costs and so do not appear in Table 21.8 or Table 21.9.

Table 21.8
Underground Mine Operating Cost
(Million USD)

Item	Y -1	Y 1	Y 2	Y 3	Y 4	Y 5	Total
Underground Mine	-	40.9	34.2	33.9	26.7	8.6	144.3
Maintenance and Infrastructure	-	11.8	12.6	13.1	11.9	2.4	51.8
Technical Services	-	2.1	2.2	2.4	2.3	0.7	9.7
Administration	-	0.9	1.0	1.1	1.1	0.3	4.4
Total Mine Cost	**-**	**55.7**	**50.0**	**50.5**	**42.1**	**12.0**	**210.3**

Table 21.9
Mine Operating Cost per Tonne

Item	Units	Y -1	Y 1	Y 2	Y 3	Y 4	Y 5	Total
Mill Production	kt	65	654	704	704	705	204	3,036
Underground Mine	USD/t		62.02	48.77	48.35	38.15	41.51	47.54
Maintenance and Infrastructure	USD/t		17.92	17.97	18.64	17.04	11.45	17.07
Technical Services	USD/t		3.14	3.15	3.41	3.35	3.34	3.20
Administration	USD/t		1.43	1.43	1.55	1.53	1.53	1.45

Life of mine average operating cost for mining in respect of the underground project is forecast to be approximately USD 70/t milled.

21.3.1 Development Costs

The development requirements for stope preparation are comprised of stope accesses in waste and ore drives. The development cost is a function of the equipment hours, personnel, and consumables required for drilling, blasting, loading, hauling, ground support, and mine services.

21.3.2 Production Drilling and Blasting Costs

The drilling and blasting requirements have been estimated based on the production schedule. The drilling and blasting cost is a function of the equipment hours, personnel, and consumables required for production drilling.

21.3.3 Loading Cost

Loading costs include the cost of loaders used to load 60-t haul trucks. The haul trucks will haul ore to the surface and either return empty or back haul waste for use in backfilling. Due to the longer cycle times and the number of haul trucks required, the utilization of the loaders is lower than would normally be expected.

21.3.4 Haulage Cost

Haulage costs have been estimated based on truck requirements to haul ore from underground to the stockpile outside the portal using 60-t haul trucks. The trucks will also haul waste material into the mine for use in backfilling. The cost of the return trip is included in the ore haulage cost. The incremental cost of the truck returning from the backfill dumping location to the production loading location has been included in the backfill costs. The haulage cost varies based on the cycle time required. Thus, the cost is distance dependent, based on locations being mined.

21.3.5 Backfill Cost

The backfill costs have been estimated to include return haulage of waste rock underground using 60-t haul trucks, and placement of the material using loaders. Part of the backfill costs have been estimated based on equipment requirements for mixing of waste rock with 4% cement. Half of the LOM backfilling requirements will be cemented rock fill and the other half dry rock fill.

21.3.6 Mine Support Cost

Mine support includes various equipment and operator costs to provide support for mine operations. Equipment includes: service truck, lube trucks, and grader. The estimated support costs are based on contractor quotations.

21.3.7 Ventilation Cost

The primary cost of ventilation is for power consumption and system maintenance.

21.3.8 Dewatering Cost

Dewatering costs are based on maintaining primary and secondary dewatering pumps for moving water from lower elevations to the surface. The pumps are staged through the life of mine to reflect the total depth of the mine. As the head increases due to depth, so does the cost to pump water from the mine. The pumping rate is designed to operate at 16 L/s at final mine development depth.

21.3.9 Mine General Services

Mine general services account for owner costs for contractor supervision, mine planning, mine geology, and supplies.

21.3.10 Contractor Overhead

Contractor overhead costs provide for administration and facilities that the contractor supplies in order to manage its operations. This is a fixed monthly cost based on contractor quotations.

21.4 PROCESSING AND GENERAL AND ADMINISTRATION OPERATING COSTS FOR SIOU UNDERGROUND PROJECT

The operating costs for processing and G&A were provided by Mana Mineral SARL. The LOM average costs in respect of the underground project are USD 17.11/t and USD 3.60/t, respectively, and are representative of the historical cost incurred.

Including processing and G&A costs, life of mine average cash operating cost for the underground project is forecast to be approximately USD 90/t milled, including mining, processing and G&A costs.

22.0 ECONOMIC ANALYSIS

22.1 BASIS OF EVALUATION

Micon has prepared its assessment of the project on the basis of a discounted cash flow model, from which net present value (NPV) and other measures of project viability can be determined. Assessments of NPV are generally accepted within the mining industry as representing the economic value of a project after allowing for the cost of capital invested.

The objective of the study was to determine the potential viability of an open pit and underground mine with an on-site mill and processing plant producing doré bullion for sale to a precious metals refinery. In order to do this, the cash flow arising from the base case has been forecast, enabling a computation of the project NPV to be made. The sensitivity of this NPV to changes in the base case assumptions is then examined.

22.2 MACRO-ECONOMIC ASSUMPTIONS

22.2.1 Exchange Rate and Inflation

All metal price forecast, capital and operating cost estimates and cash flow projections are expressed in United States dollar (USD, or $) terms, unless otherwise stated. Inputs to the cash flow model for the project have been prepared using constant, first quarter 2018 money terms, i.e., without provision for escalation or inflation.

West African CFA francs have a fixed rate of exchange with the Euro. Costs incurred or estimated in Euros have been converted at the rate of USD 1.07 per Euro.

Except where precious metal quantities are measured in troy ounces (oz), all weights and measures used in the study are metric.

22.2.2 Weighted Average Cost of Capital

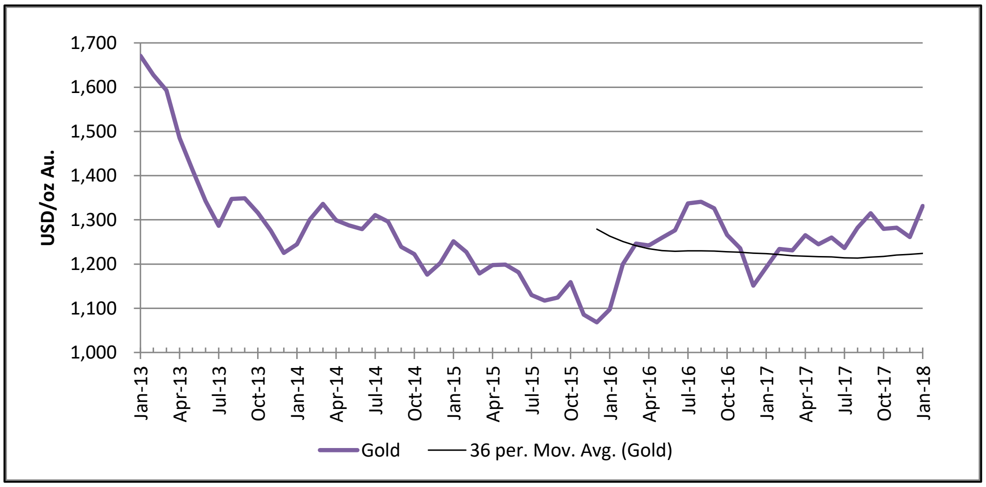
In order to find the NPV of the cash flows forecast for the project, an appropriate discount factor must be applied which represents the weighted average cost of capital (WACC) imposed on the project by the capital markets. The cash flow projections used for the valuation have been prepared on an all-equity basis. This being the case, WACC is then equal to the market cost of equity which Micon has estimated to be approximately 8.0% per year in real terms.

Micon has applied a real discount rate of 8.0% per year to the base case cash flow.

22.2.3 Expected Metal Prices

The base case cash flow projection assumes a static gold price in real terms of USD 1,200/oz, approximately equal to the 36-month average price to January, 2018. Figure 22.1 shows the spot price of gold over the past five years.

Figure 22.1
Gold Price History



22.2.4 Corporate Taxation

The project evaluation takes into account corporate income tax in Burkina Faso, charged at 17.5% after depreciation and amortization allowances calculated on a unit of production basis.

22.2.5 Royalty

A state royalty of 4.0% of sales has been provided for in the cash flow model.

22.2.6 Selling Expenses

Bullion refining and other selling expenses are forecast at USD 3.01/oz gold.

22.3 TECHNICAL ASSUMPTIONS

The technical parameters, production forecasts and estimates described elsewhere in this report are reflected in the base case cash flow model. These inputs to the model are summarized below.

22.3.1 Operating Costs

As detailed in Section 21.0, cash operating costs over the LOM period average USD 58/t milled, including waste stripping activities. Off-site costs (i.e., selling expenses and royalties) bring the total cash cost to USD 62/t. See Figure 22.2 and Table 22.1 for a breakdown of LOM average total cash costs by area.

Figure 22.2
LOM Operating Cost Breakdown by Area

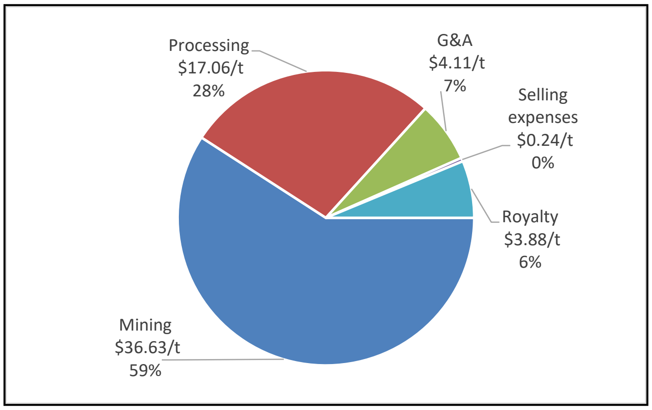


Table 22.1
LOM Annual Operating Cost Breakdown

Ore Processed	Unit	2018	2019	2020	2021	2022	2023	2024	2025	Total
Siou Underground	000't	-	65	654	704	704	705	204	-	**3,036**
Siou Open Pit	000't	711	867	-	-	-	-	-	-	**1,578**
Wona Open Pit	000't	1,411	1,277	1,646	1,683	1,683	1,698	1,337	1,606	**12,341**
Other	000't	353	-	-	-	-	-	922	-	**1,275**
Total Ore Processed	000't	2,475	2,209	2,300	2,387	2,387	2,403	2,463	1,606	**18,230**
Operating Costs		**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**Total**
Mining costs	$'000	104,012	96,319	134,788	101,333	94,365	66,375	50,970	19,678	**667,839**
Processing Costs	$'000	42,296	37,793	39,394	40,889	40,895	41,167	41,027	27,522	**310,982**
G&A Costs	$'000	9,800	9,800	9,800	9,800	9,800	9,800	9,800	6,390	**74,990**
Cash Operating Costs	$'000	156,107	143,911	183,981	152,022	145,060	117,342	101,796	53,589	**1,053,810**
Selling expenses	$'000	546	577	639	642	640	644	497	248	**4,434**
Royalty	$'000	8,711	9,206	10,197	10,236	10,205	10,266	7,930	3,954	**70,705**
Total Cash Costs	$'000	165,365	153,695	194,818	162,900	155,905	128,251	110,224	57,791	**1,128,949**
Sustaining Capital	$'000	10,319	8,000	18,523	13,016	7,000	3,000	3,000	-	**62,858**
All-In Sustaining Costs	$'000	175,684	161,695	213,341	175,916	162,905	131,251	113,224	57,791	**1,191,807**
All-In Sustaining Costs	$/oz	968	843	1,004	825	766	614	685	702	**809**
Siou Underground	$/t	-	22	106	93	93	81	79	-	**90**
Siou Open Pit	$/t	70	68	-	-	-	-	-	-	**69**
Wona Open Pit	$/t	60	66	70	52	47	35	30	33	**49**
Other	$/t	67	-	-	-	-	-	50	-	**54**
Unit Operating Cost	$/t	63	65	80	64	61	49	41	33	**58**
Mining costs	$/t	42	44	59	42	40	28	21	12	**37**
Processing Costs	$/t	17	17	17	17	17	17	17	17	**17**
G&A Costs	$/t	4	4	4	4	4	4	4	4	**4**
Cash Operating Costs	$/t	63	65	80	64	61	49	41	33	**58**
Selling expenses	$/t	0	0	0	0	0	0	0	0	**0**
Royalty	$/t	4	4	4	4	4	4	3	2	**4**
Total Cash Costs	$/t	67	70	85	68	65	53	45	36	**62**

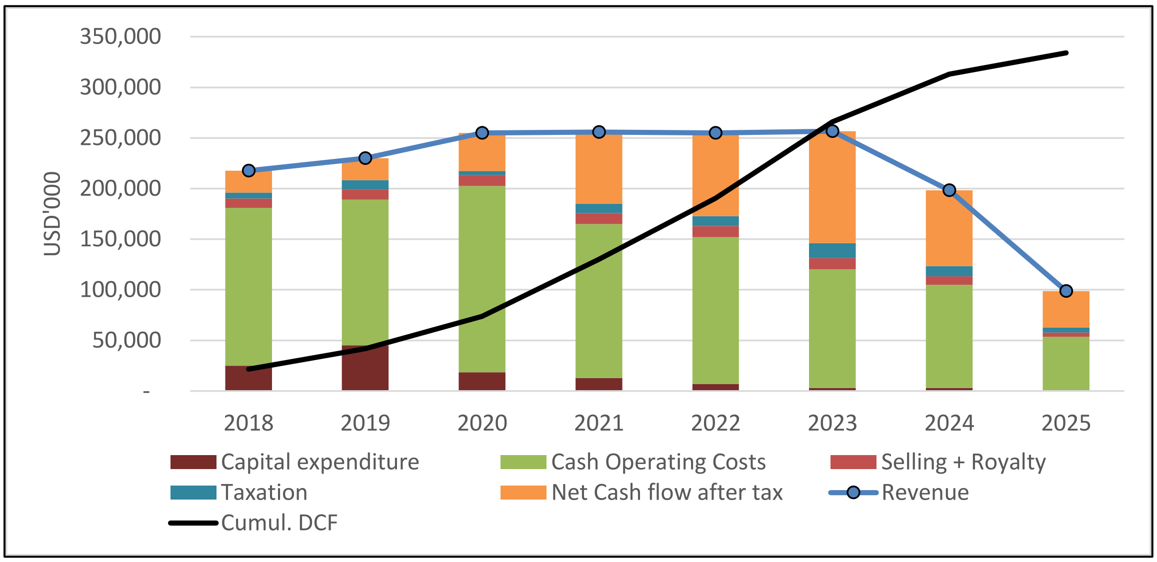
22.3.2 Capital Expenditure

As described in Section 21.0, construction of the underground mine is forecast to require USD 51.7 million. In addition, an amount of USD 62.9 million is provided for ongoing sustaining capital over the LOM period, including capitalized waste stripping activities.

22.4 BASE CASE CASH FLOW

The LOM base case project cash flow is presented graphically in Figure 22.3 and in Table 22.2, which also shows the annual tonnage of mill-feed material mined from the Mana operations including the Siou underground and the open pits, as well as the mill head grade and gold content.

Figure 22.3
LOM Annual Cash Flow Forecast



22.5 DISCOUNTED CASH FLOW EVALUATION

At an annual discount rate of 8.0%, the discounted cash flow evaluates to an NPV of USD 334 million.

Owing to the absence of negative annual cash flows in the forecast period, no internal rate of return (IRR) or payback period can be determined.

22.6 SENSITIVITY STUDY

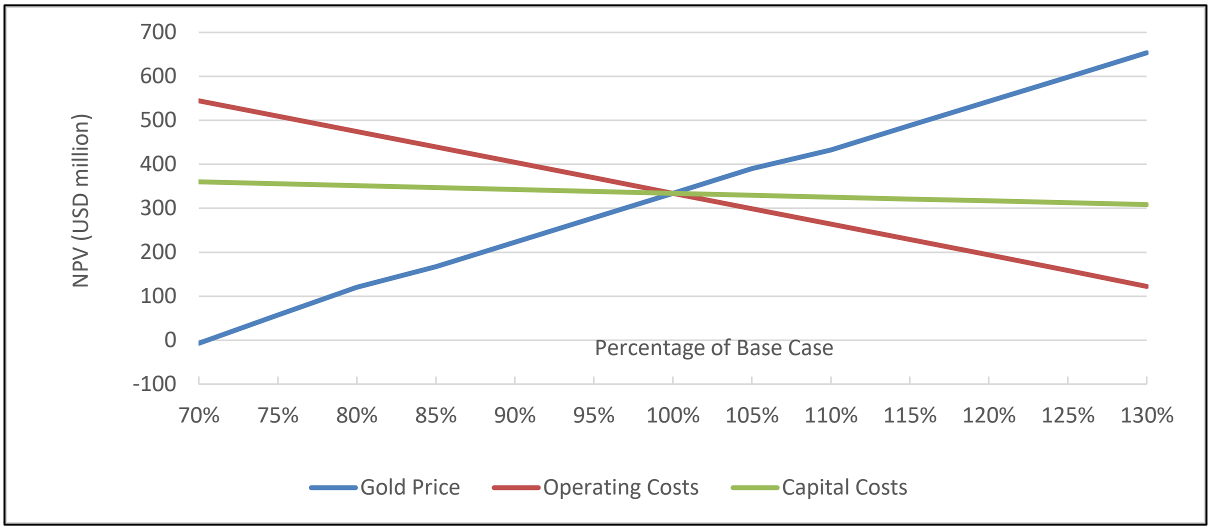
The sensitivity of project returns to changes in all revenue factors (including mill-feed grade, recovery, and gold price) and also to capital and operating costs was tested over a range of 30% above and below base case values. Figure 22.4 shows the NPVs on an after-tax basis, with an annual discount rate of 8%, for the sensitivity analysis.

