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## TECHNICAL REPORT ON THE BJÖRKDAL GOLD MINE, VÄSTERBOTTEN, SWEDEN

Report for NI 43-101

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# 1 SUMMARY

## EXECUTIVE SUMMARY

Roscoe Postle Associates Inc. (RPA), now part of SLR Consulting Ltd (SLR), was retained by Mandalay Resources Corporation (Mandalay) to prepare an independent Technical Report on the Björkdal Gold Mine (Björkdal or the Mine), located in Västerbotten County in northern Sweden. The purpose of this report is to support the disclosure of Mineral Resources and Mineral Reserves for Björkdal and the satellite Norrberget deposit (Norrberget), located approximately four kilometres east-southeast of the Mine. Mineral Resources and Mineral Reserves are estimated as of December 31, 2019, based on a drill hole database cut-off date of September 30, 2019 for Björkdal and September 30, 2017 for Norrberget. This Technical Report conforms to National Instrument 43-101 Standards of Disclosure for Mineral Projects (NI 43-101). RPA has visited the Mine on several occasions, most recently in November 2019 and January 2020.

In 2019, Björkdal produced gold from a combined open pit and underground operation. With operation of the open pit mine suspended in July 2019, approximately 69% of plant feed was delivered from the underground, with the remainder coming from the open pit (18%) and the balance drawn from the low grade stockpile (13%). Total mill feed for 2019 was 1.29 million tonnes. The average reconciled grade for 2019 was 1.43 g/t Au. The Björkdal plant uses conventional crushing and grinding, followed by a combination of gravity and flotation processing techniques to recover gold to concentrates which are sold to smelters in Europe. The plant capacity is approximately 3,700 tonnes per day (tpd) and the plant is currently operating at approximately 3,400 tpd. Gold recovery for 2019 averaged approximately 88%, and production totalled approximately 52,000 ounces of gold in saleable concentrates.

The 2017 Pre-Feasibility Study (PFS) for Norrberget envisions an open pit mining operation feeding the existing Björkdal plant. No changes have been made to the underlying assumptions for the Norrberget PFS since the last Technical Report dated March 29, 2019.

Table 1-1 lists the Mineral Resource estimate for the Mine prepared by RPA with an effective date of December 31, 2019. Mineral Resources are reported inclusive of Mineral Reserves. Canadian Institute of Mining, Metallurgy and Petroleum (CIM) Definition Standards for Mineral

Resources and Mineral Reserves dated May 10, 2014 (CIM (2014) definitions) were used for the estimate.

**TABLE 1-1 MINERAL RESOURCES AT THE BJÖRKDAL MINE AND NORRBERGET DEPOSIT AS OF DECEMBER 31, 2019**  
Mandalay Resources Corporation – Björkdal Gold Mine

Location	Area	Tonnage (kt)	Grade (g/t Au)	Contained Au (koz)
<b>Indicated Mineral Resources</b>				
Björkdal	Open Pit	3,114	2.08	208
	Underground	9,656	2.58	799
	Stockpile	2,644	0.64	54
	Subtotal	<b>15,414</b>	<b>2.14</b>	<b>1,062</b>
Norrberget	Open Pit	144	3.29	15
<b>Total, Indicated</b>		<b>15,558</b>	<b>2.15</b>	<b>1,077</b>
<b>Inferred Mineral Resources</b>				
Björkdal	Open Pit	3,338	1.30	139
	Underground	2,143	2.36	163
	Subtotal	<b>5,480</b>	<b>1.71</b>	<b>302</b>
Norrberget	Open Pit	3	4.03	0.5
<b>Total, Inferred</b>		<b>5,483</b>	<b>1.71</b>	<b>302</b>

Notes:

1. Björkdal Mineral Resources are estimated using drill hole and sample data as of September 30, 2019 and account for production to December 31, 2019.
2. Norrberget Mineral Resources are estimates using drill hole and sample data as of September 30, 2017.
3. CIM (2014) definitions were followed for Mineral Resources.
4. Mineral Resources are inclusive of Mineral Reserves.
5. Mineral Resources are estimated using an average gold price of US\$1,500/oz and an exchange rate of 9.0 SEK/US\$.
6. High gold assays were capped to 30 g/t Au for the open pit mine.
7. High gold assays for the underground mine were capped at 60 g/t Au for the first search pass and 40 g/t Au for subsequent passes.
8. High gold assays at Norrberget were capped at 24 g/t Au.
9. Interpolation was by inverse distance cubed utilizing diamond drill, reverse circulation, and chip channel samples.
10. Open pit Mineral Resources are estimated at a cut-off grade of 0.34 g/t Au for Björkdal and 0.35 g/t Au for Norrberget and constrained by the resource pit design.
11. Underground Mineral Resources are estimated at a cut-off grade of 0.80 g/t Au.
12. A nominal two metres minimum mining width was used to interpret veins using diamond drill, reverse circulation, and underground chip sampling.
13. Stockpile Mineral Resources are estimated at a cut-off grade of 0.40 g/t Au and are based upon surveyed volumes supplemented by production data.
14. Mineral Resources that are not Mineral Reserves do not have demonstrated economic viability.
15. Numbers may not add due to rounding.

RPA is not aware of any environmental, permitting, legal, title, taxation, socio-economic, marketing, political, or other relevant factors that could materially affect the Mineral Resource estimate.

Table 1-2 lists the Mineral Reserve estimate for the Björkdal Mine and Norrberget deposit as of December 31, 2018.

**TABLE 1-2 MINERAL RESERVES AT THE BJÖRKDAL MINE AND NORRBERGET DEPOSIT AS OF DECEMBER 31, 2019**  
**Mandalay Resources Corporation – Björkdal Gold Mine**

Location	Area	Tonnage (kt)	Grade (g/t Au)	Contained Au (koz)
<b>Probable Mineral Reserves</b>				
Björkdal	Open Pit	2,875	1.23	114
	Underground	5,410	2.10	365
Norrberget	Open Pit	162	2.80	15
Stockpile	Stockpile	2,644	0.64	54
<b>Total, Probable</b>		<b>11,090</b>	<b>1.54</b>	<b>548</b>

Notes:

1. Mineral Reserves are estimated using drill hole and sample data as of September 30, 2019 and depleted for production through December 31, 2019.
2. Norrberget Mineral Reserves are estimated using data as of September 30, 2017.
3. CIM (2014) definitions were followed for Mineral Reserves.
4. Open Pit Mineral Reserves are based on mine designs carried out on an updated resource model, applying a block dilution of 100% at 0.0 g/t Au for blocks above 1.0 g/t Au and 100% at in-situ grade for blocks between 0.4 g/t Au and 1.0 g/t Au. The application of these block dilution factors is based on historical reconciliation data. A cut-off grade of 0.4 g/t Au was applied. Open Pit Mineral Reserves for Norrberget are based on 15% dilution at zero grade and 100% extraction.
5. Underground Mineral Reserves are based on mine designs carried out on an updated resource model. Minimum mining widths of 3.85 m for stopes (after dilution) and 4.35 m for development (after dilution) were used. Stope dilution was applied by adding 0.5 m on each side of stopes as well as an additional 10% over break dilution. Further dilution, ranging from 10% to 100%, was added on a stope by stope basis depending on their proximity with other stopes. An overall dilution factor of 14.5% was added to development designs. Mining extraction was assessed at 95% for contained ounces within stopes and 100% for development. A cut-off grade of 0.92 g/t Au was applied. An incremental cut-off grade of 0.4 g/t Au was used for development material.
6. Stockpile Mineral Resources are estimated at a cut-off grade of 0.40 g/t Au and are based upon surveyed volumes supplemented by production data.
7. Mineral Reserves are estimated using an average long-term gold price of US\$1,300/oz, and an exchange rate of 9.0 SEK/US\$.
8. Tonnes and contained gold are rounded to the nearest thousand.
9. Totals may appear different from the sum of their components due to rounding.

RPA is not aware of any mining, metallurgical, infrastructure, permitting, or other relevant factors that could materially affect the Mineral Reserve estimate.

## CONCLUSIONS

The Björkdal plant has processed approximately 32.5 million tonnes of ore to December 31, 2019 to produce a total of approximately 1.44 million ounces of gold at an average feed grade of 1.38 g/t Au. Both open pit and underground mining methods have been employed on the property.

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**GEOLOGY AND MINERAL RESOURCES****Björkdal:**

- Historically, the gold mineralization at the Mine occurs as a large number of sub-parallel, steeply dipping, narrow quartz veins that are hosted by footwall intermediate volcanic units. The veining is locally structurally complex with many Reidel-type vein geometries as well as small quartz veinlets and pods. The strike limits of the veins are bounded largely by the Björkdal shear, a shallow to moderately north (true) dipping structure.
- On-going exploration and development work has been successful in locating and delineating additional gold-bearing mineralization in the adjoining fault block located beyond the Björkdal shear. This newly discovered mineralization (known as the Aurora Zone) is hosted by a series of mafic and intermediate volcanic units which form parts of the hangingwall of the historically known mineralized veins. This hangingwall unit has traditionally been regarded as having little potential for hosting potentially economic gold mineralization.
- On-going exploration and development work has also been successful in locating and delineating gold mineralization that is hosted by skarn units which are part of the marble sequence that forms the upper contact of the historically recognized mineralized quartz veins. From the available information, these skarn units are currently interpreted to be oriented as stratiform units with shallow to moderate northerly (true) dips.
- Many areas of the Björkdal Mine property are unexplored or under-explored and so are considered to offer good exploration potential. Along with the down-plunge projection, the upper limits of the Aurora Zone to surface have not been defined by drilling.
- Work is underway to understand the controls on the location and distribution of the skarn units. Given the flat-lying orientation of these units, their orientations are not conducive to being fully evaluated by the current drill hole patterns. Potential remains for the discovery of additional mineralization of this type.
- The Björkdal open pit (OP) wireframes were based on a nominal 0.3 g/t Au cut-off grade over a minimum of two metres. The underground (UG) wireframes were based on a nominal two metre minimum width at a cut-off grade of 0.5 g/t Au. A total of 544 mineralized wireframe models were created for the underground mine and 488 wireframe models were created for the open pit mine.
- The dual capping value approach was continued to be used for estimation of the gold grades contained within the mineralized wireframe models in the underground mine. In this approach, the composited assays for diamond drill holes (DDH) and reverse circulation (RC) drill holes are capped to values of 60 g/t Au and 40 g/t Au. Two different area of influences are then used when estimating the block grades for each mineralized wireframe. The higher grade capped composites are used within a first pass search ellipse with a 15 m radius, while the lower grade capped composites are used for subsequent estimation passes. A single capping value of 40 g/t Au was applied to the composited samples contained within the chip sample database. A value of 30 g/t Au has been selected as the capping value for the DDH, RC, and chip samples contained within the OP wireframes. This capping value was also applied to all samples contained within the dilution domain volume.
- Mandalay carried out an exercise whereby the stope volumes in the underground mine determined using the cavity monitoring system (CMS) were compared with the planned excavation designs. This program has been successful in yielding detailed information regarding the quantities of unplanned dilution and underbreak.

- Comparison of the predicted tonnages and grades from the year end 2018 Long Term block model against the realized tonnages and grades from the 2019 Grade Control model demonstrates that the sample collection, assaying, and estimation procedures used to prepare the Long Term Mineral Resource estimates continue to provide acceptable results for the underground mine.
- Reconciliation results for the open pit mine resulted in reinterpretation of the East Pit mineralized wireframes, however, production from the open pit mine was suspended in July 2019.
- The Björkdal open pit and underground Mineral Resources comprise 15.41 million tonnes at an average grade of 2.14 g/t Au containing approximately 1.1 million ounces of gold in the Indicated Mineral Resource category and 5.48 million tonnes grading 1.71 g/t Au containing approximately 302,000 ounces of gold in the Inferred Mineral Resource category. The cut-off grades used in the estimation are 0.34 g/t Au for open pit and 0.80 g/t Au for underground resources.

#### **Norrberget:**

- The primary gold mineralization at Norrberget is contained within bands of veinlets and alteration containing amphibole in a package of interbedded mafic tuffs and volcanoclastics.
- Mineralization wireframes were generated using a 0.4 g/t Au cut-off grade and a two metre minimum horizontal width. The wireframes represented a primary band of continuous mineralization and two limited footwall bands of mineralization.
- Samples within the Norrberget domains were capped at 24 g/t Au, affecting seven out of the 311 samples within the mineralized domains. Intercepts within the domain were composited to 1.0 m lengths with a minimum sample length of 0.5 m.
- Bulk density applied to the block model was based on average densities for each lithology. The mineralization has an average density of 2.78 g/cm<sup>3</sup>.
- The low number of mineralized samples at Norrberget necessitated the use of inverse distance weighted interpolation rather than the ordinary kriging method. Continuity analysis of grade contours was reviewed to help define high grade trends that were used to inform the interpolation parameters.
- At a cut-off grade of 0.35 g/t Au, the Norrberget Mineral Resources comprise 144,000 tonnes at an average grade of 3.29 g/t Au containing 15,000 ounces of gold in the Indicated Mineral Resource category and 3,000 tonnes at a grade of 4.03 g/t Au containing approximately 500 ounces of gold in the Inferred Mineral Resource category.

#### **MINING AND MINERAL RESERVES**

- At a cut-off grade of 0.4 g/t Au, open pit Probable Mineral Reserves at Björkdal are estimated to be approximately 2.88 million tonnes grading 1.23 g/t Au, containing 114,000 ounces of gold.
- At a cut-off grade 0.92 g/t Au for stopes and incremental cut-off grade of 0.4 g/t Au for development material, underground Probable Mineral Reserves at Björkdal are estimated to be approximately 5.41 million tonnes grading 2.10 g/t Au, containing 365,000 ounces of gold.

- Stockpile Mineral Reserves are estimated to be approximately 2.64 million tonnes grading 0.64 g/t Au, containing 54,000 ounces of gold, at a cut-off grade of 0.4 g/t Au.
- At Norrberget, there are approximately 162,000 tonnes of Probable Mineral Reserves at a grade of 2.80 g/t Au for a total of 15,000 ounces of contained gold.
- The current Mineral Reserves for Björkdal support a mine life of approximately ten years at approximately 1.3 Mtpa, with the exception of the last year of production. Gold production averages approximately 55,000 ounces per year. A number of opportunities that could further extend the mine life exist:
  - Continue upgrading Inferred Mineral Resources to Indicated Mineral Resources.
  - Analyze the potential to relocate surface infrastructure which could result in additional open pit mining.
  - Identify remnant underground mining areas with in-situ Mineral Resources that could be extracted in a safe and cost effective manner.
- The Björkdal open pit mining operation was suspended in July 2019 and is now scheduled to recommence in 2023.
- The open pit mining operation employs contractors for most unit operations. RPA considers that, there may be an opportunity to reduce open pit operating costs by converting to a mine-owned fleet when the open pit operation restarts in 2023.
- The current mine plan includes the recovery of the crown pillar during the final years of open pit mining. The pillar contains infrastructure servicing the underground operations that will be disrupted by mining of the crown pillar. It also contains a large number of voids from previous underground mining that may cause some operational issues during mining and potentially some high wall stability concerns. To allow the crown pillar to be mined in parallel to underground extraction, an additional portal will be developed to access the underground mine. The mining sequence will be re-examined closer to the restart date of open pit mining.
- The underground mine is scheduled to produce approximately 795,000 tonnes of run-of-mine ore during 2020 and an average of approximately 874,000 tonnes of ore over the following five years of the underground operations. Underground production will reduce and end in year seven of the current life of mine (LOM) (2026).
- The low grade stockpile will be used to provide the additional ore needed to allow the mill to operate at full capacity. Additional material is expected to be placed into the stockpile over the remaining LOM, which will allow Björkdal to run at or near capacity in all years (except the final year) of the current LOM.
- Due to the variable quality of the material that comprises the low grade stockpiles, grade variations in the feed to the mill are anticipated.
- The underground Mineral Reserves at Björkdal are based on a minimum mining width of 3.5 m. There are currently a number of areas in the mine where multiple stopes are in close proximity to each other. This could result in certain stopes having additional dilution. In RPA's opinion, additional drilling is required in these areas to collect the additional grade, structural, and geotechnical data necessary to safely maximize reserve extraction and minimize dilution.
- Structural features such as folding and their impact on metal distribution are not well understood and are therefore not considered in the current underground mining method. Advanced knowledge of such features could result in a change in mining method and Mineral Reserves.