Table 22.2
LOM Annual Production and Base Case Project Cash Flow Forecast

Production Schedule	Unit	2018	2019	2020	2021	2022	2023	2024	2025	Total
SIOU UG										
Ore processed	000't	-	65	654	704	704	705	204	-	**3,036**
Head grade	g/t	-	5.23	5.61	4.97	5.34	5.35	4.92	-	**5.29**
Recovery	%	-	96%	96%	96%	96%	96%	96%	-	**96%**
Gold recovered	oz	-	10,531	113,206	107,953	116,055	116,450	31,041	-	**495,237**
Cash Operating Cost	$/t	-	22	106	93	93	81	79	-	**90**
SIOU										
Waste	000't	12,835	15,205	-	-	-	-	-	-	**28,040**
Ore processed	000't	711	867	-	-	-	-	-	-	**1,578**
Head grade	g/t	3.50	3.63	-	-	-	-	-	-	**3.57**
Recovery	%	96%	96%	-	-	-	-	-	-	**96%**
Gold recovered	oz	76,734	97,212	-	-	-	-	-	-	**173,945**
Cash Operating Cost	$/t	70	68	-	-	-	-	-	-	**69**
WONA										
Waste	000't	21,126	22,566	32,189	19,822	16,602	8,050	3,203	6,286	**129,844**
Ore processed	000't	1,411	1,277	1,646	1,683	1,683	1,698	1,337	1,606	**12,341**
Head grade	g/t	2.31	2.53	2.31	2.40	2.20	2.20	2.35	1.97	**2.27**
Recovery	%	81%	81%	81%	81%	81%	81%	81%	81%	**81%**
Gold recovered	oz	85,050	84,047	99,234	105,305	96,553	97,418	81,786	82,371	**731,764**
Cash Operating Cost	$/t	60	66	70	52	47	35	30	33	**49**
OTHER										
Gold recovered	oz	19,694	-	-	-	-	-	52,378	-	**72,073**
MANA CONSOLIDATED										
Waste	000't	34,066	37,771	32,189	19,822	16,602	8,050	14,772	6,286	**169,558**
Ore processed	000't	2,475	2,209	2,300	2,387	2,387	2,403	2,463	1,606	**18,230**
Head grade	g/t	2.62	3.04	3.25	3.16	3.13	3.12	2.78	1.97	**2.92**
Recovery	%	87%	89%	88%	88%	89%	89%	75%	81%	**86%**
Gold recovered	oz	181,478	191,790	212,441	213,258	212,608	213,868	165,205	82,371	**1,473,019**
Cash Operating Cost	$/t	63	65	80	64	61	49	41	33	**58**
Cash Flow Projection		**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**Total**
Revenue (at $1,200/oz)	$'000	217,773	230,148	254,929	255,910	255,130	256,641	198,246	98,845	**1,767,622**
Cash Operating Costs	$'000	156,107	143,911	183,981	152,022	145,060	117,342	101,796	53,589	**1,053,810**
Selling + Royalty	$'000	9,257	9,783	10,837	10,878	10,845	10,909	8,427	4,202	**75,139**
Sustaining Capital	$'000	10,319	8,000	18,523	13,016	7,000	3,000	3,000	-	**62,858**
All In Sustaining Cost	$'000	175,684	161,695	213,341	175,916	162,905	131,251	113,224	57,791	**1,191,807**
Operating Cash Flow	$'000	42,089	68,453	41,588	79,994	92,225	125,390	85,022	41,054	**575,815**
Initial Capital expenditure	$'000	14,496	37,175	-	-	-	-	-	-	**51,671**
Net Cash flow before tax	$'000	27,593	31,278	41,588	79,994	92,225	125,390	85,022	41,054	**524,144**
Taxation	$'000	5,999	9,617	4,049	9,158	9,890	14,762	10,064	4,828	**68,367**
Net Cash flow after tax	**$'000**	**21,594**	**21,661**	**37,539**	**70,837**	**82,335**	**110,628**	**74,958**	**36,226**	**455,777**
Cash Operating Costs (1)	$/t	63	65	80	64	61	49	41	33	**58**
All-in Sustaining Cost (2)	$/oz	968	843	1,004	825	766	614	685	702	**809**
Discounted cash flow	5%	21,594	20,629	34,049	61,191	67,737	86,680	55,935	25,745	**373,561**
Discounted cash flow	8%	21,594	20,056	32,184	56,232	60,519	75,292	47,236	21,137	**334,250**
Discounted cash flow	10%	21,594	19,691	31,024	53,221	56,236	68,691	42,312	18,589	**311,359**

[1] Cash operating cost per tonne is a non-IFRS financial performance measure with no standard definition under IFRS and is calculated using total operating costs related to tonnes processed (which includes capitalized stripping activities) over tonnes processed.
[2] All-in sustaining cost is a non-IFRS financial performance measure with no standard definition under IFRS and represents the total mining operation expenses (which includes capitalized stripping activities), plus sustainable capital expenditures.

Figure 22.4
NPV Sensitivity Diagram



The chart suggests that the project is most sensitive to revenue drivers, with a 30% reduction (equating to a gold price of USD 840/oz) resulting in a near-zero NPV. The project is moderately sensitive to operating costs with NPV reduced to around USD 122 million with a 30% adverse change. The project is least sensitive to changes in capital cost, which is consistent with the relatively minor amounts of capital in the cash flow forecast.

22.7 CONCLUSION

Micon concludes that this study demonstrates the viability of the Mana Project, including the Siou underground mine, within the range of accuracy of the estimated capital and operating costs, production forecast, and price assumptions.

23.0 ADJACENT PROPERTIES

The Yaramoko property of Roxgold Inc. (Roxgold) is located adjacent to and immediately south of the Mana Permit Group, and covers an area of approximately 196 km^2. Roxgold finalized the acquisition of the property from Riverstone Resources Inc. in October, 2011 (Roxgold press release, 27 October, 2011). (See Figure 23.1.)

The property is reported to contain gold mineralization associated with quartz veining hosted in felsic intrusive rocks that is structurally associated with east-west dilation zones. As at 31 December, 2016, measured plus indicated mineral resources for the 55 Zone were reported at 1,341,000 t at an average grade of 17.1 g/t Au for a total of 738,000 oz, and inferred mineral resources were reported at 669,000 t grading 16.14 g/t Au for 347,000 oz. Estimated proven and probable mineral reserves totalled 1,770,000 t at 11.45 g/t Au for 651,000 oz. (Roxgold press release, 18 April, 2017).

Underground mine production on the 55 Zone began in May, 2016 and commercial production was declared in October, 2016.

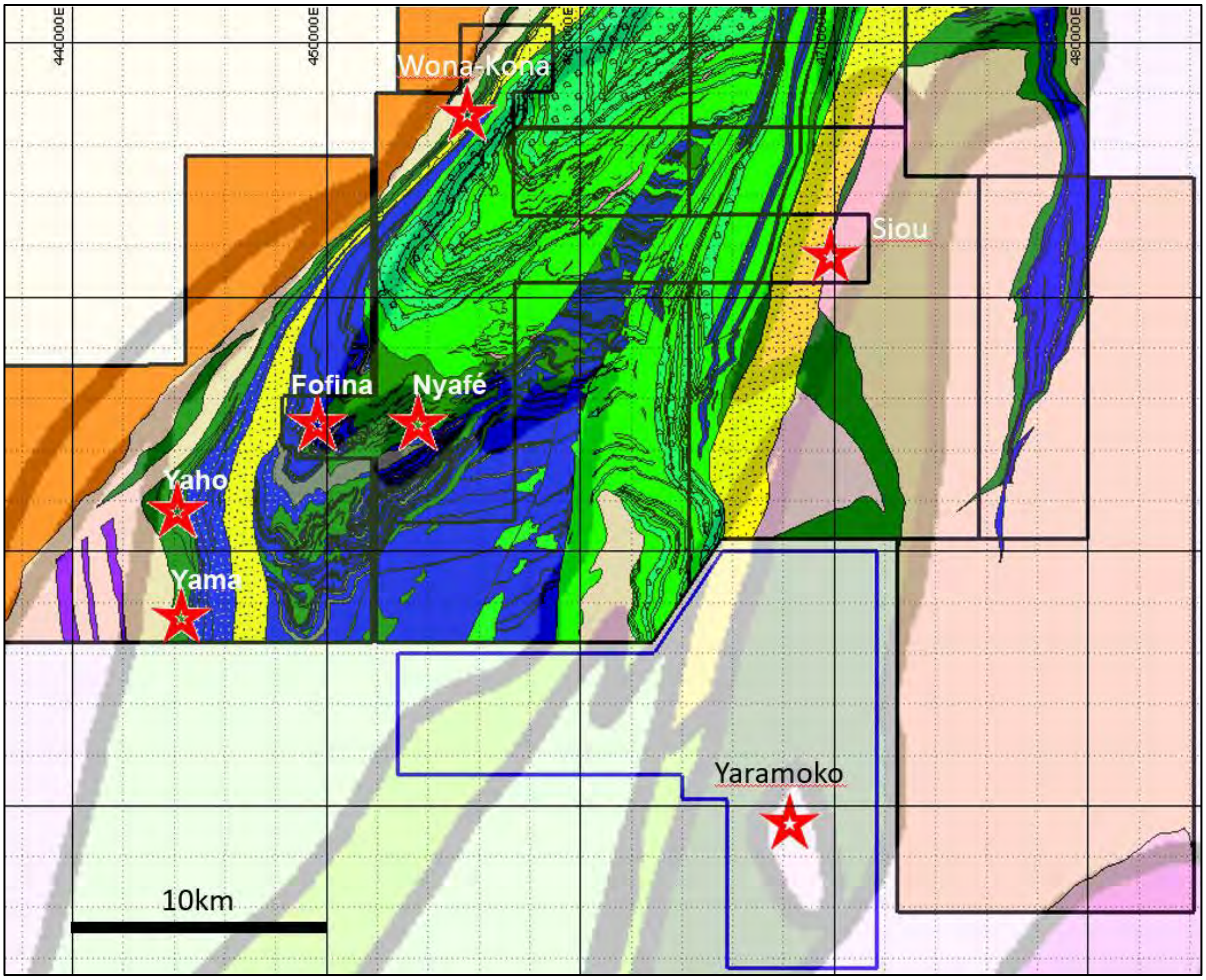
A positive feasibility study was announced for the Bagassi South expansion project and site construction work started in the third quarter of 2017. Proven and probable mineral reserves for Bagassi South were reported at 458,000 t at 11.54 g/t Au for a total of 170,000 oz. (Roxgold press releases, 6 November, 2017 and 14 November, 2017).

Roxgold produced a total of 127,000 ounces in 2017 (Roxgold Press Release, 15 January, 2018).

Roxgold continues to explore on the 55 and Bagassi South Zones, and the Houoko permit.

The mineralization, mineral resource and reserve estimates reported by Roxgold have not been independently verified by Micon and the information is not necessarily indicative of the mineralization on the Mana Permit Group.

Figure 23.1
Mana Property and Deposits, Location of Adjacent Yaramoko Property



SEMAFO, 2017.

Additionally, several properties are located adjacent to the Mana permits to the north. SEMAFO understands that these are primarily held by individuals; the public record is limited on these properties.

24.0 OTHER RELEVANT DATA AND INFORMATION

All relevant information has been provided within this report. There is no additional information or explanation necessary to make this Technical Report understandable and not misleading.

25.0 INTERPRETATION AND CONCLUSIONS

This Technical Report discloses the results of the PFS for the development of underground mineral reserves at the Mana gold project located in southwestern Burkina Faso, West Africa, and discloses updated mineral resource and mineral reserve estimates for the property.

Ore is mined using open pit methods from a number of deposits, Wona-Kona, Nyafé, Fofina and Siou. Exploration has identified the potential for underground mining at depth Siou.

25.1 GEOLOGY AND MINERAL RESOURCES

The Mana district is located in the northern part of the Houndé greenstone belt. The lithostratigraphic succession is typical of greenstone belts and is characterized at the base by a major tholeiitic basaltic suite with some intercalations of argillic sedimentary rocks that are overlain by predominant pelagic and detrital sedimentary rocks (shale, sandstones, greywacke and volcanoclastics). The Mana district basalt unit has undergone submarine hydrothermal alteration with epidote, chlorite and local albite, and shows zones of strong silicification, some of which are anomalous in gold. Accessory minerals include rutile and disseminated pyrite. Free visible gold is encountered at both the Wona-Kona and Siou deposits.

The resource modelling approach has not changed since the Technical Report of 2013, but the models have been updated with recent drilling, revised interpretations, and the gathering of information from ongoing mining. The Yama satellite deposit was discovered and added. All resource models were adjusted in line with an open pit survey carried out at the end of December, 2017. Measured and Indicated resources bordering the new underground reserves, being close to future mine openings and having a slightly lower grade than the mineral reserves cut-off, were modelled as mining blocks, including mining dilution. If further drilling supports a grade estimate above the reserve cut-off for those blocks, it will be possible to rapidly update the mine plan to include them.

Table 14.9 presents the estimates of measured, indicated and inferred mineral resources on the Mana property, including the Siou deposit, as at 31 December, 2017.

Table 25.1
Mana Estimated Resources, Exclusive of Reserves, as at 31 December, 2017

Deposits	Measured			Indicated			Total Resources		
	Tonnage	Grade (g/t Au)	Ounces	Tonnage	Grade (g/t Au)	Ounces	Tonnage	Grade (g/t Au)	Ounces
Wona-Kona	1,331,000	2.05	87,800	21,623,000	2.55	1,775,600	**22,954,000**	**2.52**	**1,863,400**
Nyafé	286,000	3.94	36,300	223,000	5.97	42,700	**509,000**	**4.83**	**79,000**
Fofina	293,000	4.25	40,000	253,000	4.45	36,100	**546,000**	**4.34**	**76,100**
Yaho	5,738,000	0.91	168,500	11,636,000	0.88	330,800	**17,374,000**	**0.89**	**499,300**
Filon 67	26,000	2.72	2,300	9,000	3.59	1,000	**35,000**	**2.93**	**3,300**
Fobiri	469,000	1.80	27,100	114,000	1.52	5,600	**583,000**	**1.74**	**32,700**
Siou Open Pit	67,000	0.63	1,400	56,000	0.65	1,200	**123,000**	**0.66**	**2,600**

Deposits	Measured			Indicated			Total Resources		
	Tonnage	Grade (g/t Au)	Ounces	Tonnage	Grade (g/t Au)	Ounces	Tonnage	Grade (g/t Au)	Ounces
Siou Underground	513,000	3.23	53,200	787,000	3.25	82,300	**1,300,000**	**3.24**	**135,500**
Yama	0		0	99,000	1.56	4,900	**99,000**	**1.54**	**4,900**
Total Mana	**8,723,000**	**1.49**	**416,600**	**34,800,000**	**2.04**	**2,280,200**	**43,523,000**	**1.93**	**2,696,800**

Deposits	Inferred		
	Tonnage	Grade (g/t Au)	Ounces
Wona-Kona	3,466,000	2.96	329,600
Nyafé	151,000	5.87	28,400
Fofina	67,000	4.20	9,100
Yaho	223,000	0.78	5,600
Filon 67	6,000	6.32	1,100
Fobiri	578,000	1.39	25,800
Maoula	2,628,000	1.62	137,100
Siou	2,093,000	3.86	259,900
Yama	58,000	1.33	2,500
Total Mana	**9,270,000**	**2.68**	**799,100**

Notes:

6. 2014 CIM Definition Standards were followed for mineral resources.
7. The mineral resource has been estimated using a gold price of USD 1,400/oz.
8. High-grade assays have been capped.
9. The mineral resource was estimated using a block model. Three dimensional wireframes were generated using geological information. A combination of OK and ID^3 estimation methods were used to interpolate grades into blocks of varying dimensions depending on geology and spatial distribution of sampling.
10. Mineral resources that are not mineral reserves do not have demonstrated economic viability. There is currently insufficient exploration to define the inferred resources as indicated or measured resources.

Mineral resources were estimated by François Thibert M.Sc. geo., Directeur, Groupe Estimation Ressources et Réserves, Afrique de l'Ouest, of SEMAFO under the supervision of Michel Crevier, P.Geo., MScA, Vice President, Exploration and Mine Geology and SEMAFO's QP. The estimates were reviewed by Charley Murahwi, M.Sc., P.Geo., FAusIMM, Senior Geologist with Micon who is the QP responsible for the estimate.

25.2 MINING AND MINERAL RESERVES

Table 25.2 (over) presents the estimated proven and probable reserves at Mana as at 31 December, 2017. Mana's mineral reserves total 18.23 Mt at an average grade of 2.92 g/t Au containing 1.71 Moz gold.

Mineral reserves were estimated by François Thibert M.Sc. geo., Directeur, Groupe Estimation Ressources et Réserves, Afrique de l'Ouest, of SEMAFO under the supervision of Michel Crevier, P.Geo., MScA, Vice President, Exploration and Mine Geology and SEMAFO's QP. The estimates were reviewed by EurIng Bruce Pilcher, CEng, FIMMM, FAusIMM(CP), Senior Mining Engineer with Micon who is the QP responsible for the estimate.

Table 25.2
Mana Estimated Mineral Reserves at 31 December, 2017

Deposits	Proven Reserves			Probable Reserves			Total Reserves			Stripping Ratio (Waste/Ore)
	Tonnage	Grade (g/t Au)	Ounces	Tonnage	Grade (g/t Au)	Ounces	Tonnage	Grade (g/t Au)	Ounces	
Wona-Kona	6,062, 000	2.33	453,500	6,280,000	2.22	448,900	12,342,000	2.27	902,400	10.52
Nyafé	265,000	5.81	49,600	6,000	3.96	700	271,000	5.77	50,300	12.41
Fofina	33,000	4.66	4,900	3,000	3.94	300	36,000	4.49	5,200	2.95
Siou OP	1,400,000	3.78	170,200	179,000	1.92	11,000	1,579,000	3.57	181,200	17.76
Siou UG	1,047,000	5.10	171,600	1,988,000	5.38	344,200	3,035,000	5.29	515,800	-
Yama	-	-	-	651,000	1.75	36,600	651,000	1.75	36,600	12.62
Rompad	317,000	1.84	18,800	-	-	-	317,000	1.84	18,800	-
Total Mana	**9,124,000**	**2.96**	**868,600**	**9,107,000**	**2.88**	**841,700**	**18,231,000**	**2.92**	**1,710,300**	**11.40**

Notes:

1. All figures have been rounded to reflect the relative accuracy of the estimates.
2. Metal price of USD 1,200/oz gold.
3. Strip ratios include both operating and capitalized costs.

Two mining methods will be employed to recover the ore identified in the reserve estimate at Mana. Open pit mining will continue to be used at Wona-Kona and part of the Siou ore zone. Following identification of the ore at depth, and the positive results of this prefeasibility study, underground mining will be employed in the southern part of the Siou deposit.

Two underground mining methods will be used for the underground mining at Siou: long hole (longitudinal retreat and transversal) and cut and fill mining. These were selected because of the inclination of mineralized lenses and ore (stockwork) thickness.

The Siou underground ore mining rate will be 2,000 t/d. Approximately 1.5 years of pre-production has been scheduled, followed by a ramp up to full production in approximately four years.

Overall, the total open pit mine production rate for the coming years is expected to average 37 Mt material moved annually. Reserves support a LOM for open pit mining of eight years.

25.3 METALLURGICAL TESTING AND RECOVERY METHODS

Independent metallurgical testwork relating to the Mana operation has taken place in phases relating to the development of feed from:

- Wona-Kona and Nyafé deposits in 2002-2007.
- Siou deposit in 2012.
- South sector deposits, Fofina, Fobiri and Yaho in 2012-2013.

Previous test results at Siou indicated excellent gold recovery using standard CIL processing. The recovery was consistently at or above 96% for all mineralization types including oxides and sulphides, which indicate a high proportion of free gold within the mineralized samples.

Given the metallurgical processing experience gained by SEMAFO with the different types of mineralization in the area, there is no plan to undertake further testwork in support of underground development at Siou.

Gold from the Mana deposits is recovered by a modern metallurgical plant constructed in 2008 and expanded over the years to reach the current throughput capacity. No changes are envisaged in the processing plant as a result of the Siou underground development.

25.4 CAPITAL AND OPERATING COSTS

Owing to the proximity of the Siou underground project to the existing Mana processing plant, capital expenditures for the project will be minimal as there is no requirement for the construction of a new plant, TSF, camp and other significant ancillaries. The largest portion of the capital cost estimate is attributed to underground development costs which are based on contractor quotations. Mining capital includes development capital, pre-production mining costs, and other mine capital that is comprised of contractor mobilization, mine surface facilities and portal collar work.

Mine operating costs have been estimated from development and production scheduling and equipment cycle times. Contractor mining labour, equipment and variable rates have been applied to obtain unit costs per tonne of ore mined.

The operating costs for processing and G&A are based on SEMAFO's operating experience.

25.5 ECONOMIC ANALYSIS

Economic analysis of the Siou underground development project is based on a discounted cash flow model, from which NPV and other measures of project viability can be determined.

The objective of the study was to determine the potential viability of an open pit and underground mine with an on-site mill and processing plant producing doré bullion for sale to a precious metals refinery.

Micon concludes that this study demonstrates the viability of the project within the range of accuracy expected of a prefeasibility study for the estimated capital and operating costs, production forecast, and price assumptions.

25.6 ENVIRONMENTAL STUDIES, PERMITTING, AND SOCIAL AND COMMUNITY IMPACT

There are no identified environmental or social issues on the Mana property that would materially impact SEMAFO's ability to operate the mining and processing facilities.

A mining plan will be filed with the Burkina Faso authorities as a requirement to amend the existing permit to allow underground mining. Initiation of a ramp as an exploration opening is allowed under the existing permit.

25.7 RISKS AND OPPORTUNITIES

Even though the rock is qualified as Good to Very Good according to the Q' index for the four geological units present at Siou, minor risk exists that the rock quality encountered during underground development and production activities may be worse than anticipated. This will be mitigated by development of a ground control management program.

The use of a mining contractor with demonstrated experience in underground mining operations in Burkina Faso will mitigate other risks inherent to the nature of underground operations and will also serve to control mine capital and operating costs.

Criteria and assumptions used in this study for the Siou underground project are considered to be reasonably conservative. However, detailed engineering may lead to opportunities for optimization in the areas of mine design and scheduling, and control of grade and dilution.

Although the Mana property has been aggressively explored by SEMAFO, particularly since 2010, remaining targets could produce significant discoveries. Exploration will be centred principally on the Siou Shear Zone which crosses the property from south to north, but is also planned for the Pompoi permit to test for vein mineralization similar to that identified at the adjacent Yaramoko deposit.

26.0 RECOMMENDATIONS

This prefeasibility study demonstrates that the transition from an open pit to an underground operation for the Siou deposit is economically viable and it is recommended that SEMAFO advances the project to development and undertakes the tasks summarized described below.

A budget of USD 1.25 million has been allocated, of which USD 0.25 million will be used for drilling four holes in an area of probable reserves in order to improve the confidence category to proven reserves. The sum of USD 1.00 million will be expended on preparation of an operational readiness plan for underground development.

26.1 GEOLOGY AND MINERAL RESOURCES

Continued exploration is warranted in order to expand the mineral resources at Siou along strike and at depth. Exploration will be principally centred on the Siou shear zone which crosses the property from south to north. Once development of the haulage decline is sufficiently advanced, drilling can be conducted to test for potential extensions of the mineral deposit down-dip and to the north and south of the current known resource. The decline will also be available for infill-drilling recommended to further delineate the deposit.

26.2 MINING AND MINERAL RESERVES

In order to advance the Siou underground project beyond the prefeasibility study stage, more detailed work will be required on the following areas of the development:

- Sizing and location of the main underground ventilation fans.
- Specifications for mine dewatering pumps.
- Review of surface water collection pond and well capacity for mining water supply.
- Surface layout and installations (generator set, office, workshop, etc.).
- Final decision on portal location and pit floor layout.
- Relationship and interaction between the surface and underground operations.
- Establish detailed block sequencing and adjust development schedules and advances.
- Develop a ground control management plan.
- Develop stope design procedures to incorporate all sampling.
- Planning and implementation of definition drilling and grade control programs and procedures in order to manage dilution and mining losses.
- Update budgeting and project cash flow model.

An area of probable mineral reserves between 132090N and 132100N and mine elevation 5,100 to 5,000, warrants the drilling of four additional holes for 1,300 m to increase the classification to proven reserves. Those holes have to be drilled from surface. The cost of

USD 0.25 million is included within an exploration budget of USD 7 million for the Mana property as a whole in 2018 and which comprises a total of 35,000 m of drilling and 60,000 m of auger geochemical sampling.

This prefeasibility study is based on a contractor mining approach for the Siou underground project. Proposals have been received and discussions are underway with a number of mining contractors, some of which have local experience in underground development and production. Negotiations should be advanced to ensure a good working relationship with the contractor that will promote safety and productivity within optimum operating costs.

26.2.1 Operational Readiness Plan for Underground Development

A rigorous operational readiness plan will include a detailed list of activities that either need to occur or be achieved prior to the first blast which is planned for the third quarter of 2018. It will significantly enhance achievement of this timeline.

A budget of USD 1.00 million has been allocated to the operational readiness plan, covering the cost items listed above, as well as such as contract negotiation, site visits, permitting, Owner recruitment, site preparation and detailed engineering.

26.3 ENVIRONMENT PERMITTING

The mining permit for Siou will require amendment to allow underground mining.

A mining plan will be filed with the Burkina Faso authorities. On site, a full-time team of professionals has been assigned to work on the permitting process and is collaborating with governmental officials to advance the process. Initiation of a ramp as an exploration opening is allowed under the existing permit.

26.4 ECONOMIC ANALYSIS

It is recommended that the project financial model is updated in order to provide a detailed monthly schedule and budget for the period of underground mine development and to regularly monitor the impact of actual data on the underground development project.

26.5 CONCLUSIONS

Micon has reviewed the budget for the work described above and recommends that SEMAFO proceeds with development of an underground mining operation at Siou.

27.0 DATE AND SIGNATURE PAGE

The effective date of this Technical Report is December 31st, 2017.

"Christopher Jacobs" {signed and sealed}

Christopher Jacobs, CEng MIMMM
Vice President and Mineral Economist

Date of signature: March 26, 2018.

"Bruce Pilcher" {signed and sealed}

Eur Ing Bruce Pilcher, CEng, FIMMM, FAusIMM(CP)
Senior Mining Engineer

Date of signature: March 26, 2018.

"Jane Spooner" {signed and sealed}

Jane Spooner, M.Sc., P.Geo.
Vice President

Date of signature: March 26, 2018.

"Richard Gowans" {signed and sealed}

Richard Gowans, B.Sc., P.Eng.
President and Principal Metallurgist

Date of signature: March 26, 2018.

"Charley Murahwi" {signed and sealed}

Charley Murahwi, M.Sc., P. Geo. Pr.Sci.Nat., FAusIMM
Senior Geologist

Date of signature: March 26, 2018.

28.0 REFERENCES

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29.0 CERTIFICATES

micon INTERNATIONAL LIMITED | mineral industry consultants

CERTIFICATE OF QUALIFIED PERSON
Christopher Jacobs, CEng, MIMMM

As the co-author of this report for SEMAFO Burkina Faso S.A. (SEMAFO BF) entitled “Mana Property, Burkina Faso, NI 43-101 Technical Report, Disclosing the Results of the Siou Underground Prefeasibility Study”, effective date 31 December, 2017, I, Christopher Jacobs, do hereby certify that:

1. I am employed as a Vice President and Mining Economist by, and carried out this assignment for, Micon International Limited, Suite 900 - 390 Bay Street, Toronto, Ontario M5H 2Y2. tel. (416) 362-5135, email:cjacobs@micon-international.com.
2. I hold the following academic qualifications:

   B.Sc. (Hons) Geochemistry, University of Reading, 1980;
   M.B.A., Gordon Institute of Business Science, University of Pretoria, 2004.
3. I am a Chartered Engineer registered with the Engineering Council of the U.K. (registration number 369178).
4. Also, I am a professional member in good standing of: The Institute of Materials, Minerals and Mining; and The Canadian Institute of Mining, Metallurgy and Petroleum (Member).
5. I have worked in the minerals industry for more than 35 years; my work experience includes 10 years as an exploration and mining geologist on gold, platinum, copper/nickel and chromite deposits; 10 years as a technical/operations manager in both open-pit and underground mines; 3 years as strategic (mine) planning manager and the remainder as an independent consultant when I have worked on a variety of deposits including cobalt, copper and gold.
6. I am familiar with NI 43-101 and, by reason of education, experience and professional registration, fulfill the requirements of a Qualified Person as defined in NI 43-101.
7. I have not visited the Property that is the subject of this report.
8. I am responsible for Sections 1.17, 22 and 26.4 of this Technical Report.
9. I am independent of SEMAFO BF, SEMAFO Inc. and related entities, as defined in Section 1.5 of NI 43-101.
10. I have not worked on or been associated with the Property prior to this Technical Report.
11. I have read NI 43-101 and the Sections of this report for which I am responsible have been prepared in compliance with the instrument.
12. As of the date of this certificate to the best of my knowledge, information and belief, the sections of this Technical Report for which I am responsible contain all scientific and technical information that is required to be disclosed to make this report not misleading.

Effective Date: 31 December, 2017
Signing Date: 26 March, 2018

“Christopher Jacobs” {signed and sealed}

Christopher Jacobs, CEng, MIMMM

CERTIFICATE OF QUALIFIED PERSON
Eur Ing Bruce Pilcher, CEng FIMMM FAusIMM CP(Min)

As a co-author of this report for SEMAFO Burkina Faso S.A. (SEMAFO BF) entitled "Mana Property, Burkina Faso, NI 43-101 Technical Report, Disclosing the Results of the Siou Underground Prefeasibility Study", effective date 31 December, 2017, I, Bruce Pilcher do hereby certify that:

1. I am employed as a Senior Mining Engineer by, and carried out this assignment for
   Micon International Co Ltd
   Tremough Innovation Centre, Penryn Campus, Penryn, TR10 9TA Cornwall, UK
   tel.: +44 1326 567338
   e-mail: bpilcher@micon-international.co.uk

2. I am a graduate of the University of Sydney with a Bachelor of Engineering (Mining Engineering, 1984).

3. I am a fellow in good standing of the Institute of Materials, Minerals and Mining (IOM3)(#50141), a fellow of the Australasian Institute of Mining and Metallurgy (AusIMM) (#101906) and am a registered Chartered Engineer (CEng) with the Engineering Council UK (#526806), Chartered Professional (Mining) with the AusIMM (#101906) and European Engineer (Eur Ing) with the European Federation of National Engineering Associations (FEANI) (#30087).

4. I have worked as a mining engineer in the minerals industry for 30 years;

5. I am familiar with NI 43-101 and, by reason of education, experience and professional registration, I fulfill the requirements of a Qualified Person as defined in NI 43-101. My relevant experience as a mining engineer in the mining industry in Australia, Africa, South America, UK, Europe and the former Soviet Union countries.

6. I have read NI 43-101 and the Sections of this report for which I am responsible have been prepared in compliance with the instrument;
7. I visited the Mana property between 26 and 29 July, 2017;
8. I have not worked on or been associated with the Mana Project prior to this Technical Report;
9. I am independent of SEMAFO BF, SEMAFO Inc. and related companies according to the definition described in NI 43-101 and the Companion Policy 43-101 CP;
10. I am responsible for Sections 1.10, 1.11, 1.16.1 to 1.16.3, 15, 16, 21.1, 21.2, 25.2 and 26.2 of this Technical Report.
11. As of the date of this certificate, to the best of my knowledge, information and belief, the sections of this Technical Report for which I am responsible contain all scientific and technical information that is required to be disclosed to make this technical report not misleading;

Effective Date: 31 December, 2017
Signing Date: 26 March, 2018

"Bruce Pilcher" {signed and sealed}

Eur Ing Bruce Pilcher CEng FIMMM FAusIMM CP(Min)

micon INTERNATIONAL LIMITED | mineral industry consultants

CERTIFICATE OF QUALIFIED PERSON

Jane Spooner, M.Sc., P.Geo.

As a co-author of this report for SEMAFO Burkina Faso S.A. (SEMAFO BF) entitled "Mana Property, Burkina Faso, Ni 43-101 Technical Report, Disclosing the Results of the Siou Underground Prefeasibility Study", effective date 31 December, 2017, I, Jane Spooner, P.Geo., do hereby certify that:

1. I am employed as an Associate Specialist in Mineral Market Analysis and carried out this assignment for
Micon International Limited
Suite 900, 390 Bay Street
Toronto, Ontario
M5H 2Y2
tel. (416) 362-5135 fax (416) 362-5763
e-mail: jspooner@micon-international.com

2. I hold the following academic qualifications:

   B.Sc. (Hons) Geology, University of Manchester, U.K. 1972
   M.Sc. Environmental Resources, University of Salford, U.K. 1973

3. I am a member of the Association of Professional Geoscientists of Ontario (membership number 0990); as well, I am a member in good standing of the Canadian Institute of Mining, Metallurgy and Petroleum.

4. I have worked as a specialist in mineral market analysis for over 30 years.

5. I do, by reason of education, experience and professional registration, fulfill the requirements of a Qualified Person as defined in NI 43-101. My work experience includes the analysis of markets for base and precious metals, industrial and specialty minerals, coal and uranium; project due diligence assessments and project management.

6. I have not visited the project site.

7. I am responsible for Sections 1.14 and 19 of this report entitled "Mana Property, Burkina Faso, Ni 43-101 Technical Report, Disclosing the Results of the Siou Underground Prefeasibility Study", effective date 31 December, 2017.

8. I am independent of SEMAFO BF, SEMAFO Inc. and related companies according to the definition described in NI 43-101 and the Companion Policy 43-101 CP.

9. I have not worked on or been associated with had no previous involvement with the Property prior to this Technical Report.

10. I have read NI 43-101 and the Sections 1.14 and 19 of this report for which I am responsible have been prepared in compliance with the instrument.

11. As of the date of this certificate, to the best of my knowledge, information and belief, the sections of this Technical Report for which I am responsible contain all scientific and technical information that is required to be disclosed to make this report not misleading.

Effective Date: 31 December, 2017
Signing Date: 26 March, 2018

"Jane Spooner" {signed and sealed}

Jane Spooner, M.Sc., P.Geo.

CERTIFICATE OF QUALIFIED PERSON
Richard Gowans, P.Eng.

As the co-author of this report on behalf of SEMAFO Burkina Faso S.A. (SEMAFO BF), entitled "Mana Property, Burkina Faso, Ni 43-101 Technical Report, Disclosing the Results of the Siou Underground Prefeasibility Study", effective date 31 December, 2017, I, Richard Gowans do hereby certify that:

1. I am employed as the President and Principal Metallurgist by, and carried out this assignment for Micon International Limited, Suite 900, 390 Bay Street Toronto, Ontario, M5H 2Y2. tel. (416) 362-5135 fax (416) 362-5763 e-mail: rgowans@micon-international.com

2. I hold the following academic qualifications:

   B.Sc. (Hons) Minerals Engineering, The University of Birmingham, U.K., 1980

3. I am a registered Professional Engineer of Ontario (membership number 90529389); as well, I am a member in good standing of the Canadian Institute of Mining, Metallurgy and Petroleum.

4. I have worked as an extractive metallurgist in the minerals industry for over 30 years.

5. I do, by reason of education, experience and professional registration, fulfill the requirements of a Qualified Person as defined in NI 43-101. My work experience includes the management of technical studies and design of numerous metallurgical testwork programs and metallurgical processing plants.

6. I visited the Mana property on 26-29 July, 2017.

7. I am responsible for the preparation of Sections 1.1, 1.8, 1.12, 1.13, 1.15, 1.16.4, 1.18, 2, 3, 4.2, 5.0, 13, 17, 18, 20, 21.3, 24, 25.3, 25.4, 25.6, 25.7, 26.3 and 26.5 of this Technical Report.

8. I am independent of SEMAFO BF, SEMAFO Inc. and related companies according to the definition described in NI 43-101 and the Companion Policy 43-101 CP.

9. I have not worked on or been associated with had no previous involvement with the Property prior to this Technical Report.

10. I have read NI 43-101 and the Sections of this report for which I am responsible have been prepared in compliance with the instrument.

11. As of the date of this certificate, to the best of my knowledge, information and belief, the sections of this Technical Report for which I am responsible contain all scientific and technical information that is required to be disclosed to make this report not misleading.

Effective Date: 31 December, 2017
Signing Date: 26 March, 2018

"Richard Gowans" {signed and sealed}

Richard Gowans, B.Sc., P.Eng.

CERTIFICATE OF QUALIFIED PERSON
Charley Murahwi, P.Geo.

As a co-author of this report on behalf of SEMAFO Burkina Faso S.A. (SEMAFO BF) entitled "Mana Property, Burkina Faso, Ni 43-101 Technical Report, Disclosing the Results of the Siou Underground Prefeasibility Study", effective date 31 December, 2017, I, Charley Z. Murahwi do hereby certify that:

1. I am employed as a Senior Geologist by, and carried out this assignment for, Micon International Limited, Suite 900, 390 Bay Street, Toronto, Ontario M5H 2Y2, telephone 416 362 5135, fax 416 362 5763, e-mail cmurahwi@micon-international.com.

2. I hold the following academic qualifications:

   B.Sc. (Geology) University of Rhodesia, Zimbabwe, 1979;
   Diplome d´Ingénieur Expert en Techniques Minières, Nancy, France, 1987;
   M.Sc. (Economic Geology), Rhodes University, South Africa, 1996.

3. I am a registered Professional Geoscientist in Ontario (membership # 1618) and in PEGNL (membership # 05662), a registered Professional Natural Scientist with the South African Council for Natural Scientific Professions (membership # 400133/09) and am a Fellow of the Australasian Institute of Mining & Metallurgy (FAusIMM) (membership number 300395).

4. I have worked as a mining and exploration geologist in the minerals industry for over 30 years.

5. I do, by reason of education, experience and professional registration, fulfill the requirements of a Qualified Person as defined in NI 43-101. My work experience includes 18 years on gold, silver, copper, tin and tantalite projects (on and off mine), 12 years on Cr-Ni-Cu-PGE deposits in layered intrusions/komatiitic environments.

6. I visited the Mana property on 26-29 July, 2017.

7. I have not worked on or been associated with had no previous involvement with the Property prior to this Technical Report.

8. As of the date of this certificate to the best of my knowledge, information and belief, the sections of this Technical Report for which I am responsible contain all scientific and technical information that is required to be disclosed to make this report not misleading;

9. I am independent of SEMAFO BF, SEMAFO Inc. and related companies according to the definition described in NI 43-101 and the Companion Policy 43-101 CP.

10. I have read NI 43-101 and the Sections of this Technical Report for which I am responsible have been prepared in compliance with this Instrument.

11. I am responsible for Sections 1.2 to 1.7, 1.9, 4, 6, 7 to 12, 14, 23, 25.1 and 26.1 of this Technical Report.

Effective Date: 31 December, 2017
Signing Date: 26 March, 2018

"Charley Murahwi" {signed and sealed}

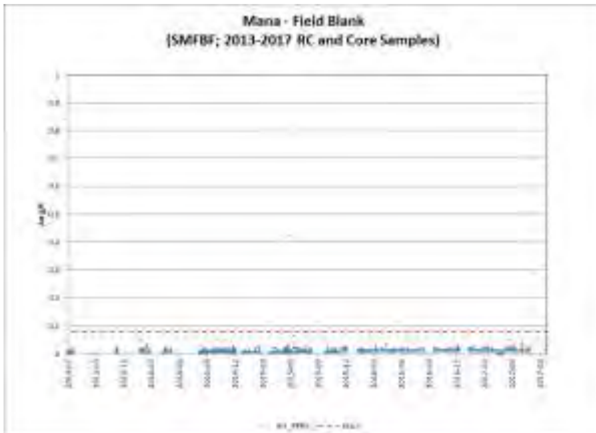
Charley Murahwi, M.Sc., P. Geo. Pr.Sci.Nat., FAusIMM

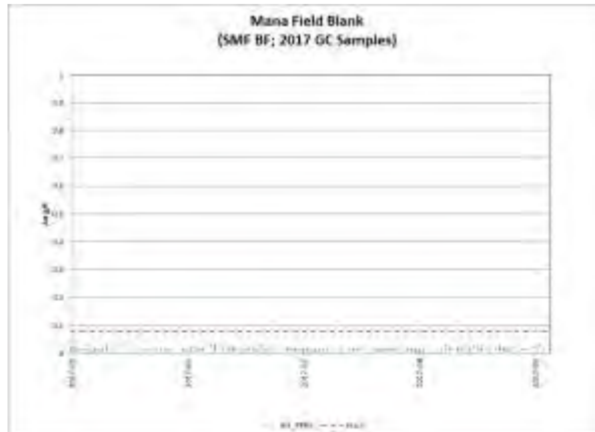
APPENDIX 1

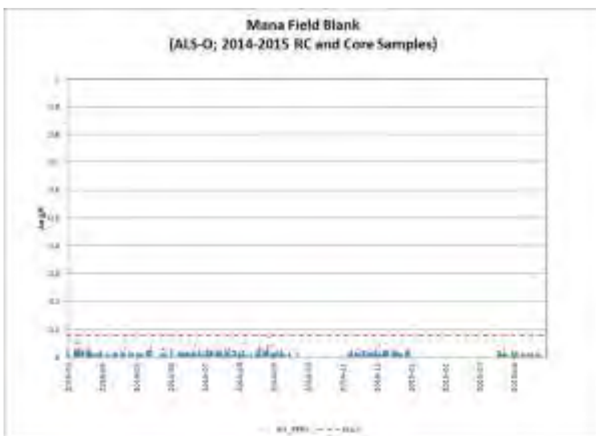
Analytical Quality Data and Relative Precision Charts

Time series plots for field blanks assayed by SMF BF and ALS-OU (2013-2017).