- RPA considers it essential that continued attention be given to local and global rock mechanics issues during future mine design as underground stresses are redistributed.
- A detailed reconciliation that compared the design and actual tonnes (using CMS) and grade from a large number of stopes was carried out during 2018 and 2019. This indicated that ore tonnage was under-estimated by approximately 5% and Au content by approximately 13%. Dilution averages 50%. This is consistent with factors used in the mine design.
- Mining losses were included as direct gold losses and not ore tonne losses.
- The nature of the mining method is such that development ore will always represent a large proportion of the underground tonnage production.
- As presently planned, mining of the Norrberget open pit will be carried out with the same contract mining fleet used at Björkdal. The total mine life for Norrberget is estimated to be seven months.

### **PROCESSING**

- Björkdal has been successful in recovering nearly 90% of the gold, with approximately 73% of the gold recovered in gravity concentrates (i.e., gravity concentrate, middlings, and Knelson concentrate) and an additional 12% to 17% of the gold recovered in flotation concentrates.
- Recent additions to the processing equipment, reagent changes, and improvements in the processing strategy have improved the gold recovery by 1% to 2%.
- Preliminary metallurgical tests using samples from Norrberget show that the mineralogy is more complex and the gold grain sizes are smaller which requires a finer grind size to achieve liberation. Since the deposit is small, it is not anticipated that modifications to the existing processing plant will be cost effective. Therefore, the data indicates that the average gold recovery for Norrberget will be approximately 75%.

### **PERMITTING**

- A new operating permit was granted in December 2018 and remains valid for ten years. Expansion of the tailings management facility (TMF) and its continuing operation is covered by the new permit.
- A compensation agreement for lost grazing land and increased operating costs for the reindeer herders was signed in April 2017. This agreement is valid for the planned operating life of the Björkdal Mine.
- The Norrberget deposit is not covered by the above agreement. A new mining concession has been granted that covers Norrberget and is valid until January 2044.
- The newly granted environmental permit includes an updated closure and reclamation plan.

### **RISKS**

- The Mine has been in production for over 30 years and is a mature operation. In RPA's opinion, there are no significant risks or uncertainties that could reasonably be expected to affect the reliability or confidence in the exploration information, Mineral Resource or Mineral Reserve estimates, or projected economic outcomes.

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## RECOMMENDATIONS

RPA presents the following recommendations:

### **GEOLOGY AND MINERAL RESOURCES**

- Improve the precision of the duplicate sample assay results by examining the impact of using a larger aliquot or a finer grind size.
- Investigate using conventional fire assay method to determine the gold grades of the assays obtained from the on-site PAL1000 unit to quantify the amount of gold remaining in the LeachWELL residues.
- Consider the preparation of a two kilogram pulp from the coarse reject material at a frequency of approximately one sample in 50, to permit a review of the precision of the analytical method.
- Review and update as appropriate the validation procedures for the drill hole management protocol.
- Use the actual as-mined volumes as determined from the CMS surveys to code the block model rather than the design shapes. Use of the actual excavated volumes will improve the block model reconciliation results for those stopes which are accessed by means of a bottom drive only (i.e., the “blind” stopes).
- Create a new category for the Confidence Interval of the drill hole collar table of the drill hole database. This new category will be used to identify grab samples or other sample information that do not have a meaningful sample length associated with them.
- Continue efforts to construct a full three-dimensional digital model of the distribution of the host rocks in the vicinity of the mine area. Use of immobile element geochemical signatures (e.g., Ti vs Zr plots) may be useful in assisting to discriminate between the footwall intermediate volcanic and the hangingwall mafic volcanic units.
- Ensure that all wireframe interpretations are fully “snapped” to the sampled assay intervals, as doing so will improve the accuracy of the local tonnage and grade estimates.
- Use the graphical compositing function of the Surpac software package as a guide to selection of the optimal wireframe widths and to minimize the amount of dilution introduced into the mineralized wireframes.
- Further divide the SKS-series wireframes into shear-hosted units versus skarn-hosted units, and group them by open pit or underground mining methods. These further divisions will be of great assistance for future geostatistical studies and block modelling efforts.
- Examine the two metre minimum width criteria used to create the vein interpretations in light of the reconciliation information being collected for the excavated stopes. Consideration may be given to modifying this minimum width to better reflect the thinnest openings that are being achieved on a day-to-day operational basis.
- Collect additional samples of the Aurora Zone and of the Skarn Zone mineralization for density measurements as development activities continue to progress. RPA also recommends that samples be collected from selected exploration drill holes for density measurements.



- Re-examine and reclassify as appropriate the confidence classification for chip/channel samples collected by previous operators for the LZA group of wireframes.
- Examine the distribution of the gold contents within the mineralized wireframes by contouring the gold grades longitudinal projections. The results will be useful in short term planning and will improve the targeting of exploration and in-fill drilling programs.
- Continue collecting information regarding the distribution of the gold grades in the walls of the development headings by means of the POD-series drill holes.
- Carry out studies to examine the impact of the spacing of the POD-series drill holes on the accuracy of the local grade estimate.
- Examine whether the use of assay information from the sludge samples collected from development drilling can be used to improve the accuracy of the long-term Mineral Resource block model estimate.
- Continue collecting chip samples across the full width of the face for underground development headings and entering all chip sample information into the drill hole database as pseudo-drill holes that span the full width of the face of the development heading.
- Harmonize the across-strike dimensions (i.e., the northing, or Y-direction) of the blocks with the minimum widths selected for preparation of the mineralized wireframes to reduce the amount of dilution being introduced into the block model.
- Evaluate alternate parameters for the search strategies to reduce the presence of estimation artifacts and improve the accuracy of the local estimate.
- Continue drilling programs to both search for new areas of mineralization on the Mine property and expand the limits of the known mineralization.
- Continue to collect high quality scans of all stope voids on a regular and timely basis. This information should then be integrated into the material tracking and metal accounting systems to permit comparisons to be made for the block model versus the mine actual production and then the mill output. The information will also be useful in evaluating the accuracy of the excavation voids against the designed excavations.
- Consider expanding the time period for the reconciliation studies. The current reconciliation studies evaluate the predictive accuracy of the year-end 2018 LT block model over the most recent 12-month production period. Use of the year-end 2017 block model for comparison with the production data for 2018 and 2019 will enable the quantification of the accuracy of the estimation procedures and parameters over a 24-month period.
- Amend the Mineral Resource reporting criteria for the underground mine to include the use of constraining volumes for defining the potentially economic portions of the mineralized wireframes as use of such constraining volumes will improve the accuracy of the Mineral Resource statements.
- At Norrberget, carry out additional drilling to delineate the mineralization at depth and along strike.

#### **MINING AND MINERAL RESERVES**

- Adjust the mining loss estimate to include an estimate of lost ore tonnes.
- Review all the proximal stopes and update the dilution estimate in those stopes.

- Continue reconciliation and production management work to improve future grade and dilution forecasts.

### **PROCESSING**

- Continue to monitor the performance of all unit operations and to optimize plant performance to achieve the highest economic outcome possible.
- Continue to evaluate historic data and to use the results to estimate future plant gold recovery and operating costs.
- In future, metallurgical tests for Norrberget, should use variability samples with a range of head grades from throughout the deposit, using test conditions that evaluate what the metallurgical response will be in the existing processing facility.

## **ECONOMIC ANALYSIS**

This section is not required as the property is currently in production, Mandalay is a producing issuer, and there is no material expansion of current production.

## **TECHNICAL SUMMARY**

### **PROPERTY DESCRIPTION AND LOCATION**

The Björkdal property is located in Västerbotten County in northern Sweden, at approximately 20°35'26" E longitude and 64°56'7" N latitude (WGS84). Björkdal is located approximately 28 km northwest of the municipality of Skellefteå and approximately 750 km north of Stockholm. The property is accessible via Swedish national road 95 or European highway route E4 followed by all-weather paved roads. On the property, gravel roads link the main site gate entrance to the surface infrastructure. The nearest airport, located in Skellefteå, has regular daily service to Stockholm.

The Norrberget property is located approximately four kilometres east of the Björkdal Mine and is currently accessible via a forest road.

### **LAND TENURE**

Mandalay is a publicly listed company that effectively holds 100% of Björkdal through the Swedish registered companies Björkdalsgruvan AB (Björkdalsgruvan) and its subsidiary Björkdal Exploration AB (Björkdal Exploration). Björkdalsgruvan owns nine mining concessions on the Björkdal property and one mining concession on the Norrberget property.

An eleventh concession, Norrliden K nr 1, is held by Explor Björkdalsgruvan AB. There are 17 exploration permits, 15 of which are owned by Björkdal Exploration and two by Explor Björkdalsgruvan AB.

The holder of an exploitation concession must pay an annual minerals fee to the landowners of the concession area and to the State. The fee is 0.2% of the average value of the minerals mined from the concession, 0.15% of which is paid to the landowners in proportion to their share of ownership of the concession area. The remaining 0.05% is paid to the State to be used for research and development in the field of sustainable development of mineral resources. The fee is estimated after consideration of the amount of mined ore, the amount of minerals in the ore, and the average price of the mineral during the year or by use of an equivalent value.

## **HISTORY**

### ***BJÖRKDAL***

The Björkdal deposit was originally discovered in 1983 by Terra Mining AB (Terra Mining) during a till sampling program which discovered anomalous gold values in the glacial till profile. Anomalous gold values in bedrock were discovered in 1985 and definition drilling began in 1986.

Definition drilling was coincident with metallurgical testing and positive feasibility studies were completed in 1987. Terra Mining commenced mining operations at Björkdal in July 1988. In 1996, Terra Mining was purchased by William Resource Ltd. (William). William continued to operate the mine until the end of June 1999 when it was petitioned into bankruptcy. The assets were bought through public auction in June 2001 by International Gold Exploration, which operated the Mine from September 2001 until 2003 when it was acquired by Minmet plc (Minmet).

In 2006, Gold-Ore Resources Ltd. (Gold-Ore) acquired an option from Minmet to purchase the holding company for the mine. On December 31, 2007, Gold-Ore exercised its option and acquired all the shares of Björkdalsgruvan AB. During exploration and development of the Björkdal Mine, Gold-Ore generated cash flow from gold sales from the operation of the plant at the mine, fed by stockpiled material, open pit mining, and underground development operations, which commenced on a full scale basis in mid-2008. In January 2009, Gold-Ore's

management concluded that there were sufficient mineral reserves and resources at Björkdal for at least a five year mine life and declared commercial production.

In May 2012, Elgin Mining Inc. (Elgin) acquired all of the issued and outstanding common shares of Gold-Ore. On June 4, 2014, Mandalay announced that it had entered into an arrangement agreement pursuant to which Mandalay would acquire all the outstanding common shares of Elgin. The transaction was completed on September 10, 2014.

The Mine has produced a total of 1.44 million ounces of gold since the start of production in 1988.

### **NORRBERGET**

The Norrberget deposit was discovered by COGEMA in 1994 and drilling occurred until 1996. In 1997, COGEMA withdrew from Sweden, and the exploration permits around the Björkdal dome including the Norrberget deposit were taken up by NAN.

On September 28, 2007, Gold-Ore purchased exploration permits surrounding the Björkdal property from NAN. The property was acquired by Elgin and subsequently passed to Mandalay through the acquisition process described above.

## **GEOLOGY AND MINERALIZATION**

The Skellefteå region lies within an ancient cratonic block named the Fennoscandian shield and consists of Paleoproterozoic-aged rocks that host several world-class volcanogenic massive sulphide (VMS) copper, zinc, and lead deposits. Mineralization in the Skellefteå region is focused within and around the Skellefteå belt, a regionally extensive, northwest trending structural feature 120 km long and 30 km wide, which consists of deformed and metamorphosed Paleoproterozoic-aged volcanic, sedimentary, and igneous rocks. The stratigraphy in the Mine area is divided into two groups, the Skellefte Group (lower division) and the Vargfors Group (upper division). The Björkdal gold deposit is hosted within the upper portions of the Skellefte Group, which is dominated by successions of mafic volcanic flows that are interbedded or intercalated on a large scale with clastic sediments.

As a result of detailed litho-stratigraphic mapping, petrological observations, and geochemical analysis undertaken by Mandalay/Björkdalsgruvan, geologists have observed that host rock geology, metamorphism, and alteration styles are much more complex and variable than

previously documented. Instead of a large, massive plutonic-type intermediate intrusion occupying the domal structure observed within the Björkdal area, a variable and complex alteration signature overprints many different rock-types including pyroclastic, volcano-sedimentary, tuffaceous, extrusive-volcanic (andesitic to basaltic compositions), sub-volcanic intrusive (andesitic compositions), and sedimentary (silici-clastics, shales and carbonates) lithologies. Common alteration and metasomatic styles include silicification, carbonatization, calc-silicate (actinolite) alteration, albitization, chloritization, potassic (biotite and K-feldspar), epidotization, pyritization, tourmalinization, with various skarn-type alteration assemblages common in areas where a calcareous host rock is present (including actinolite, tremolite, pyroxene, and minor garnet).

The local stratigraphic succession consists of a lower assemblage that is dominated by intermediate volcanic units; this unit has historically been the host rock to all of the gold mineralization at the Mine. It is overlain by a narrow interval of clastic and chemical sediments referred to as the marble unit, which in turn is overlain by a mixed assemblage of mafic and intermediate volcanic units. The footwall contact of the marble unit has traditionally been thought to represent an unconformity, however, detailed mapping activities in the Mine suggest that the footwall contact may, in part, be due to faulting. A number of faults and shears have been recognized and mapped, of which the Björkdal shear is the most important. It has a north to northeasterly (true) dip, and observed kinematic indicators suggest oblique movement. Recent mapping activities have shown that this shear has truncated the footwall and marble unit in the northern extremities of the Mine and has brought the hangingwall mafic volcanic unit into fault contact with the footwall intermediate volcanic unit. To the north of the Björkdal shear, in the northern extremities of the Mine, drilling and development activities have shown that significant quantities of economic grade mineralization are hosted by the hangingwall mafic volcanic unit. This newly discovered zone is referred to as the Aurora Zone and is currently the main focus of the mining and exploration activities. The full extent of the gold mineralization in the Aurora Zone has not been defined by drilling. Initial exploration activities to the north of the Aurora Zone are discovering additional gold-bearing veins and structures.

The Björkdal gold deposit has traditionally been viewed as a lode-style, sheeted vein deposit hosted within the upper portions of the Skellefte Group sediments. Gold is found within quartz veins that range in thickness from less than a centimetre to over several decimetres. These veins are usually observed as vertical to sub-vertical dipping veins that strike between azimuth 000° and azimuth 090°, with the majority of veins striking between azimuth 030° and 060°.

The veining is locally structurally complex, with many cross-veining features observed and thin mineralized quartz veinlets in the wall rocks proximal to the main quartz veins. Gold-rich quartz veins are most often associated with the presence of minor quantities of sulphide minerals such as pyrite, pyrrhotite, marcasite, and chalcopyrite alongside more common non-sulphide minerals such as actinolite, tourmaline, and biotite. Scheelite and bismuth-telluride compounds (i.e., tellurobismuthite and tsumoite) are also commonly found within the gold-rich quartz veins and are both excellent indicators of gold mineralization.

Recent exploration and development activities have discovered that economic gold grades can also be hosted in skarn-altered rocks. Skarnification occurs commonly within the Björkdal Mine, especially in the limestone/marble unit as discrete patches and lenses.