		Statistics	**SMF BF**	**GC**	**ALS-OU**
Project	Mana	**Sample Count**	8167	189	2534
Data Series	2013-2017 Blanks	**Detection Limit**	0.01	0.01	0.01
Data Type	RC and Core Samples	**StdDev**	0.011	0.005	0.006
Commodity	Au in gpt	**Data Mean**	0.008	0.013	0.008
Laboratory	SMF BF, ALS-OU	**Upper limit (0.08ppm)**	0%	0%	0%
Analytical method	Fire assay – AAS finish				
Detection Limit	0.01gpt (Au)				

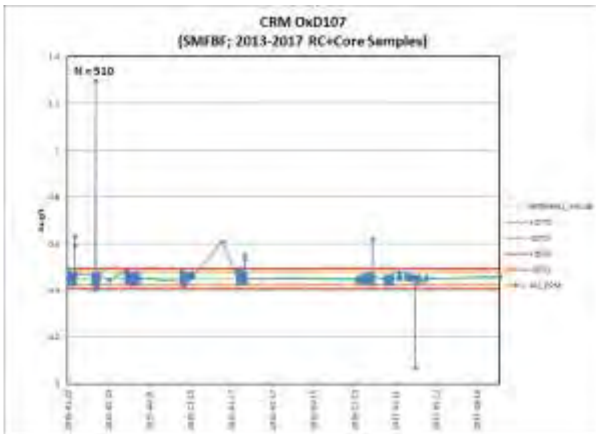


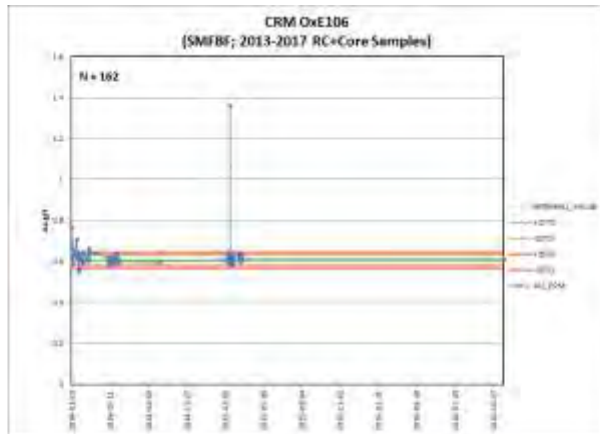


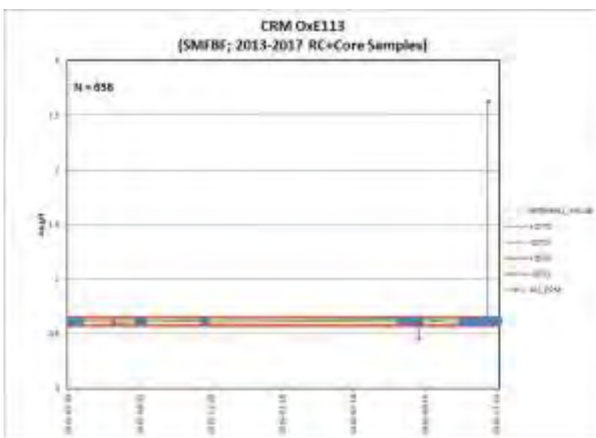


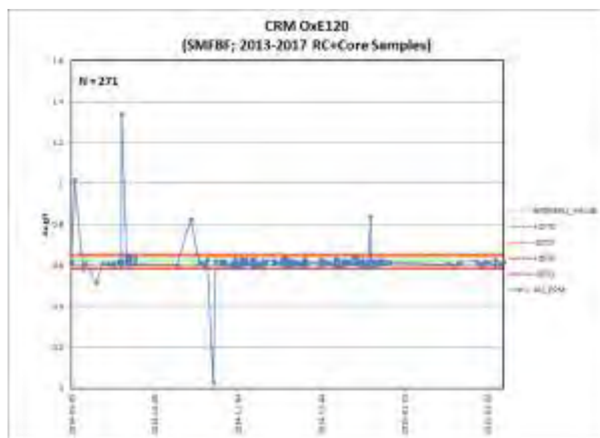
Time series plots for certified reference materials assayed by SMF BF at Mana Mine site (2013-2017).

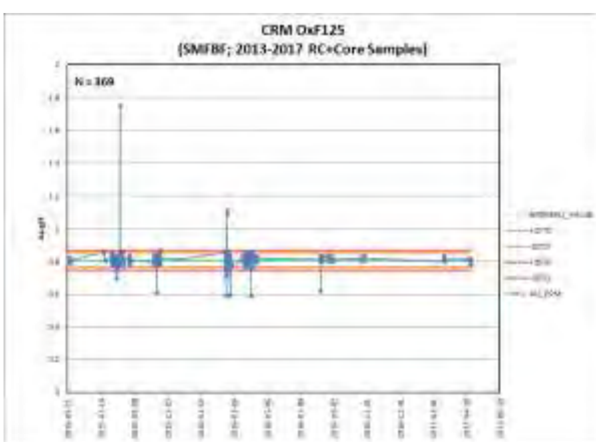
		Statistics	**OxD107**	**OxE106**	**OxE113**	**OxE120**	**OxF125**	**OxG98**
Project	Mana	Sample Count	510	162	658	271	369	98
Data Series	2013-2017 Standards	Expect. Value	0.452	0.606	0.609	0.620	0.806	1.017
Data Type	RC and Core Samples	StdDev	0.014	0.013	0.014	0.012	0.020	0.019
Commodity	Au in gpt	Data Mean	0.456	0.620	0.618	0.616	0.809	1.032
Laboratory	SMF BF	Outside 3SD	1.8%	4.9%	0.3%	2.6%	3.5%	9.2%
Analytical method	Fire assay – AAS finish	Below 3SD	2	1	1	3	9	6
Detection Limit	0.01 gpt (Au)	Above 3SD	7	7	1	4	4	3

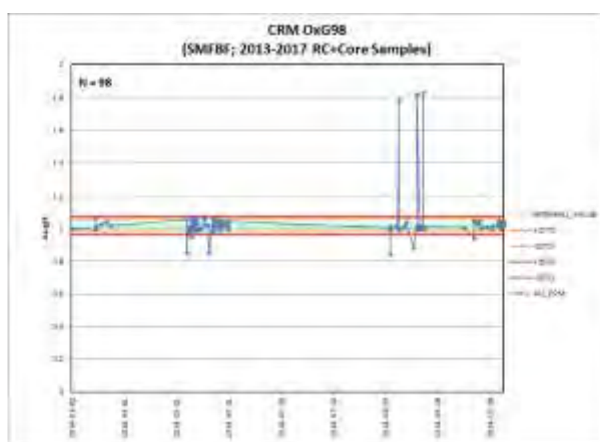






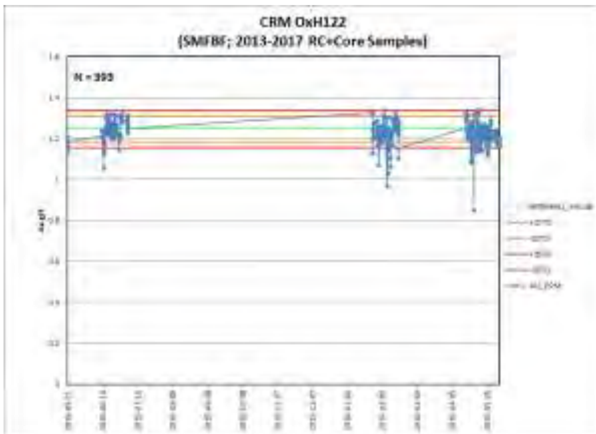


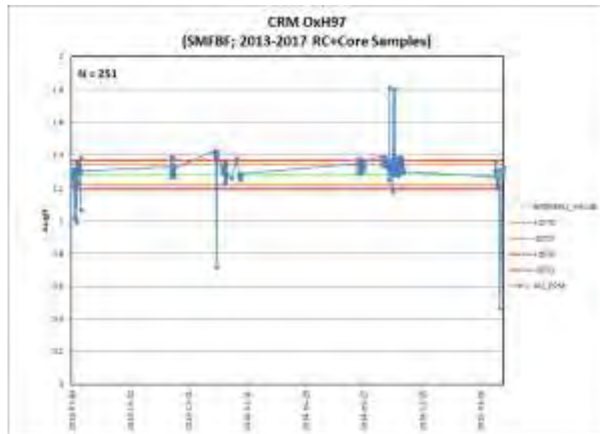


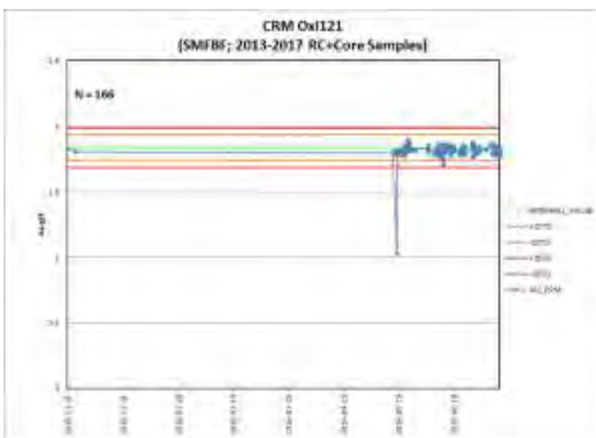


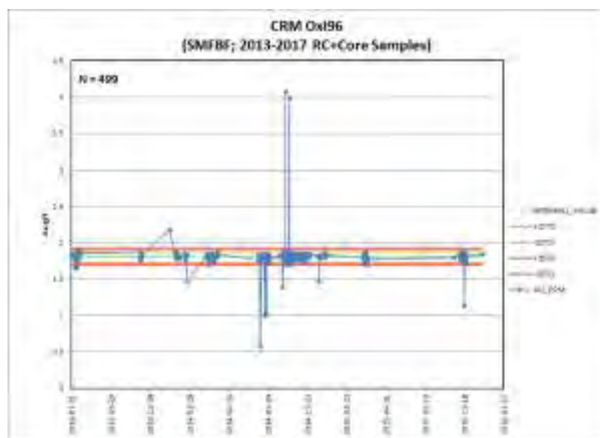
Time series plots for certified reference materials assayed by SMF BF at Mana Mine site (2013-2017).

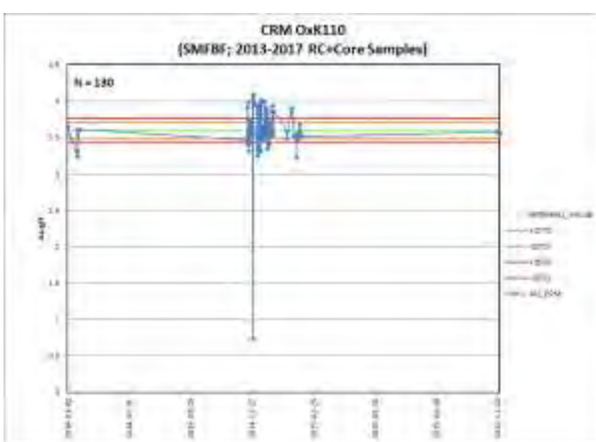
		Statistics	**OxH122**	**OxH97**	**OxI121**	**OxI96**	**OxK110**
Project	Mana	Sample Count	393	251	166	499	130
Data Series	2013-2017 Standards	Expect. Value	1.247	1.278	1.834	1.802	3.602
Data Type	RC and Core Samples	StdDev	0.031	0.030	0.050	0.39	0.053
Commodity	Au in gpt	Data Mean	1.223	1.316	1.816	1.810	3.594
Laboratory	SMF BF	Outside 3SD	8.1%	12.7%	0.6%	2.8%	34.6%
Analytical method	Fire assay – AAS finish	Below 3SD	32	7	1	11	18
Detection Limit	0.01 gpt (Au)	Above 3SD	0	25	0	3	27





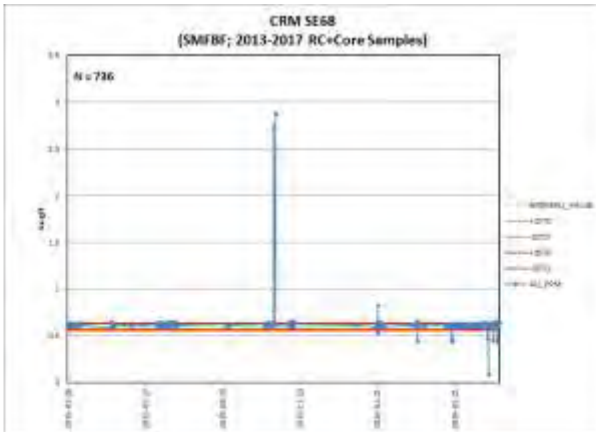


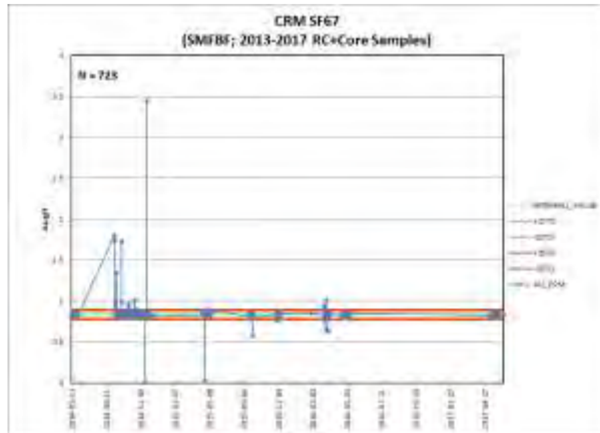


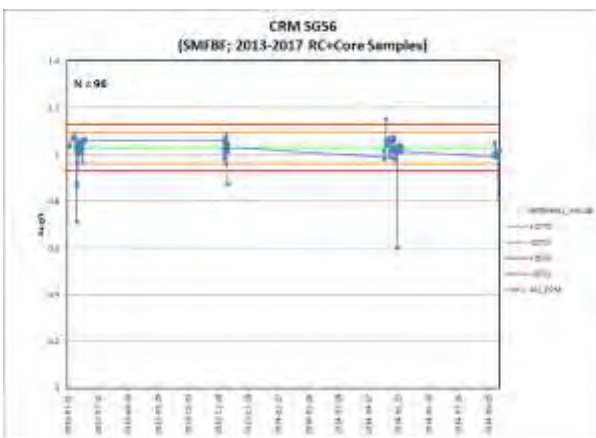


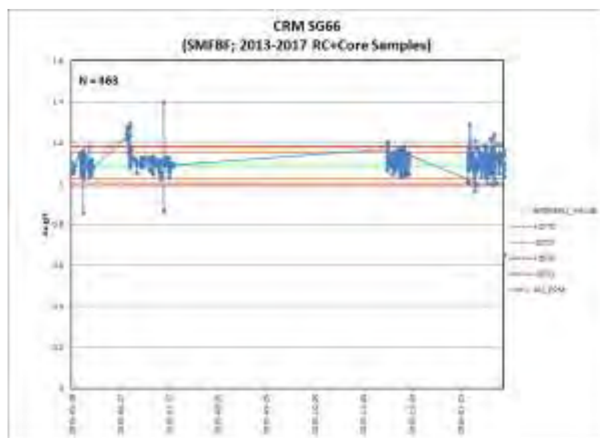
Time series plots for certified reference materials assayed by SMF BF at Mana Mine site (2013-2017).

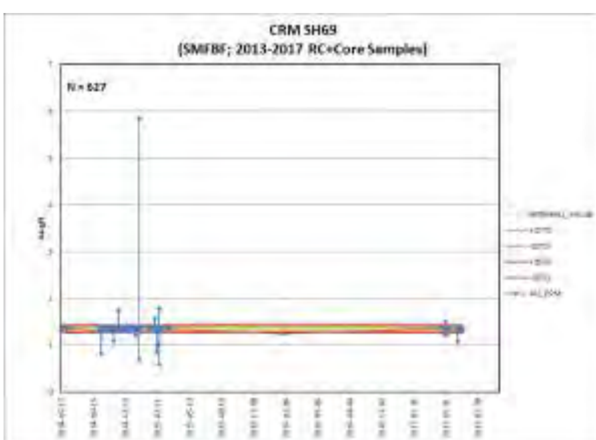
		Statistics	**SE68**	**SF67**	**SG56**	**SG66**	**SH69**	**Si64**
Project	Mana	Sample Count	736	723	96	463	627	364
Data Series	2013-2017 Standards	Expect. Value	0.599	0.835	1.027	1.086	1.346	1.780
Data Type	RC and Core Samples	StdDev	0.013	0.021	0.033	0.032	0.026	0.042
Commodity	Au in gpt	Data Mean	0.619	0.846	1.015	1.105	1.357	1.804
Laboratory	SMF BF	Outside 3SD	7.5%	4.0%	7.3%	6.0%	3.3%	2.2%
Analytical method	Fire assay – AAS finish	Below 3SD	8	8	6	6	16	5
Detection Limit	0.01 gpt (Au)	Above 3SD	47	21	1	22	5	3

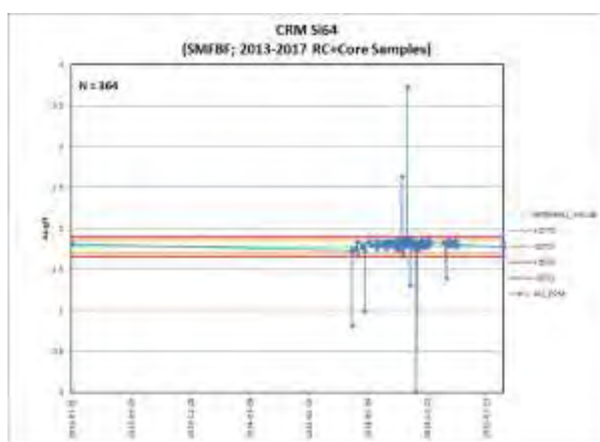






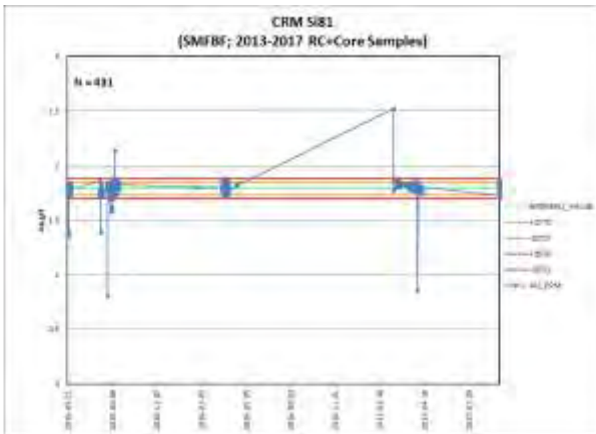


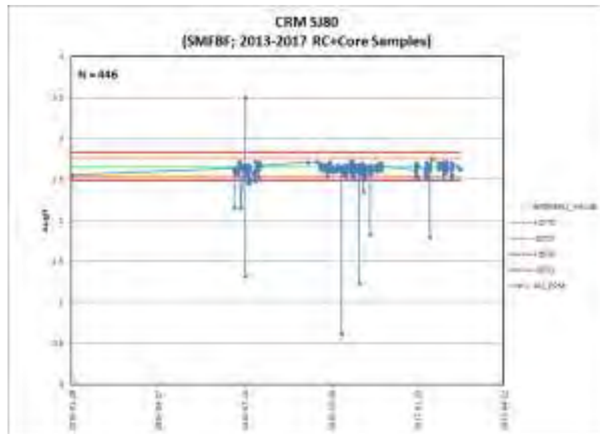


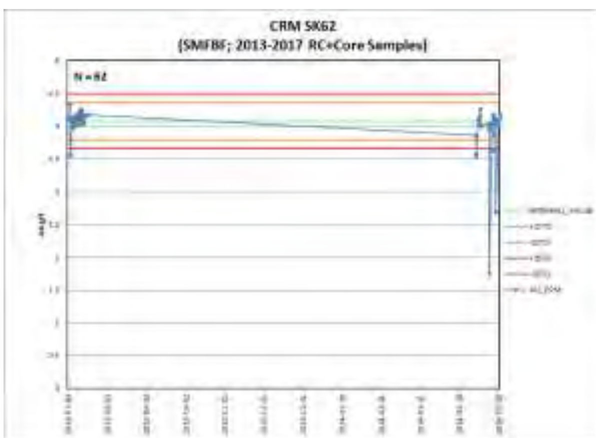


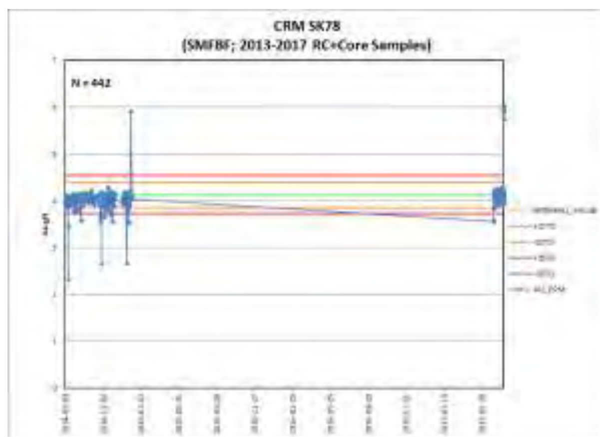
Time series plots for certified reference materials assayed by SMF BF at Mana Mine site (2013-2017).