At Norrberget, the mineralization is stratabound within an interbedded altered volcanoclastic package that sits unconformably below a 30 m to 40 m thick marble unit. Gold mineralization has been observed up to 50 m below this contact. The mineralization is primarily associated with amphibole alteration bands and veinlets. The gold is very fine grained and rarely visible. Where gold grains have been observed, they are found to be on the boundary or in the interstitial material between grains. High grade gold is mostly found in areas with low to no pyrite.

## **EXPLORATION STATUS**

For the period of January 2015 to September 2019, Mandalay drilled a total of 131,600 m of exploration diamond-core drilling from underground stations at the Björkdal Mine. This drilling has most recently focused on outlining the newly discovered mineralization of the Aurora Zone as well as outlining the extents of the newly discovered skarn-hosted mineralization. While the majority of the drilling in 2019 was carried out in support of the newly discovered Aurora Zone and skarn mineralization, a lesser amount of drilling was also completed to test selected targets in the open pit area.

The drilling programs were successful in extending the known limits of the Aurora Zone, for outlining the limits of the high grade, skarn-hosted zones, and for the discovery of additional gold mineralization in the area to the north of the Aurora Zone. As of September 30, 2019, the Aurora Zone has been outlined by drill hole and channel sample information along a strike length of approximately 500 m and along a dip length of approximately 400 m. As of

September 30, 2019, the limits of the mineralization in the Aurora Zone have not been defined by drilling.

There is high likelihood of further discoveries in the Björkdal area, as deposit models currently being formulated and tested by Mandalay geologists are proving successful and much of the held ground remains either unexplored or under-explored.

## **MINERAL RESOURCE ESTIMATE**

### ***BJÖRKDAL***

RPA reviewed data for Björkdal and has independently prepared Mineral Resource estimates using a drill hole database with a cut-off date of September 30, 2019. The Mineral Resource estimate has an effective date of December 31, 2019. Mineral Resources were estimated for open pit, underground, and stockpile areas (Table 1-1).

Mandalay built individual mineralized wireframes separately for OP and UG domains. The OP wireframes were based on a nominal 0.3 g/t Au cut-off value over a minimum of two metres. The UG wireframes were based on a nominal two metre minimum width at a cut-off value of 0.5 g/t Au. The OP mineralized wireframe models were grouped into five separate areas and a total of 448 individual wireframe models were created for the open pit mine. The UG mineralized wireframe models were grouped into six separate areas and a total of 554 individual wireframe models were created for the underground mine.

Mandalay elected to maintain a dual capping value approach for estimation of the gold grades contained within the mineralized wireframe models in the underground mine. In this approach, the composited assays for diamond drill holes and RC drill holes are capped to values of 60 g/t Au and 40 g/t Au. A value of 30 g/t Au has been selected as the capping value for the diamond drill hole, RC drill hole, and chip samples contained within the open pit wireframes. This capping value was also applied to all samples contained within the dilution domain volume.

An upright, non-rotated block model was constructed to model the mineralization in the underground and open pit mines together. Gold grades were estimated into the blocks by means of inverse distance cubed (ID<sup>3</sup>) interpolation algorithm. A total of three interpolation passes were carried out to estimate the grades in the underground block model. A two-pass search strategy was applied to estimate the grades in the open pit block model. A single-pass

estimation strategy was applied when estimating the grades for the dilution domain in the open pit mine block model.

Separate cut-off grades were developed for reporting of the underground and open pit Mineral Resources. Each cut-off grade was developed using the January to September 2019 actual cost information along with a gold price of US\$1,500 per ounce and an exchange rate of 9.0 SEK/US\$. The cut-off grade for reporting of Mineral Resources was determined to be 0.80 g/t Au within the underground mine and 0.34 g/t Au for the open pit mine.

RPA classified the Mineral Resources as Indicated and Inferred based on drill hole spacing, grade continuity, and reliability of data. All material contained within either the North or South stockpile areas was classified into the Indicated Mineral Resource category.

#### ***NORRBERGET***

RPA reviewed data for Norrberget and has independently prepared Mineral Resource estimates using a drill hole database with a cut-off date of September 30, 2017. RPA estimated the Norrberget Mineral Resources for the Technical Report dated March 29, 2018 and that Mineral Resource estimate remains unchanged as of the effective date of this report. Mineral Resources were estimated within an open pit.

RPA generated three mineralized domains for Norrberget that reflected packages of mineralized and altered material above a 0.35 g/t Au cut-off grade that was a minimum of two metres in horizontal width.

RPA reviewed the Norrberget data and capped the grades to ensure that sporadic high grade values were not over-represented. A 24 g/t Au capping value was applied. The capped samples were flagged by the mineralized domain wireframes and the intercepts were composited on a 1.0 m length between the wireframe boundaries, with a minimum residual of 0.5 m.

A block model that encompassed the mineralization wireframes and sufficient waste to constrain the resource within a pit was generated. Gold grade were interpolated into the mineralized blocks using ID<sup>3</sup>. A total of three interpolation passes were carried out to estimate the grades in the block model.



Cut-off grades were developed using the January to September 2017 actual cost information from Björkdal along with a gold price of US\$1,400 per ounce. The cut-off grade for reporting of Mineral Resources for Norrberget was determined to be 0.35 g/t Au.

RPA classified the Mineral Resources as Indicated and Inferred based on drill hole spacing, grade continuity, and reliability of data.

## **MINERAL RESERVE ESTIMATE**

Open pit and underground Mineral Reserve estimates were prepared by Mandalay Resources, and reviewed by RPA, using mine designs based on the updated Mineral Resource model. The Mineral Reserves have an effective date of December 31, 2019.

### ***BJÖRKDAL***

Underground Mineral Reserve estimate was based on a minimum mining width of 3.5 m for stopes (after dilution) and 4.35 m for development. Dilution was applied by adding 0.5 m on each side of stopes and an additional 10% for overbreak dilution. An overall dilution factor of 14.5% was applied to development designs. The resulting overall stope dilution averages approximately 54%. Mining extraction was assessed at 95% for contained ounces within stopes and 100% for development. For stopes, a cut-off grade of 0.92 g/t Au was applied, while for development material, an incremental cut-off grade of 0.4 g/t Au was used.

For the Björkdal open pit, potential pits were evaluated via pit optimization. A selective mining unit (SMU) of 5 m x 3 m x 3 m was used in the block model, and was reblocked to 10 m x 6 m x 6 m to improve processing time. Based on historical reconciliation data for the Björkdal open pit, a tonnage dilution factor of 100% at in-situ grade was applied for blocks between 0.4 g/t Au and 1.0 g/t Au. For blocks above 1.0 g/t Au within the Björkdal open pit, compiled reconciliation data of the open pit high grade and low grade ore supports the use of a block dilution of 100% at 0.1 g/t Au. Based on the results of several pit optimization runs, the majority of ore tonnage is located in the crown pillar along the east wall of the pit.

### ***NORRBERGET***

The Norrberget Mineral Reserve estimate remains unchanged from the Technical Report dated March 29, 2018.

For the Norrberget open pit, potential pits were evaluated using the Lerchs-Grossmann pit optimization algorithm and a parent block size of 6 m x 4 m x 4 m. As no production has occurred within the Norrberget open pit, a reconciled dilution and extraction factor cannot be obtained, and as a result, a dilution factor of 15% and extraction factor of 100% has been nominally assigned based on reconciled production data from mining shallow dipping structures at the Björkdal open pit.

## **MINING**

### ***BJÖRKDAL***

The Björkdal open pit ceased production in late 2019 as the processing of the low grade stockpile generated more value than the continued mining of the open pit. The company intends to restart the open pit in 2023 as the underground reserves become depleted.

The underground mining method used at Björkdal is longhole stoping with a sub-level spacing of 15 m to 20 m, depending on the zone. Cross-cuts are established perpendicular to the vein system. Veins are then developed by drifting on each sub-level from the cross-cut. All pre-production vein, cross-cut, and ramp development is drilled and blasted using conventional trackless mining equipment.