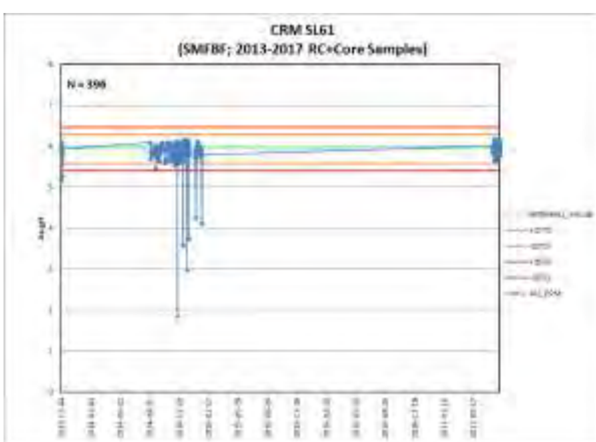
		Statistics	**Si81**	**SJ80**	**SK62**	**SK78**	**SL61**	**SN60**
Project	Mana	Sample Count	431	446	62	442	396	107
Data Series	2013-2017 Standards	Expect. Value	1.790	2.656	4.075	4.134	5.931	8.595
Data Type	RC and Core Samples	StdDev	0.030	0.057	0.140	0.138	0.177	0.223
Commodity	Au in gpt	Data Mean	1.795	2.619	3.985	4.064	5.851	8.383
Laboratory	SMF BF	Outside 3SD	4.9%	2.7%	12.9%	4.5%	2.0%	10.3%
Analytical method	Fire assay – AAS finish	Below 3SD	14	11	8	14	8	11
Detection Limit	0.01 gpt (Au)	Above 3SD	7	1	0	6	0	0

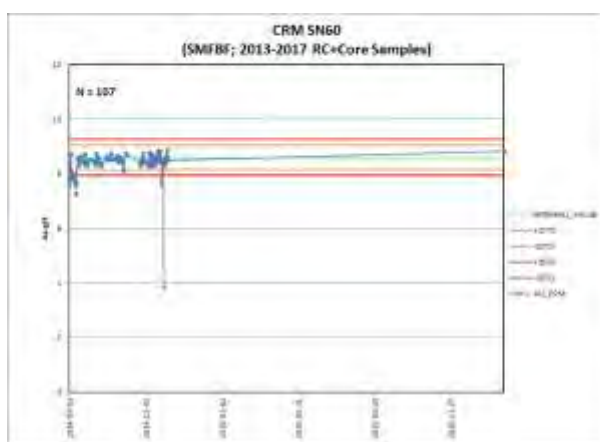






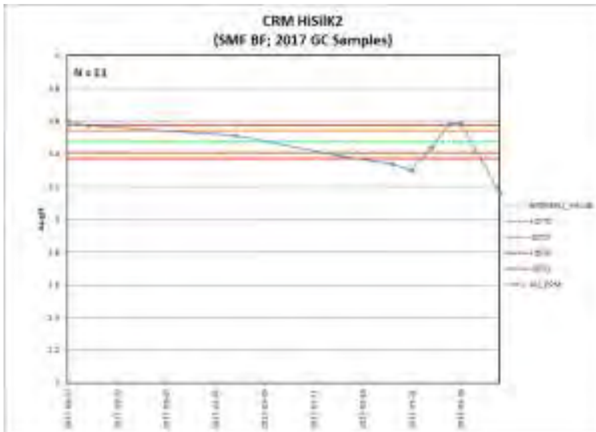


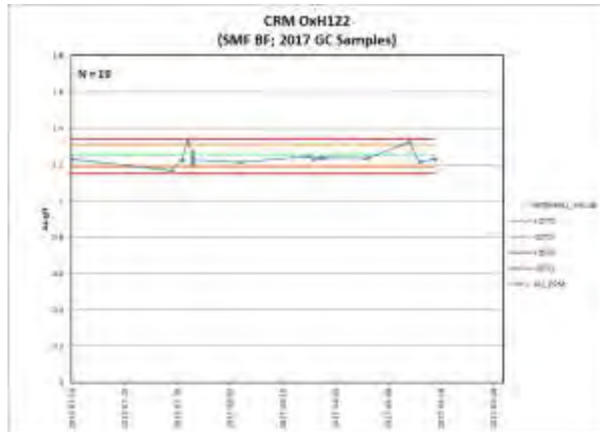


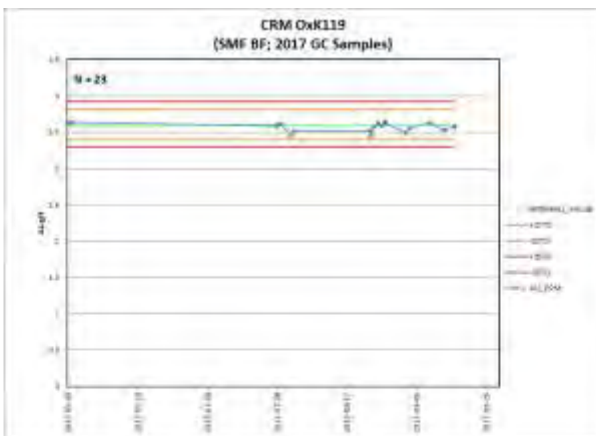


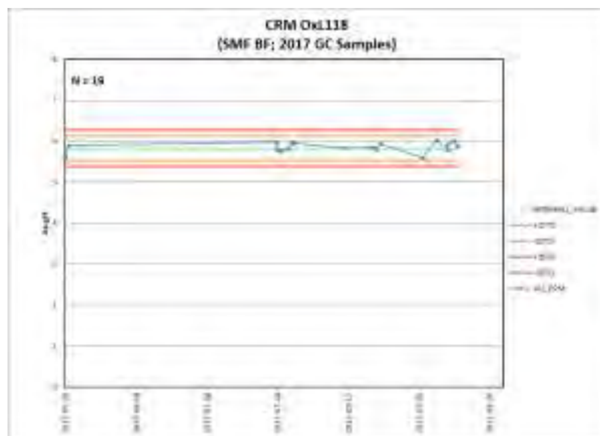
Time series plots for certified reference materials assayed by SMF BF (GC) at Mana Mine site (2017).

		Statistics	**HiSilK2**	**OxH122**	**OxK119**	**OxI118**
Project	Mana	Sample Count	11	19	23	19
Data Series	2017 Standards	Expect. Value	3.474	1.247	3.604	5.828
Data Type	GC Samples	StdDev	0.034	0.031	0.105	0.149
Commodity	Au in gpt	Data Mean	3.462	1.237	3.570	5.863
Laboratory	SMF BF	Outside 3SD	63.6%	0%	0%	0%
Analytical method	Fire assay – AAS finish	Below 3SD	3	0	0	0
Detection Limit	0.01 gpt (Au)	Above 3SD	4	0	0	0



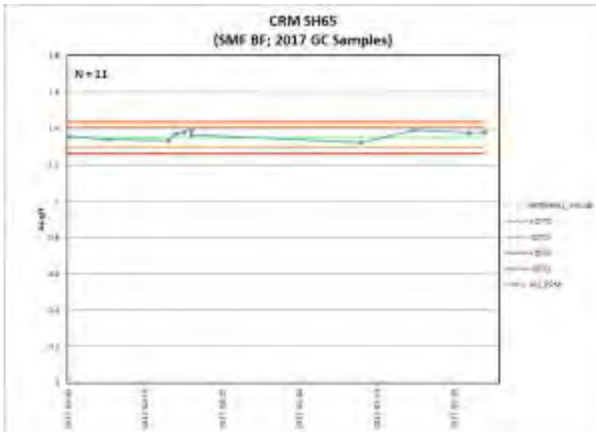


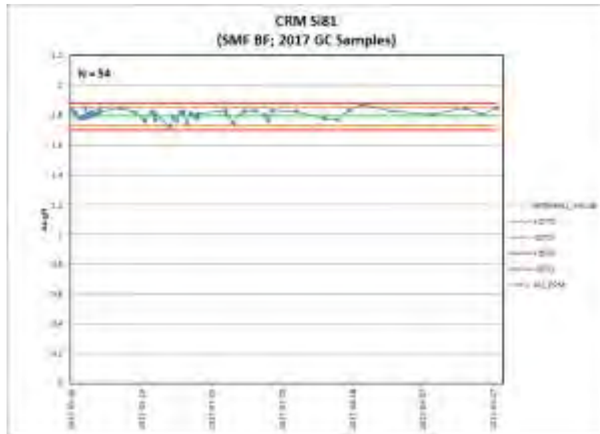


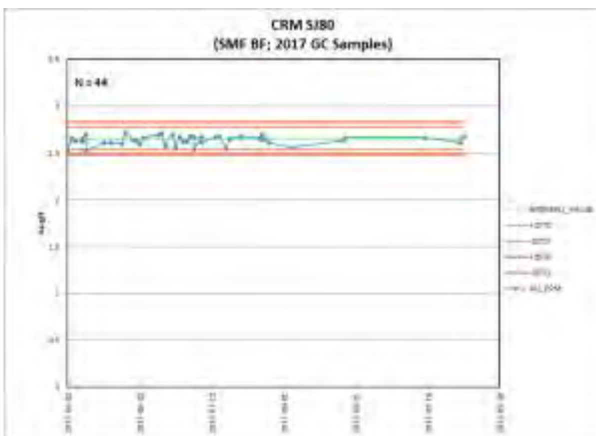


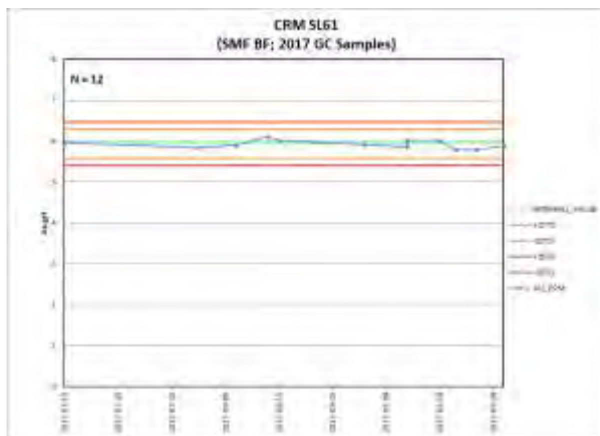
Time series plots for certified reference materials assayed by SMF BF (GC) at Mana Mine site (2017).

		Statistics	**SH65**	**Si81**	**SJ80**	**SL61**
Project	Mana	Sample Count	11	54	44	12
Data Series	2017 Standards	Expect. Value	1.348	1.790	2.656	5.931
Data Type	GC Samples	StdDev	0.028	0.030	0.057	0.177
Commodity	Au in gpt	Data Mean	1.364	1.807	2.638	5.927
Laboratory	SMF BF	Outside 3SD	0%	0%	0%	0%
Analytical method	Fire assay – AAS finish	Below 3SD	0	0	0	0
Detection Limit	0.01 gpt (Au)	Above 3SD	0	0	0	0



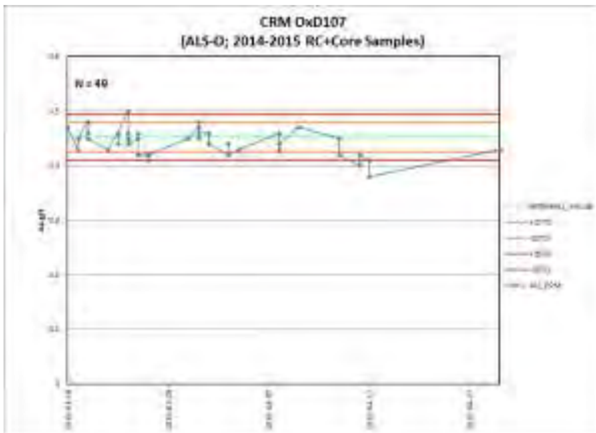


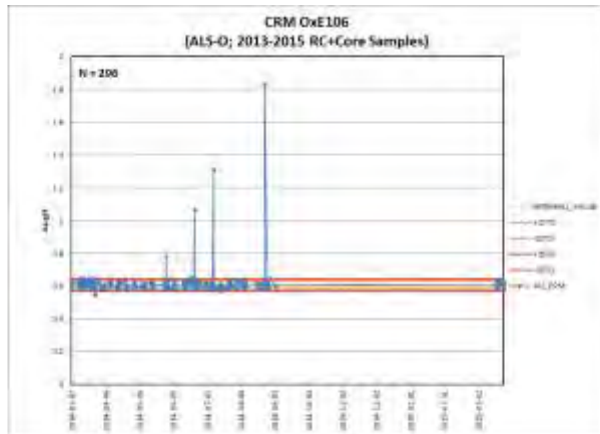


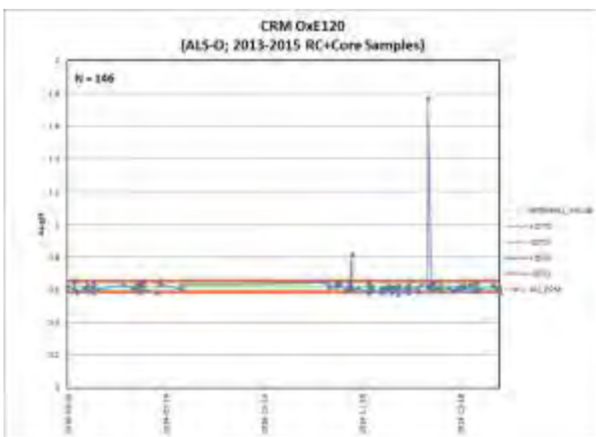


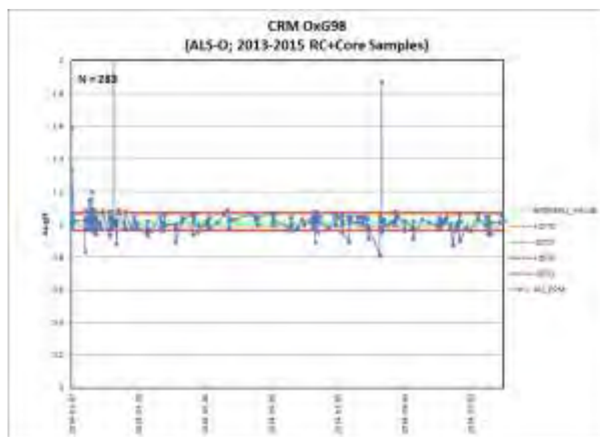
Time series plots for certified reference materials assayed by ALS in Ouagadougou (2014-2015).