The current mill constraints limit the total Björkdal production capacity to 1.3 Mtpa. The average LOM underground mine production rate is currently 0.86 Mtpa. A further 0.4 Mtpa of ore is planned from the low grade stockpile, for an average annual throughput rate of 1.3 Mtpa. The open pit will be restarted when underground production volumes start to reduce and as the low grade stockpile becomes depleted.

### ***NORRBERGET***

The Norrberget open pit will be mined by a contractor with trucks and shovels, as part of the larger Björkdal contract. Norrberget will be mined from 2027, when ore from the main Björkdal pit begins to reduce.

The Norrberget mining schedule is integrated into the Björkdal open pit schedule to minimize potential production shortfalls and to provide added flexibility to the deliverable mill feed. The plan for Norrberget will provide a further 162,000 tonnes to the mill over seven months. Stripping of overburden is scheduled to commence at the beginning of 2027, with ore being mined in the last quarter of 2027.

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## MINERAL PROCESSING

The mineral processing plant at Björkdal commenced operation in 1989. Since that time, it has processed more than 32.6 million tonnes of ore from open pit and underground sources and produced approximately 1.4 million ounces of gold. Currently, the concentrator throughput is 1.3 Mtpa and the overall gold recovery is 88.3% of which 73% is obtained from the gravity processes and 17% from flotation.

The concentrator includes primary, secondary, and tertiary crushing, primary and secondary grinding, a series of gravity concentration steps, regrinding, and flotation to produce three gravity concentrates and a flotation concentrate.

A new plant project designed to increase rougher flotation retention time and to install a second stage of cleaner flotation was completed in 2017. In 2018, an Expert Control System was installed.

The ore from the Norrberget deposit has more complex mineralogy than the mineralogy at Björkdal. Preliminary metallurgical tests show that the gold recovery in the existing plant will be at least 15% lower than the gold recovery for Björkdal ore.

The TMF is located in an area of gently undulating relief approximately 1.5 km north of the processing plant. During 2019 the Western Barrier Dam was raised by 2.5 m, which provides sufficient tailings capacity to April 2022. The raising of dam K1 will be carried out in two stages with the Stage 1 raise being initiated during 2020 and Stage 2 scheduled to be completed during 2023. At the planned plant throughput of 1.3 Mtpa, this will provide sufficient tailings storage capacity for ten more years of mine life up to 2031.

## ENVIRONMENTAL, PERMITTING AND SOCIAL CONSIDERATIONS

All operations are fully permitted in accordance with Swedish environmental and health and safety legislation. A new operating permit (M 771-17) was granted in December 2018 and remains valid for ten years from the date of issue at which point a new permit will be required.

The environmental permit allows for expansion of the TMF for a mill throughput of 1.7 Mtpa.

A full environmental audit is carried out every three years by an independent consultant and the local authorities. The monitoring, control, and management policies and procedures are well documented and entirely appropriate to the type of operation.

The 2018 environmental permit includes an updated closure and reclamation plan. Mandalay presently has approximately US\$4.43 million (SEK 43 million) held in a secured reclamation account with a bank as required by the Swedish authorities.

## CAPITAL AND OPERATING COSTS

A summary of capital requirements anticipated over the LOM is summarized in Table 1-3.

**TABLE 1-3 CAPITAL COST SUMMARY**  
Mandalay Resources Corporation – Björkdal Gold Mine

Description	Value (US\$000)
Sustaining Capital Fixed Assets	41,062
Capital Development Underground	22,572
Pre-Strip Open Pit	45,052
<b>Total Sustaining Capital</b>	<b>108,685</b>
Growth Capital Fixed Assets	8,011
<b>Total LOM Capital Expenditure</b>	<b>116,696</b>

Operating costs for the LOM plan are shown below in Table 1-4.

**TABLE 1-4 LIFE OF MINE OPERATING COSTS**  
Mandalay Resources Corporation – Björkdal Gold Mine

Description	LOM (US\$000)	Annual Average (US\$000)	Unit Cost (US\$/t processed)
Mining	135,406	16,926	12.15
Processing	86,693	10,837	7.78
G&A	91,345	11,418	8.20
Royalties and Refining	10,150	1,269	0.91
<b>Total Operating Cost</b>	<b>323,594</b>	<b>40,449</b>	<b>29.03</b>

## 2 INTRODUCTION

Roscoe Postle Associates Inc. (RPA), now part of SLR Consulting Ltd (SLR), was retained by Mandalay Resources Corporation (Mandalay) to prepare an independent Technical Report on the Björkdal Gold Mine (Björkdal or the Mine), located in Västerbotten County in northern Sweden. The purpose of this report is to support the disclosure of Mineral Resources and Mineral Reserves for Björkdal and the satellite Norrberget deposit (Norrberget), located approximately four kilometres east-southeast of the Mine. Mineral Resources and Mineral Reserves are estimated as of December 31, 2019, based on a drill hole database cut-off date of September 30, 2019 for Björkdal and September 30, 2017 for Norrberget. RPA has previously prepared Mineral Resource and Mineral Reserve estimates and supporting Technical Reports for the Björkdal Mine, with the most recent in March 2019 (RPA, 2019). This Technical Report conforms to National Instrument 43-101 Standards of Disclosure for Mineral Projects (NI 43-101).

In 2019, Björkdal produced gold from a combined open pit and underground operation. With operation of the open pit mine suspended in July 2019, approximately 69% of plant feed was delivered from the underground, with only 18% of the production coming from the open pit and the balance drawn from the low grade stockpile (13%). Total mill feed for 2019 was 1.29 million tonnes. The average reconciled grade for 2019 was 1.43 g/t Au. The Björkdal plant uses conventional crushing and grinding, followed by a combination of gravity and flotation processing techniques to recover gold to concentrates which are sold to smelters in Europe. The plant capacity is 3,700 tonnes per day (tpd) and the plant is currently operating at approximately 3,400 tpd. Gold recovery for 2019 averaged approximately 88%, and production totalled approximately 52,000 ounces of saleable gold in concentrates.

The 2017 Pre-Feasibility Study (PFS) for Norrberget envisions an open pit mining operation feeding the existing Björkdal plant. No changes have been made to the underlying assumptions for the Norrberget PFS since the last Technical Report dated March 28, 2019.

Mandalay is a publicly listed Canadian mining company that holds 100% of Björkdal through its wholly-owned subsidiaries in Sweden. Mandalay's other operating mine is located in Australia (Costerfield).

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## SOURCES OF INFORMATION

Site visits to Björkdal were carried out by Reno Pressacco, M.Sc.(A), P.Geo., RPA Principal Geologist, from November 18 to 21, 2019, as well as Jack P. Lunnon, CGeol, EurGeol, RPA Senior Geologist, Kathleen A. Altman, Ph.D., P.E., RPA Principal Metallurgist, and David J.F. Smith, CEng, RPA Principal Mining Engineer, from September 22 to 25, 2017 and most recently by Derek Holm, FSAIMM, RPA Senior Mining Engineer, from January 22 to 24, 2020. RPA visited all of the Björkdal open pit and underground operations, the processing plant, and surface infrastructure including the assay laboratory. A visit was also made to the Norrberget Project site.

The report was prepared by Reno Pressacco, Jack P. Lunnon, Derek Holm, Kathleen A. Altman, and David J.F. Smith, all of whom are independent Qualified Persons (QP). Mr. Pressacco is responsible for Sections 2 to 12, 23, and 24 and parts of Sections 1, 14 (Björkdal Mineral Resources), 25, 26, and 27. Mr. Lunnon is responsible for parts of Section 1, 14 (Norrberget Mineral Resources), 25, and 26. Messrs. Smith and Holm share responsibility for Sections 15, 16, 18 to 22, and parts of Sections 1, 25, 26, and 27. Dr. Altman is responsible for Sections 13 and 17, and parts of Sections 1, 25, 26, and 27.

Discussions in relation to the year end 2019 Mineral Resource and Mineral Reserve estimates, discussions were held with personnel from Mandalay:

- Mr. Chris Gregory, Vice President – Operational Geology and Exploration
- Mr. Gunnar Rådberg, Björkdal General Manager
- Mr. Jose Javier Santabarbara, Björkdal Senior Resource Geologist
- Ms. Helena Moosberg-Bustnes, Björkdal Plant Manager
- Ms. Åsa Corin, Björkdal Geology Manager
- Mr. Samuel Miller, Björkdal Senior Exploration Geologist
- Mr. Anton Anundsson, Technical Services Manager
- Mr. Nils Lindberg, Björkdal Open Pit Engineer
- Mrs. Charlotte Odenberger, Environmental Manager

The documentation reviewed, and other sources of information, are listed at the end of this report in Section 27 References.

## LIST OF ABBREVIATIONS

Units of measurement used in this report conform to the metric system. All currency in this report is US dollars (US\$) unless otherwise noted.

a	annum	kWh	kilowatt-hour
A	ampere	L	litre
bbl	barrels	lb	pound
btu	British thermal units	L/s	litres per second
°C	degree Celsius	m	metre
C\$	Canadian dollars	M	mega (million); molar
cal	calorie	m <sup>2</sup>	square metre
cfm	cubic feet per minute	m <sup>3</sup>	cubic metre
cm	centimetre	μ	micron
cm <sup>2</sup>	square centimetre	MASL	metres above sea level
d	day	μg	microgram
dia	diameter	m <sup>3</sup> /h	cubic metres per hour
dmt	dry metric tonne	mi	mile
dwt	dead-weight ton	min	minute
°F	degree Fahrenheit	μm	micrometre
ft	foot	mm	millimetre
ft <sup>2</sup>	square foot	mph	miles per hour
ft <sup>3</sup>	cubic foot	Mtpa	million tonnes per annum
ft/s	foot per second	MVA	megavolt-amperes
g	gram	MW	megawatt
G	giga (billion)	MWh	megawatt-hour
Gal	Imperial gallon	oz	Troy ounce (31.1035g)
g/L	gram per litre	oz/st, opt	ounce per short ton
Gpm	Imperial gallons per minute	ppb	part per billion
g/t	gram per tonne	ppm	part per million
gr/ft <sup>3</sup>	grain per cubic foot	psia	pound per square inch absolute
gr/m <sup>3</sup>	grain per cubic metre	psig	pound per square inch gauge
ha	hectare	RL	relative elevation
hp	horsepower	s	second
hr	hour	st	short ton
Hz	hertz	stpa	short ton per year
in.	inch	stpd	short ton per day
in <sup>2</sup>	square inch	t	metric tonne
J	joule	tpa	metric tonne per year
k	kilo (thousand)	tpd	metric tonne per day
kcal	kilocalorie	US\$	United States dollar
kg	kilogram	USg	United States gallon
km	kilometre	USgpm	US gallon per minute
km <sup>2</sup>	square kilometre	V	volt
km/h	kilometre per hour	W	watt
koz	thousand ounces	wmt	wet metric tonne
kPa	kilopascal	wt%	weight percent
kt	thousand tonnes	yd <sup>3</sup>	cubic yard
kVA	kilovolt-amperes	yr	year
kW	kilowatt		

### 3 RELIANCE ON OTHER EXPERTS

This report has been prepared by RPA for Mandalay. The information, conclusions, opinions, and estimates contained herein are based on:

- Information available to RPA at the time of preparation of this report, and
- Assumptions, conditions, and qualifications as set forth in this report.

For the purpose of this report, RPA has relied on ownership information provided by Mandalay in Sections 1 and 4 of this Technical Report. RPA has not researched property title or mineral rights for the Mine and expresses no opinion as to the ownership status of the property.

RPA has relied on Mandalay for guidance on applicable taxes, royalties, and other government levies or interests, applicable to revenue or income from the Mine.

Except for the purposes legislated under provincial securities laws, any use of this report by any third party is at that party's sole risk.



## 4 PROPERTY DESCRIPTION AND LOCATION

The Björkdal property is located in Västerbotten County in northern Sweden, at approximately 20°35'26" E longitude and 64°56'7" N latitude (WGS84). In the Swedish coordinate system used for government maps (SWEREF 99) the Björkdal property is located at approximately X: 7212941 and E: 764003. The Norrberget property is located approximately four kilometres east of the Björkdal Mine. The Björkdal Mine is situated approximately 28 km northwest of the municipality of Skellefteå and approximately 750 km north of Stockholm (Figure 4-1).

### SWEDISH MINING LAWS AND REGULATIONS

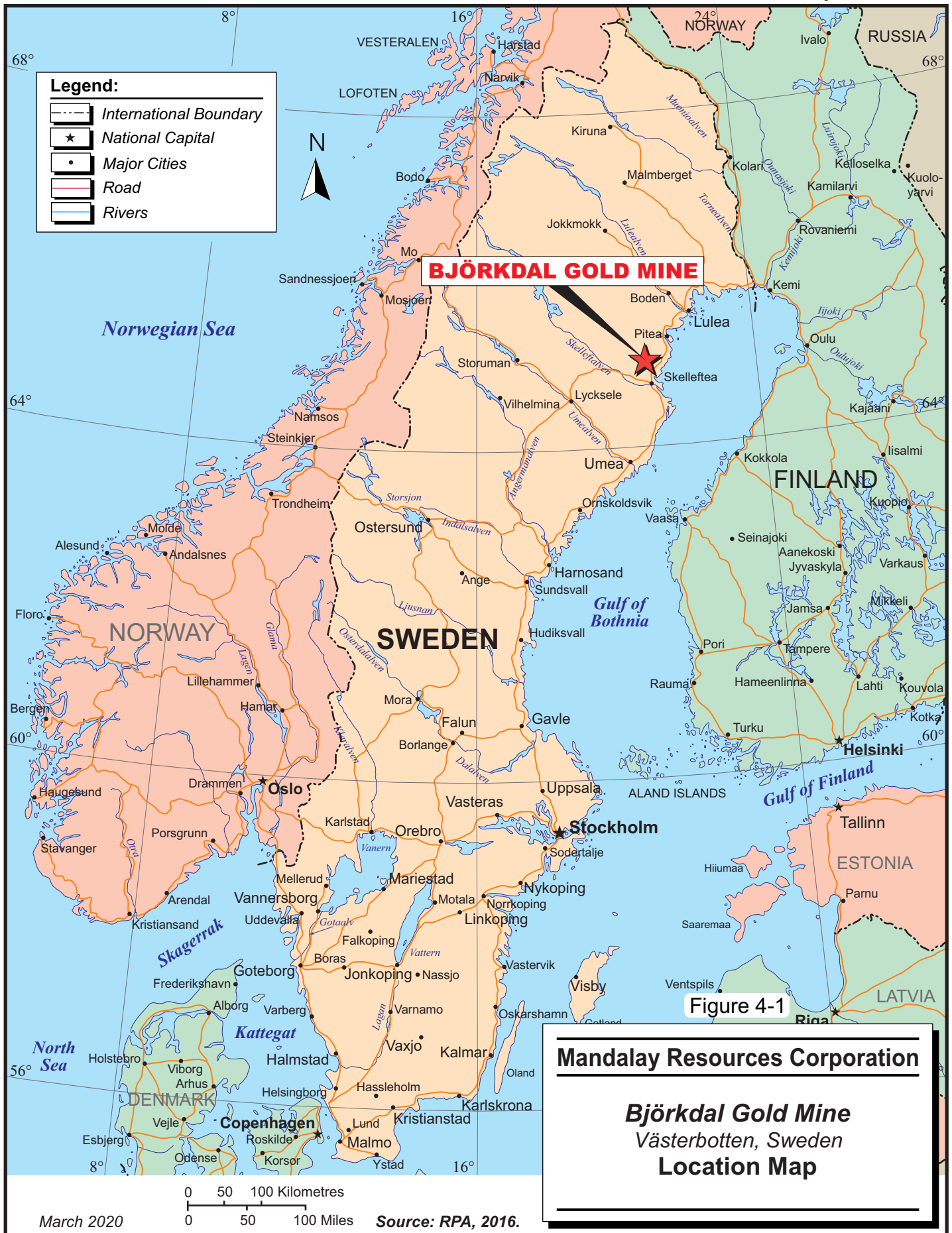
The Minerals Act (1991:45) came into force on July 1, 1992. The Mining Inspectorate of Sweden (Bergsstaten) is the agency responsible for decisions concerning permits for exploration (exploration permits) and mining (exploitation concessions). The Mining Inspectorate also carries out inspections of mines and provides information on mineral legislation and prospecting in Sweden.