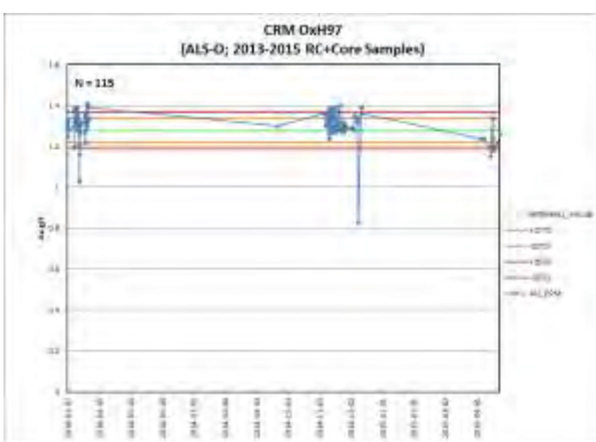
		Statistics	**OxD107**	**OxE106**	**OxE120**	**OxG98**	**OxH97**	**Oxi96**
Project	Mana	Sample Count	49	296	146	283	115	348
Data Series	2014-2015 Standards	Expect. Value	0.452	0.606	0.62	1.017	1.278	1.802
Data Type	RC and Core Samples	StdDev	0.014	0.013	0.012	0.019	0.03	0.039
Commodity	Au in gpt	Data Mean	0.44	0.62	0.62	1.03	1.30	1.82
Laboratory	ALS-OU	Outside 3SD	12.2%	3.4%	8.9%	13.8%	18.3%	12.4%
Analytical method	Fire assay – AAS finish	Below 3SD	5	1	11	23	5	7
Detection Limit	0.01 gpt (Au)	Above 3SD	1	9	2	16	16	36

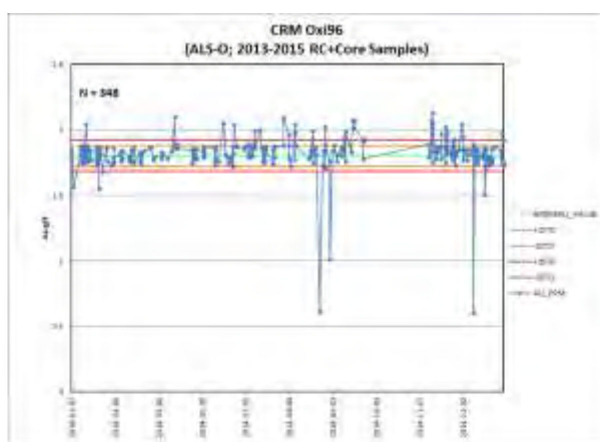






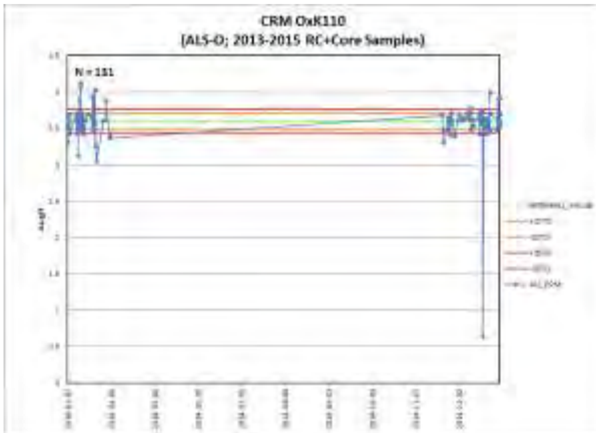


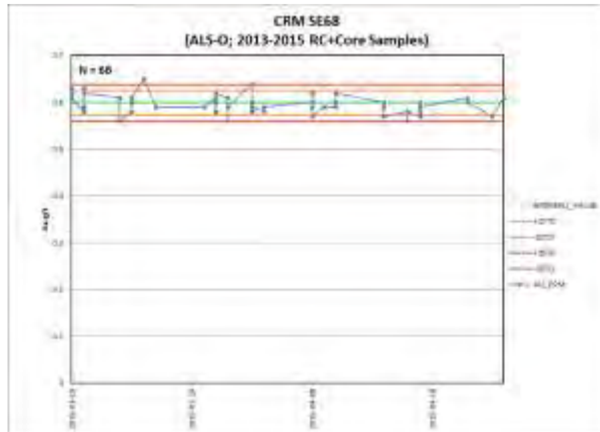


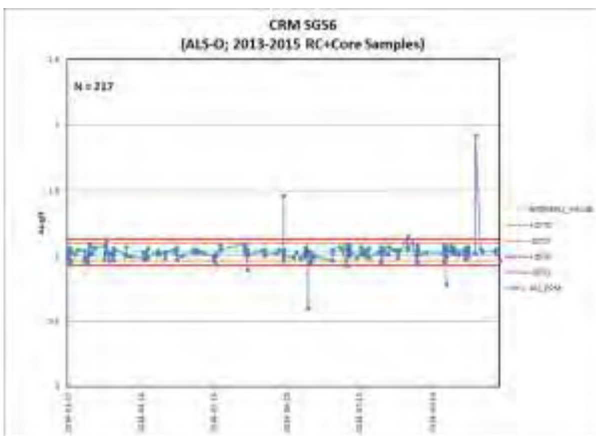


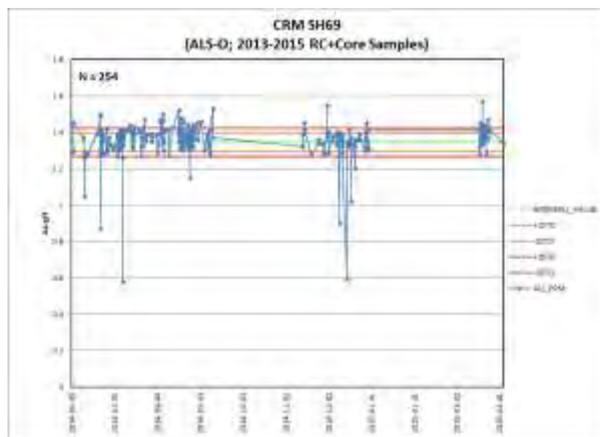
Time series plots for certified reference materials assayed by ALS in Ouagadougou (2014-2015).

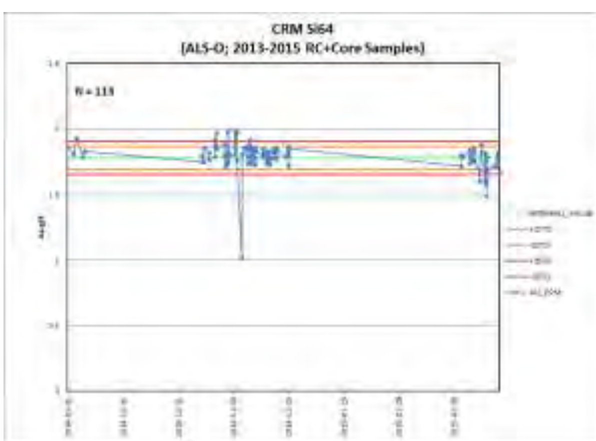
		Statistics	**OxK110**	**SE68**	**SG56**	**SH69**	**Si64**	**SK62**
Project	Mana	Sample Count	131	66	217	254	113	109
Data Series	2014-2015 Standards	Expect. Value	3.602	0.599	1.027	1.346	1.78	4.075
Data Type	RC and Core Samples	StdDev	0.053	0.013	0.033	0.026	0.042	0.14
Commodity	Au in gpt	Data Mean	3.58	0.6	1.03	1.36	1.79	4.06
Laboratory	ALS-OU	Outside 3SD	19.8%	3.0%	3.2%	16.1%	12.4%	7.3%
Analytical method	Fire assay – AAS finish	Below 3SD	16	0	4	10	7	6
Detection Limit	0.01 gpt (Au)	Above 3SD	10	2	3	31	7	2

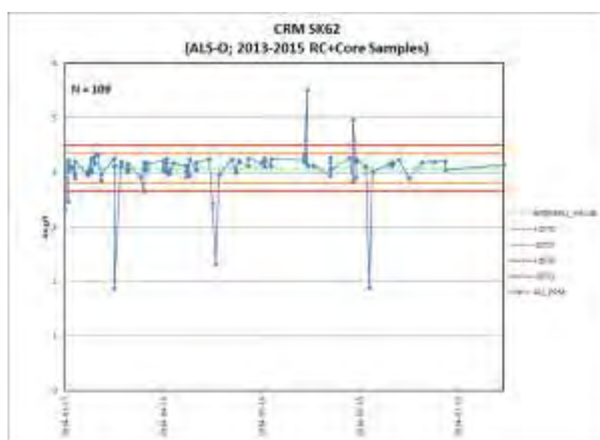






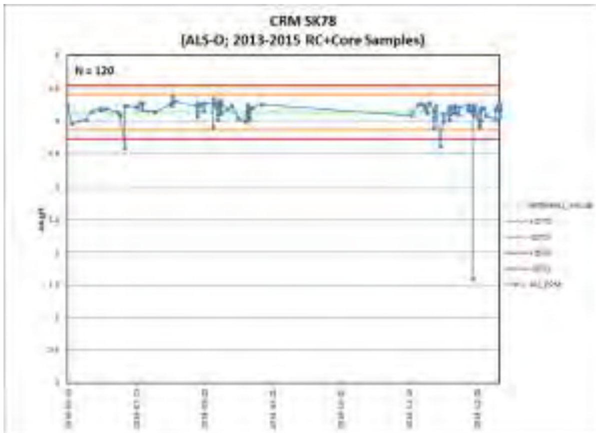


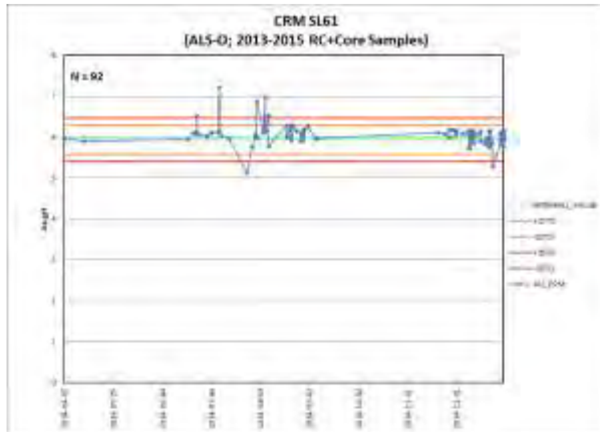


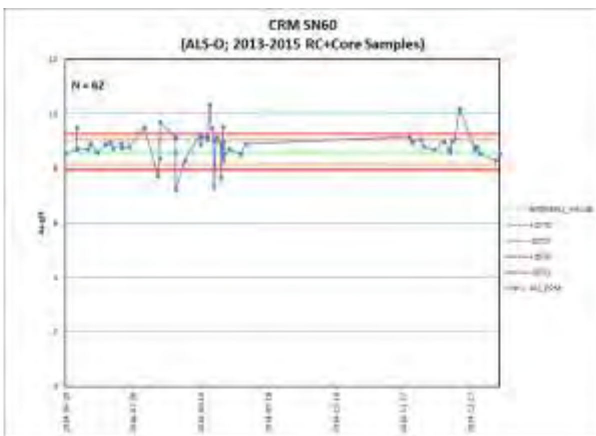


Time series plots for certified reference materials assayed by ALS in Ouagadougou (2014-2015).

		Statistics	SK78	SL61	SN60
Project	Mana	Sample Count	120	92	62
Data Series	2014-2015 Standards	Expect. Value	4.134	5.931	8.595
Data Type	RC and Core Samples	StdDev	0.138	0.177	0.223
Commodity	Au in gpt	Data Mean	4.14	6.06	8.82
Laboratory	ALS-OU	Outside 3SD	2.5%	7.6%	21.0%
Analytical method	Fire assay – AAS finish	Below 3SD	3	2	5
Detection Limit	0.01 gpt (Au)	Above 3SD	0	5	8

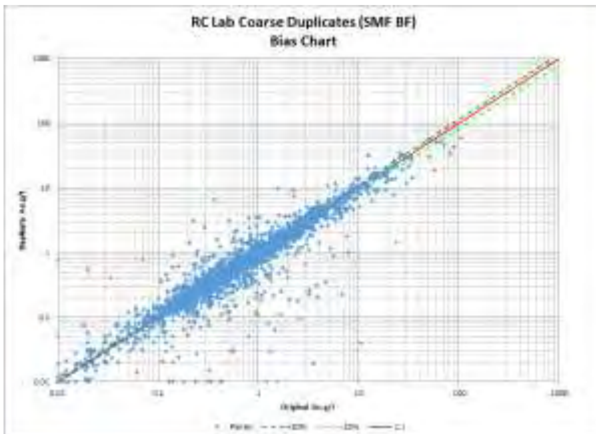


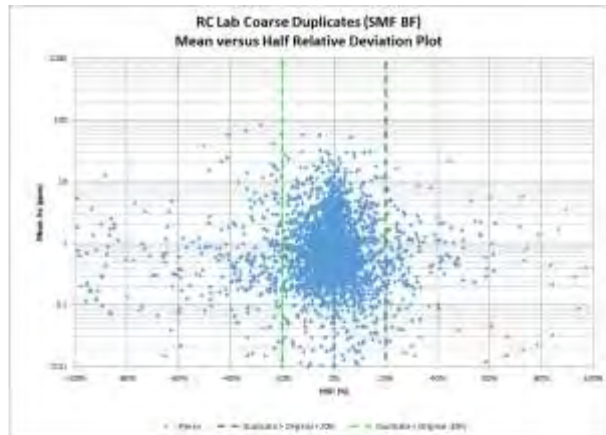


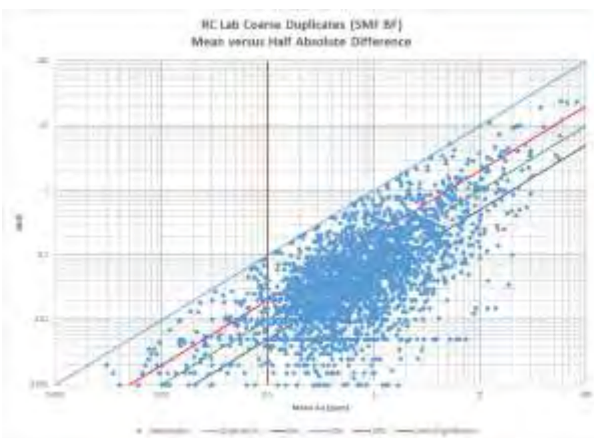


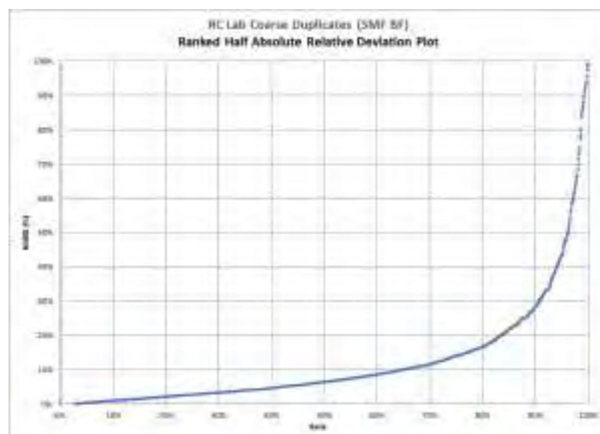
Biais charts and precision plots for RC lab coarse duplicates assayed by SMF BF (2013-2017).

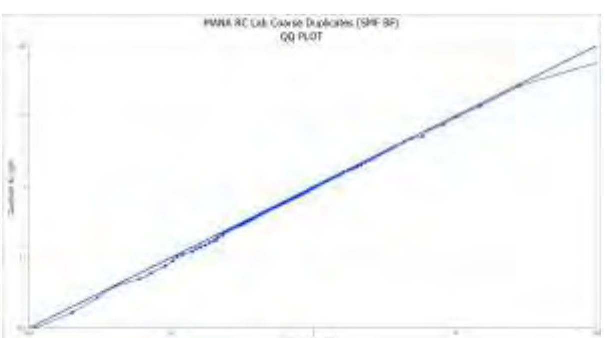
		Statistics	Original	Lab Duplicates
Project	Mana	**Sample Count**	3108	3108
Data Series	2013-201717 Coarse Lab Dups	**Minimum Value**	0.01	0.001
Data Type	RC Samples	**Maximum Value**	106.70	59.60
Commodity	Au in gpt	**Data Mean**	1.73	1.58
Analytical Method	Fire Assay – AAS Finish	**Median**	0.58	0.56
Detection Limit	0.01 gpt Au	**Standard Error**	0.09	0.07
Original Dataset	Original Assays	**Standard deviation**	4.93	3.78
Paired Dataset	Lab Duplicate Assays	**Correlation Coefficient**	0.9540	
		Pairs ≤ 10% HARD	65.0%	





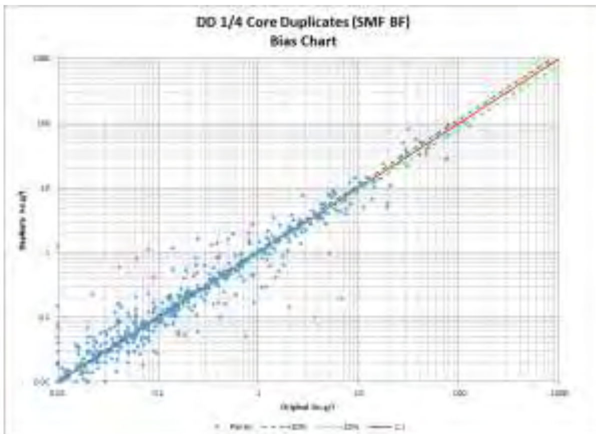


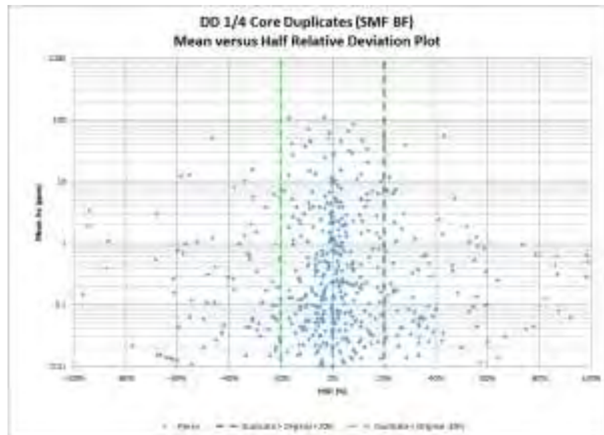


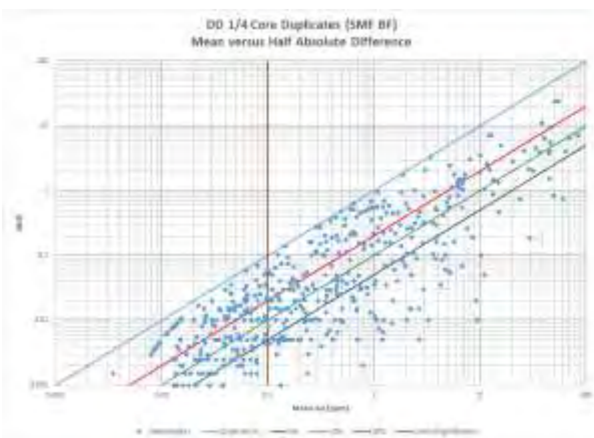


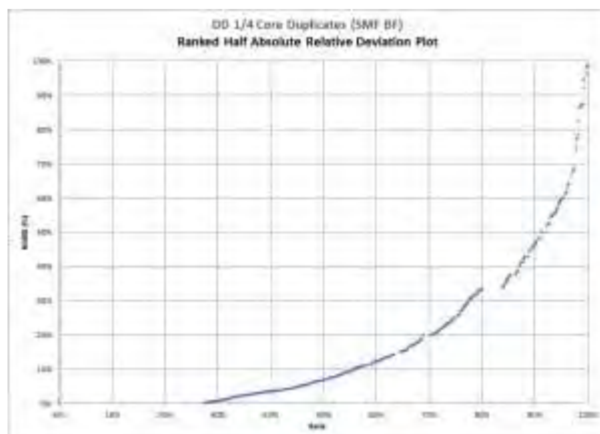
Biais charts and precision plots for DD quarter core duplicates assayed by SMF BF (2013-2017).

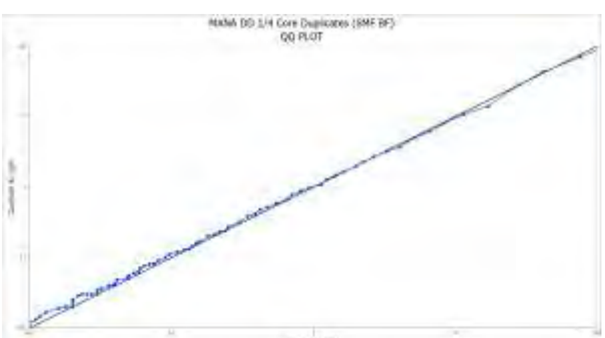
		Statistics	**Original**	**Lab Duplicates**
Project	Mana	**Sample Count**	789	789
Data Series	2013-2017 Field Dups	**Minimum Value**	0.01	0.002
Data Type	Core Samples	**Maximum Value**	127.2	107.2
Commodity	Au in gpt	**Data Mean**	2.37	2.31
Analytical Method	Fire Assay – AAS Finish	**Median**	0.05	0.05
Detection Limit	0.01 gpt Au	**Standard Error**	0.36	0.34
Original Dataset	Original Assays	**Standard deviation**	10.02	9.62
Paired Dataset	Field Duplicate Assays	**Correlation Coefficient**	0.9575	
		Pairs ≤ 10% HARD	55.8%	





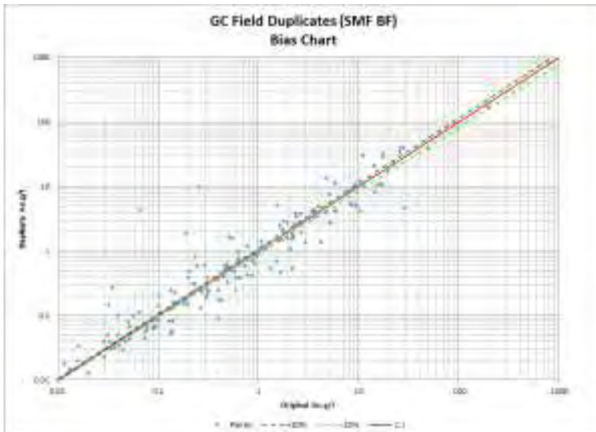


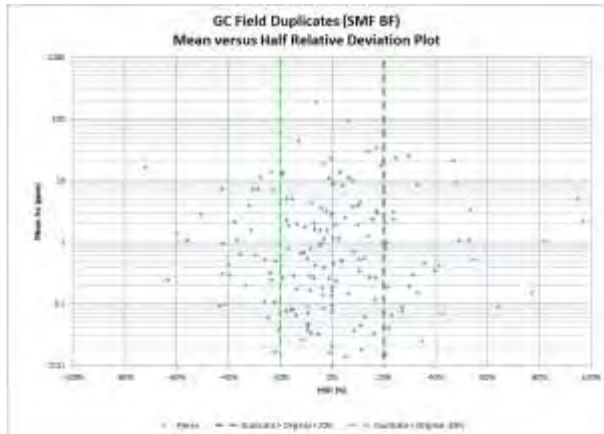


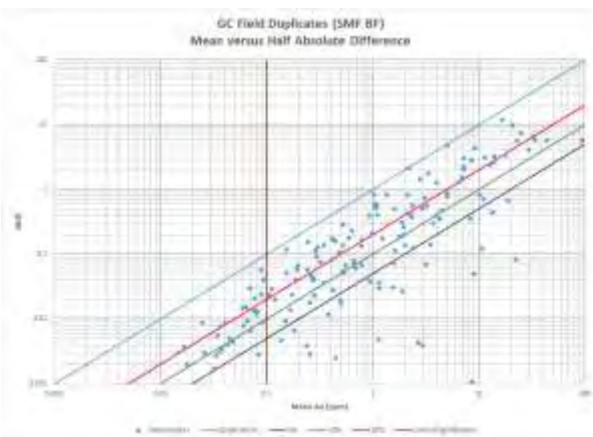


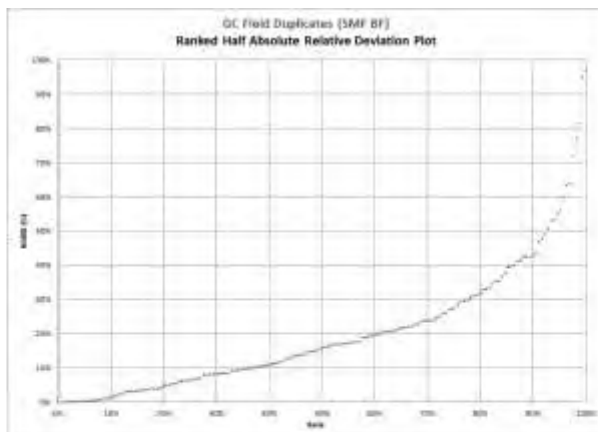
Biais charts and precision plots for GC field coarse duplicates assayed by SMF BF (2017).

		Statistics	Original	Lab Duplicates
Project	Mana	**Sample Count**	171	171
Data Series	2017 Field Dups	**Minimum Value**	0.01	0.01
Data Type	GC Samples	**Maximum Value**	194.00	171.25
Commodity	Au in gpt	**Data Mean**	5.02	5.18
Analytical Method	Fire Assay – AAS Finish	**Median**	0.58	0.59
Detection Limit	0.01 gpt Au	**Standard Error**	1.32	1.27
Original Dataset	Original Assays	**Standard deviation**	17.29	16.55
Paired Dataset	Field Duplicate Assays	**Correlation Coefficient**	0.9701	
		Pairs ≤ 10% HARD	37.4%	



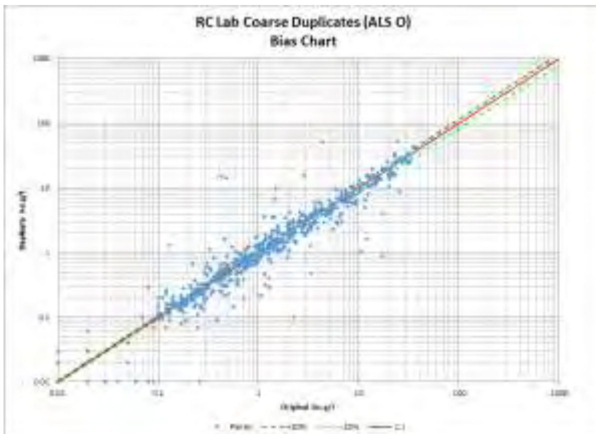


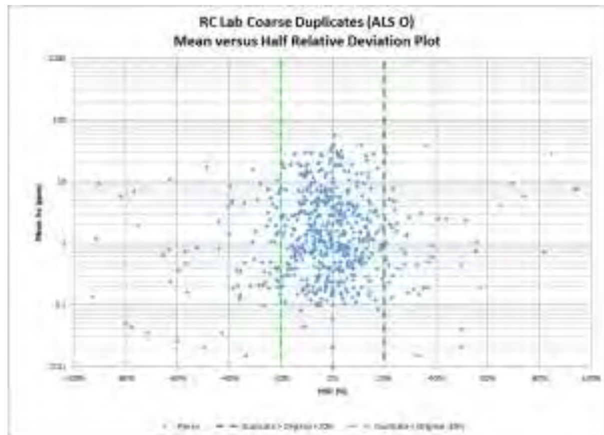


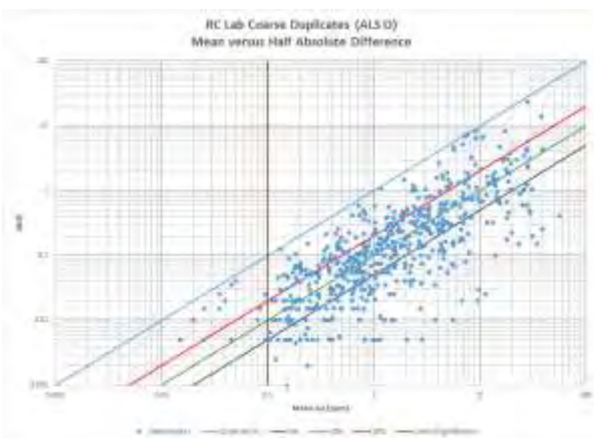


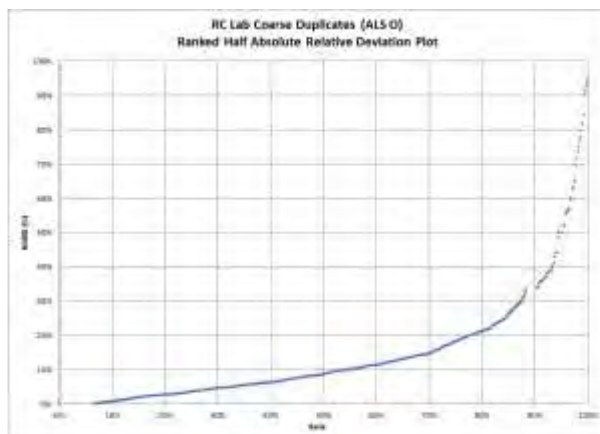
Biais charts and precision plots for RC lab coarse duplicates assayed by ALS O (2014-2015).

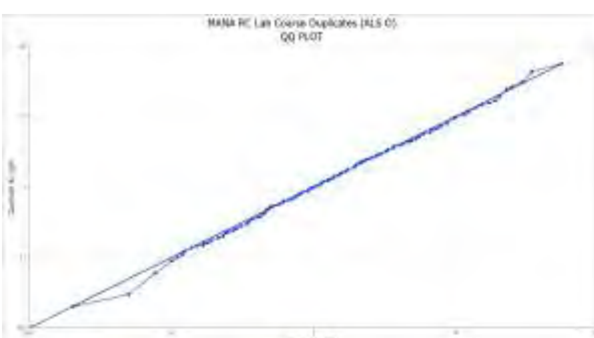
		Statistics	Original	Lab Duplicates
Project	Mana	**Sample Count**	644	644
Data Series	2014-2015 Coarse Lab Dups	**Minimum Value**	0.01	0.01
Data Type	RC Samples	**Maximum Value**	56.20	57.00
Commodity	Au in gpt	**Data Mean**	3.82	3.78
Analytical Method	Fire Assay – AAS Finish	**Median**	1.01	0.99
Detection Limit	0.01 gpt Au	**Standard Error**	0.27	0.28
Original Dataset	Original Assays	**Standard deviation**	6.84	7.20
Paired Dataset	Lab Duplicate Assays	**Correlation Coefficient**	0.8851	
		Pairs ≤ 10% HARD	54.5%	





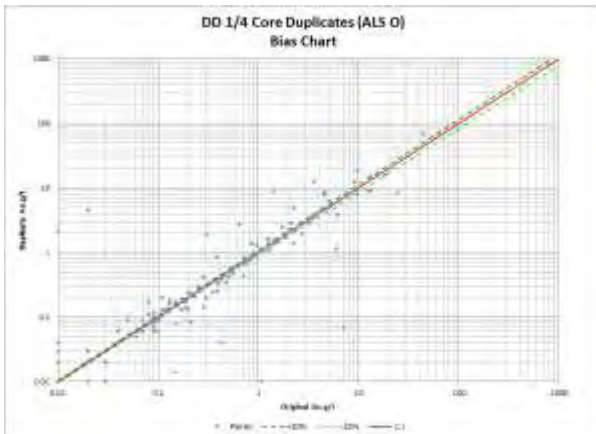


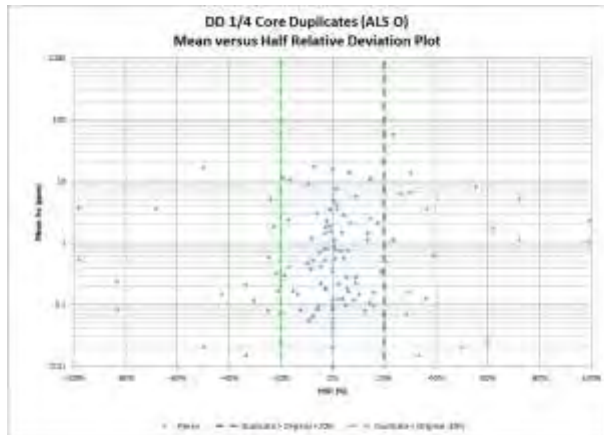


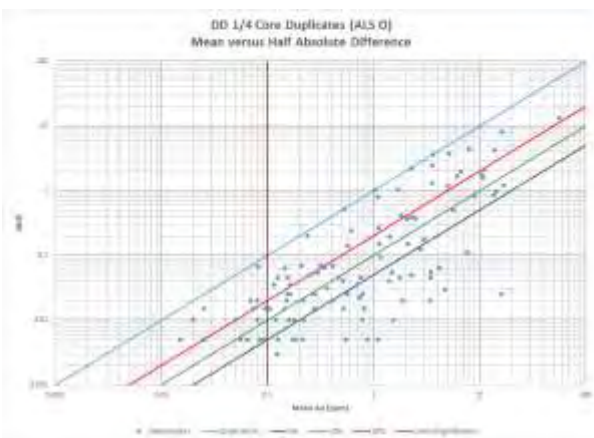


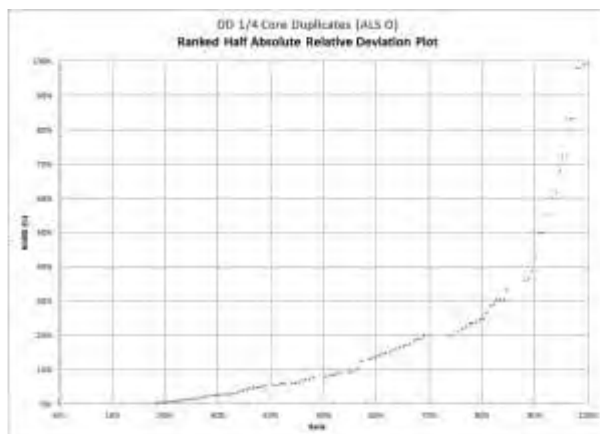
Biais charts and precision plots for DD quarter core duplicates assayed by ALS O (2014-2015).

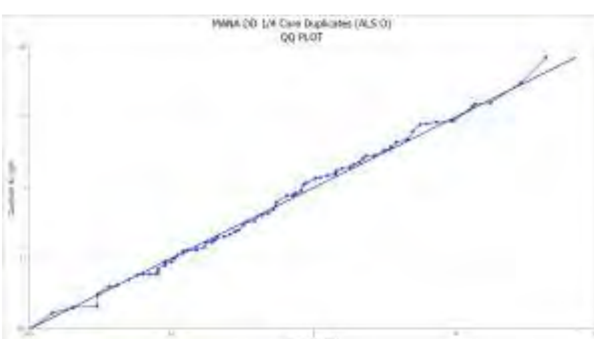
		Statistics	Original	Lab Duplicates
Project	Mana	**Sample Count**	153	153
Data Series	2014-2015 Field Dups	**Minimum Value**	0.01	0.01
Data Type	Core Samples	**Maximum Value**	43.80	70.60
Commodity	Au in gpt	**Data Mean**	2.03	2.27
Analytical Method	Fire Assay – AAS Finish	**Median**	0.21	0.19
Detection Limit	0.01 gpt Au	**Standard Error**	0.41	0.54
Original Dataset	Original Assays	**Standard deviation**	5.06	6.62
Paired Dataset	Field Duplicate Assays	**Correlation Coefficient**	0.8996	
		Pairs ≤ 10% HARD	56.2%	





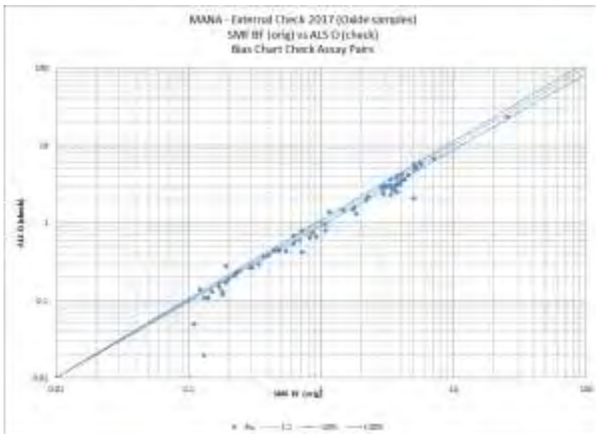


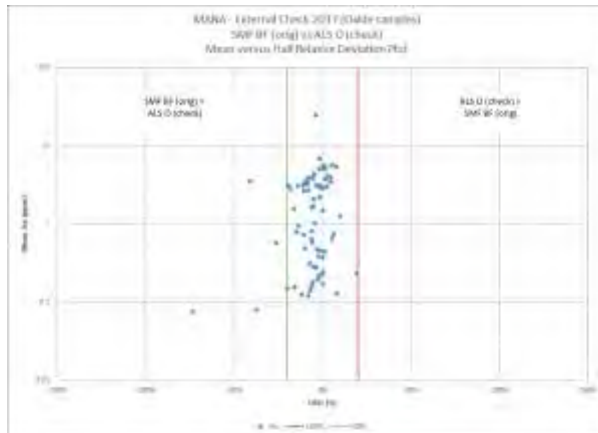


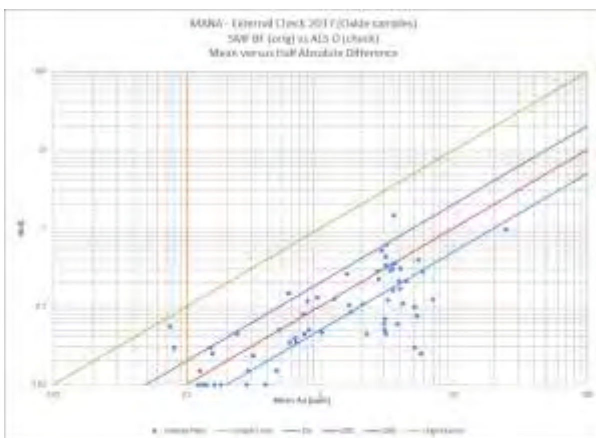


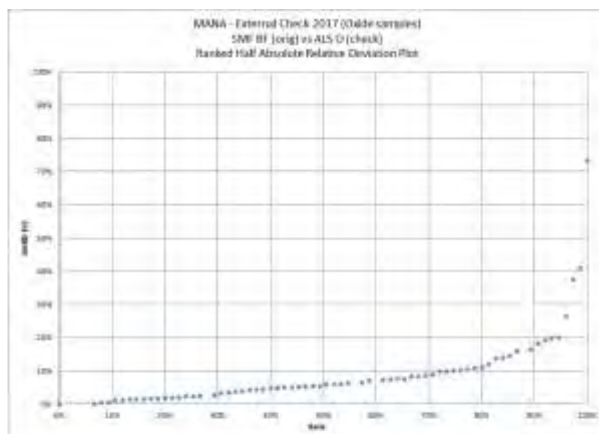
Biais charts and precision plots for oxide samples assayed between SMF BF and ALS-OU (2017).

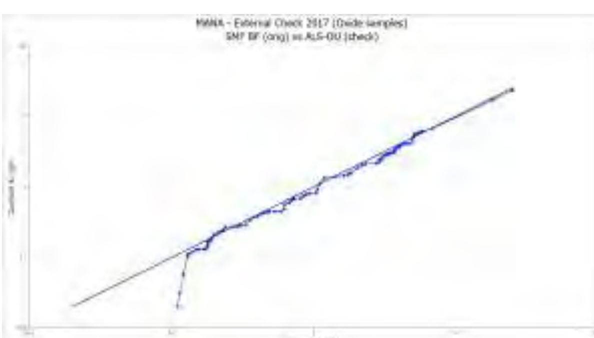
		Statistics	SMF BF (orig)	ALS O (check)
Project	Mana	**Sample Count**	76	76
Data Series	2017 Lab Pulp Duplicates	**Minimum Value**	0.11	0.02
Data Type	RC and Core Samples	**Maximum Value**	25.43	23.50
Commodity	Au in gpt	**Data Mean**	2.33	2.14
Analytical Method	Fire Assay – AAS Finish	**Median**	1.31	1.36
Detection Limit	0.01 gpt Au	**Standard Error**	0.37	0.35
Original Dataset	Original Assays	**Standard deviation**	3.26	3.06
Paired Dataset	Lab Pulp Replicate Assays	**Correlation Coefficient**	0.9898	
		Pairs ≤ 10% HARD	74%	





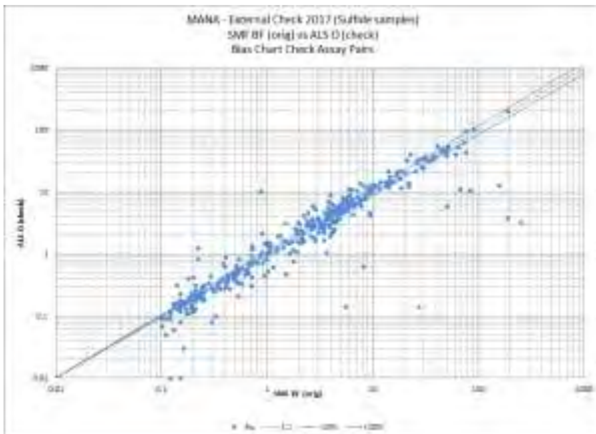


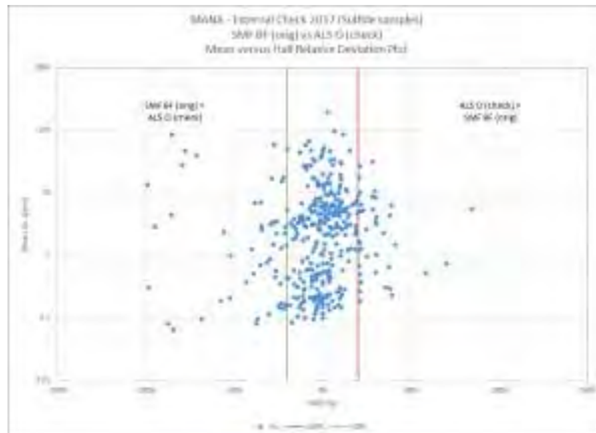


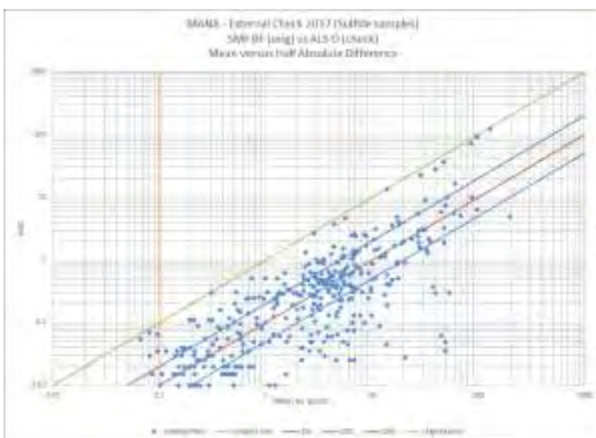


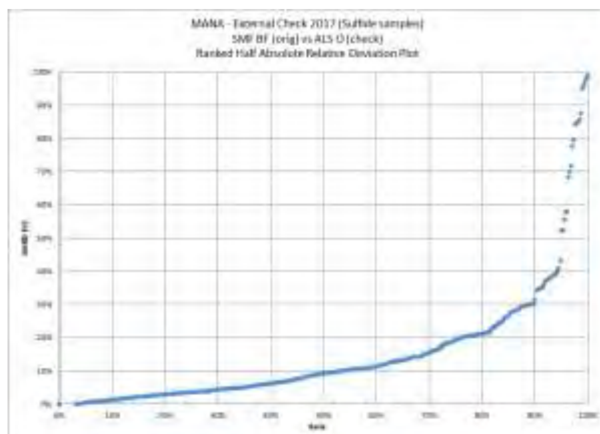
Biais charts and precision plots for sulfide samples assayed between SMF BF and ALS-OU (2017).

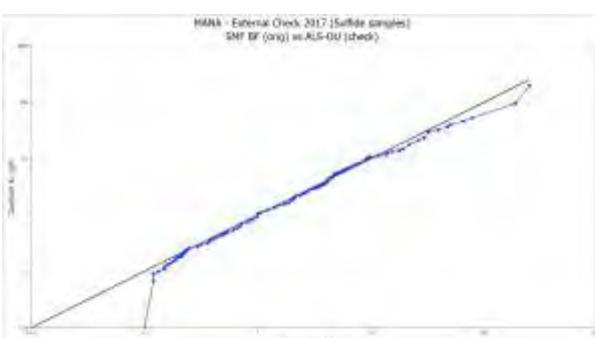
		Statistics	SMF BF (orig)	ALS O (check)
Project	Mana	**Sample Count**	380	380
Data Series	2017 Lab Pulp Duplicates	**Minimum Value**	0.10	0.01
Data Type	RC and Core Samples	**Maximum Value**	252.29	201.00
Commodity	Au in gpt	**Data Mean**	9.14	7.20
Analytical Method	Fire Assay – AAS Finish	**Median**	2.58	2.43
Detection Limit	0.01 gpt Au	**Standard Error**	1.24	0.82
Original Dataset	Original Assays	**Standard deviation**	24.08	15.96
Paired Dataset	Lab Pulp Replicate Assays	**Correlation Coefficient**	0.6329	
		Pairs ≤ 10% HARD	53%	





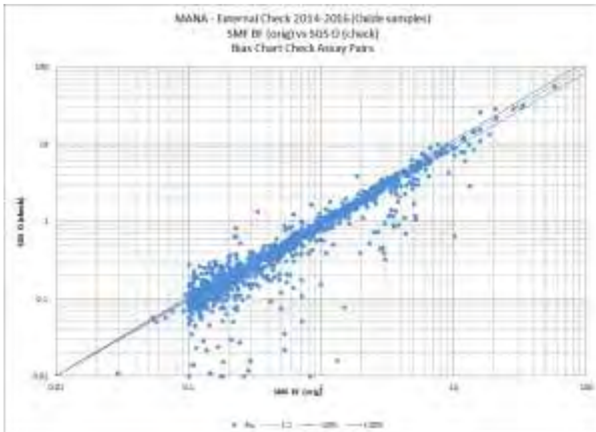


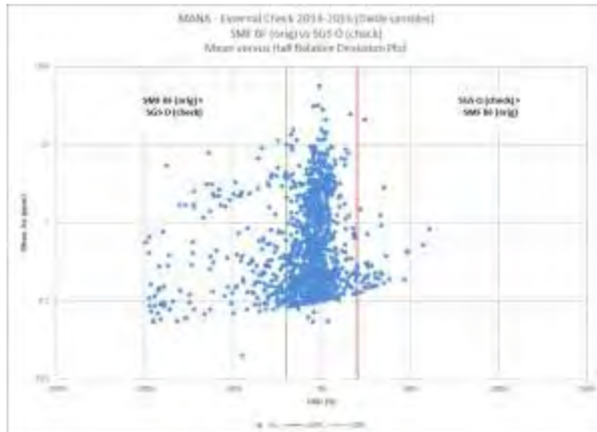


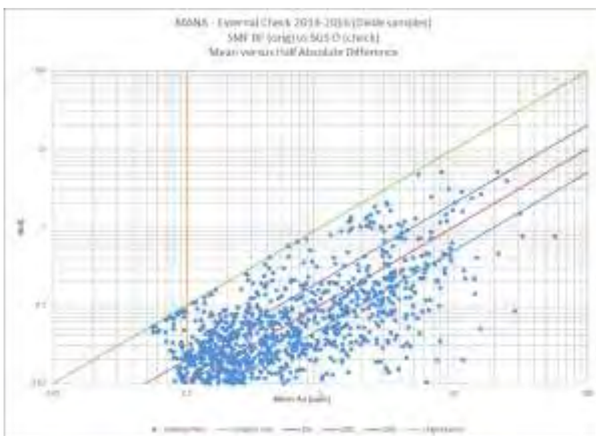


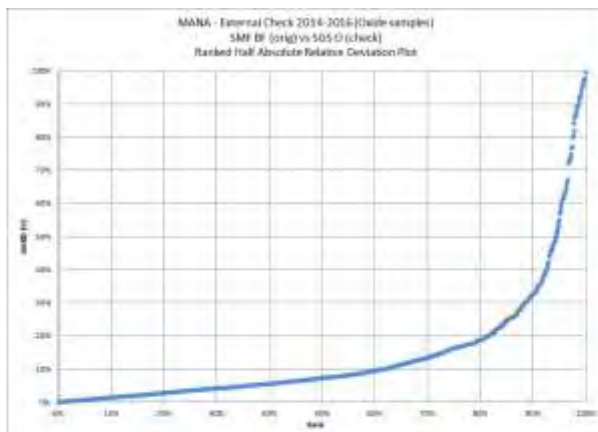
Biais charts and precision plots for oxide samples assayed between SMF BF and SGS-OU (2014-16).

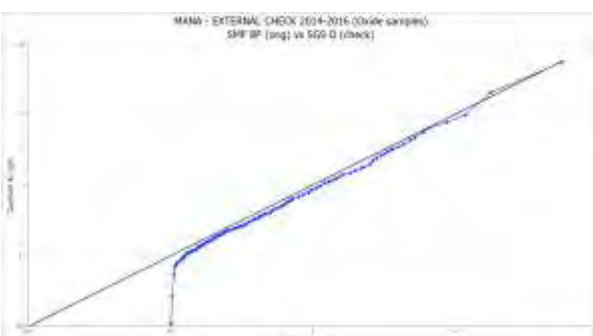
		Statistics	SMF BF (orig)	SGS O (check)
Project	Mana	**Sample Count**	1237	1237
Data Series	2014-2016 Lab Pulp Duplicates	**Minimum Value**	0.03	0.01
Data Type	RC and Core Samples	**Maximum Value**	57.77	56.20
Commodity	Au in gpt	**Data Mean**	1.43	1.27
Analytical Method	Fire Assay – AAS Finish	**Median**	0.37	0.31
Detection Limit	0.01 gpt Au	**Standard Error**	0.09	0.09
Original Dataset	Original Assays	**Standard deviation**	3.20	3.10
Paired Dataset	Lab Pulp Replicate Assays	**Correlation Coefficient**	0.9670	
		Pairs ≤ 10% HARD	62%	





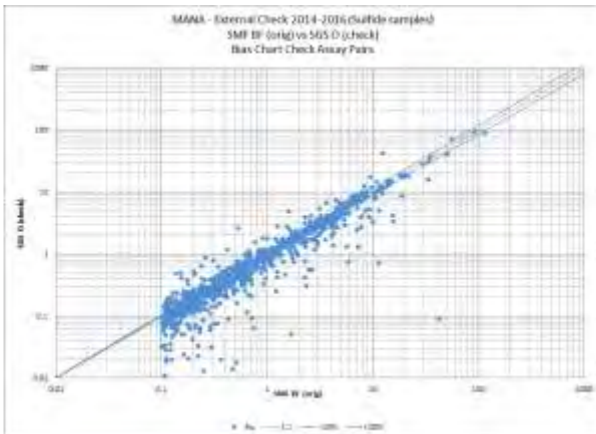


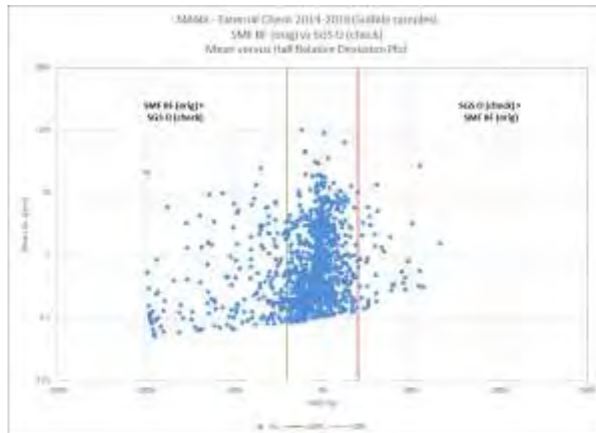


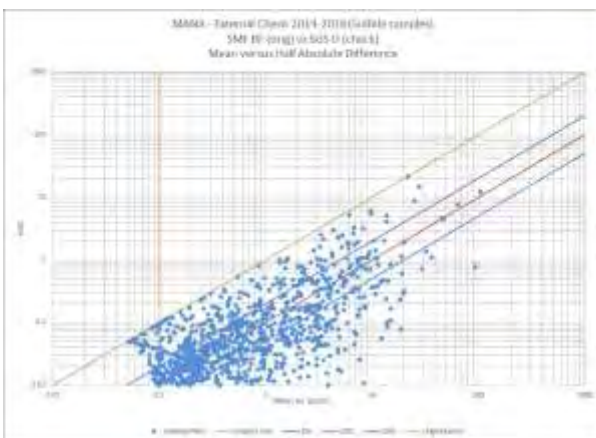


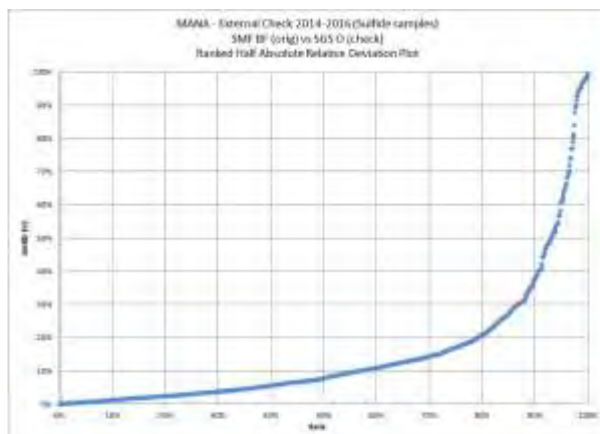
Biais charts and precision plots for sulfide samples assayed between SMF BF and SGS-OU (2014-16).

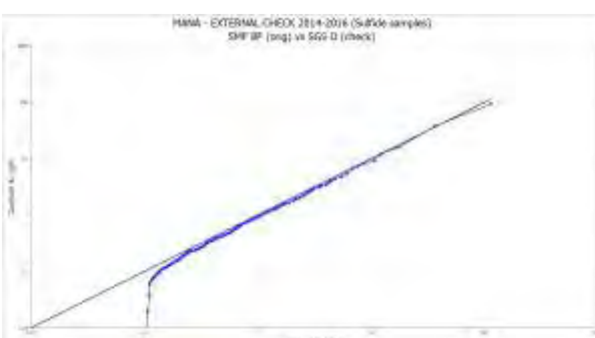
		Statistics	SMF BF (orig)	SGS O (check)
Project	Mana	**Sample Count**	1147	1147
Data Series	2014-2016 Lab Pulp Duplicates	**Minimum Value**	0.10	0.01
Data Type	RC and Core Samples	**Maximum Value**	115.40	93.10
Commodity	Au in gpt	**Data Mean**	2.12	1.94
Analytical Method	Fire Assay – AAS Finish	**Median**	0.51	0.44
Detection Limit	0.01 gpt Au	**Standard Error**	0.18	0.17
Original Dataset	Original Assays	**Standard deviation**	6.16	5.70
Paired Dataset	Lab Pulp Replicate Assays	**Correlation Coefficient**	0.9380	
		Pairs ≤ 10% HARD	57%	





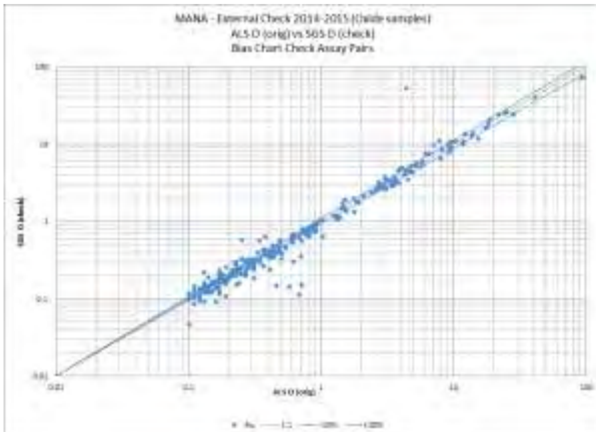


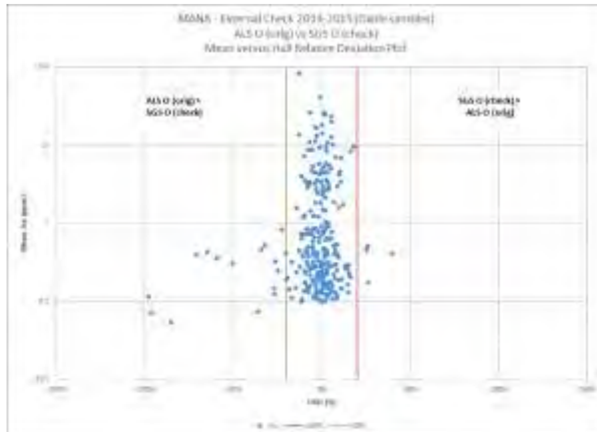


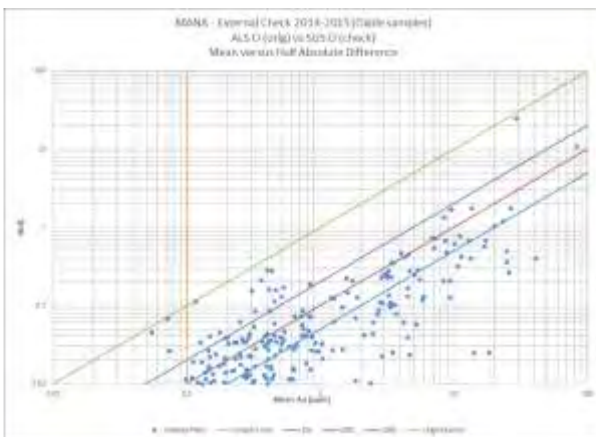


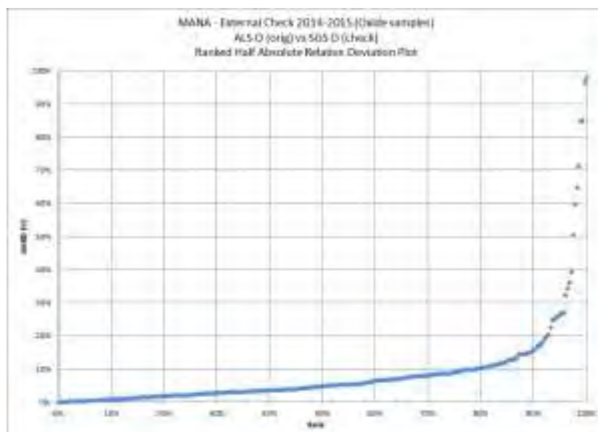
Biais charts and precision plots for oxide samples assayed between ALS-OU and SGS-OU (2014-15).

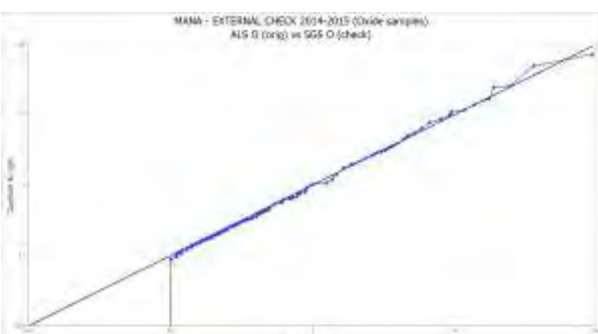
		Statistics	**ALS O (orig)**	**SGS O (check)**
Project	Mana	**Sample Count**	282	282
Data Series	2014-2015 Lab Pulp Duplicates	**Minimum Value**	0.10	0.01
Data Type	RC and Core Samples	**Maximum Value**	93.50	72.15
Commodity	Au in gpt	**Data Mean**	2.68	2.76
Analytical Method	Fire Assay – AAS Finish	**Median**	0.43	0.39
Detection Limit	0.01 gpt Au	**Standard Error**	0.44	0.43
Original Dataset	Original Assays	**Standard deviation**	7.41	7.21
Paired Dataset	Lab Pulp Replicate Assays	**Correlation Coefficient**	0.9003	
		Pairs ≤ 10% HARD	79%	











Biais charts and precision plots for sulfide samples assayed between ALS-OU and SGS-OU (2014-15).

		Statistics	ALS O (orig)	SGS O (check)
Project	Mana	**Sample Count**	347	347
Data Series	2014-2015 Lab Pulp Duplicates	**Minimum Value**	0.10	0.01
Data Type	RC and Core Samples	**Maximum Value**	100.00	91.20
Commodity	Au in gpt	**Data Mean**	3.35	3.07
Analytical Method	Fire Assay – AAS Finish	**Median**	0.43	0.39
Detection Limit	0.01 gpt Au	**Standard Error**	0.52	0.49
Original Dataset	Original Assays	**Standard deviation**	9.77	9.12
Paired Dataset	Lab Pulp Replicate Assays	**Correlation Coefficient**	0.9629	
		Pairs ≤ 10% HARD	67%