On June 11, 2014, the Swedish Parliament amended the provisions of the Minerals Act (1991:45) governing exploration works. As per this bill, exploration permit holders are required to provide more detailed information about their exploration works.

An exploration permit does not give the right to undertake exploration work in contravention of any environmental regulations applying to the area. Applications for exemption are normally submitted to the County Administration Board (Länstyrelsen).

Acts and regulations governing exploration work include:

- Minerals Act (1991:45)
- Mineral Ordinance (1992:285)
- Environmental Code (1998:808)
- Work Environment Act (1977:1160)
- Work Environment Ordinance (1977:1166)



- The Work Environment Authority’s Statute Book (AFS)
- Off-Road Driving Act (1975:1313)
- Off-Road Driving Ordinance (1978:594)
- Forest Conservation Act (1979:429)
- Forest Conservation Ordinance (1993:1096)
- Heritage Conservation Act (1988:950)
- Heritage Conservation Ordinance (1988:1188)
- Protection Act (2010:305)

## PROPERTY OWNERSHIP AND LAND TENURE

Mandalay is a publicly listed company that effectively holds 100% of Björkdal through the Swedish registered companies Björkdalsgruvan AB (Björkdalsgruvan) and its subsidiary Björkdal Exploration AB (Björkdal Exploration). Björkdalsgruvan owns nine mining concessions on the Björkdal property and one mining concession on the Norrberget property. An eleventh concession, Norrliden K nr 1, is held by Explor Björkdalsgruvan AB. There are 17 exploration permits, 15 of which are owned by Björkdal Exploration and two by Explor Björkdalsgruvan AB. Mining and exploration concessions are listed in Tables 4-1 and 4-2, respectively, and shown in Figure 4-2.

**TABLE 4-1 MINING CONCESSIONS**  
**Mandalay Resources Corporation – Björkdal Gold Mine**

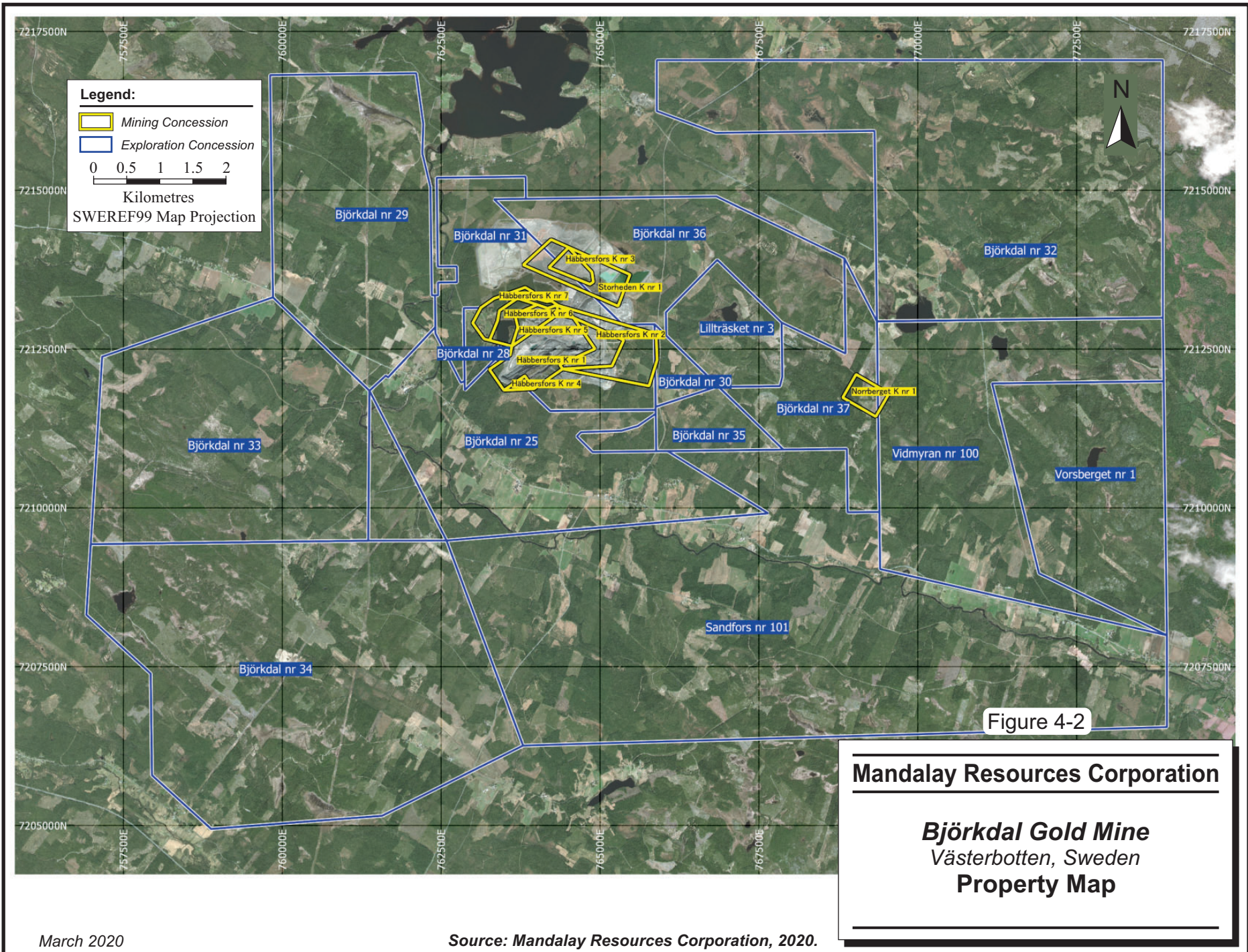
<b>Permit Name</b>	<b>Size (ha)</b>	<b>Expiry Date</b>
Häbbersfors K nr 1	98.6894	January 1, 2031
Häbbersfors K nr 2	34.8839	February 2, 2025
Häbbersfors K nr 3	18.8864	April 29, 2027
Häbbersfors K nr 4	5.0012	November 21, 2025
Häbbersfors K nr 5	21.8263	March 6, 2034
Häbbersfors K nr 6	23.4887	April 24, 2038
Häbbersfors K nr 7	32.1100	January 17, 2042
Norrberget K nr 1	25.28	January 25, 2044
Nylund K nr 1	73.4700	January 30, 2043
Storheden K nr 1	61.27	November 8, 2043
Norrliden K nr 1*	18.51	January 1, 2032
<b>Total</b>	<b>413.42</b>	

Note. \* Permit held by Explor Björkdalsgruvan AB

**TABLE 4-2 EXPLORATION CONCESSIONS**  
**Mandalay Resources Corporation – Björkdal Gold Mine**

<b>Permit Name</b>	<b>Size (ha)</b>	<b>Expiry Date</b>	<b>Remarks</b>
Björkdal nr 25	967.70	May 9, 2020	Application for dispensation from moratorium
Björkdal nr 28	39.53	October 14, 2023	
Björkdal nr 29	1,073.89	November 30, 2020	Application for Extension
Björkdal nr 30	64.03	February 23, 2021	
Björkdal nr 31	540.52	November 7, 2020	Application for Extension and Exploitation Concession (Kvarnforsliden K nr 1)
Björkdal nr 32	2,219.60	November 27, 2021	
Björkdal nr 33	1,409.35	October 19, 2020	Application for Extension
Björkdal nr 34	2,520.16	November 9, 2020	Application for Extension
Björkdal nr 35	135.43	October 17, 2021	
Björkdal nr 36	670.40	April 10, 2021	
Björkdal nr 37	378.45	August 28, 2022	
Lillträsket nr 3	246.59	October 17, 2021	
Malånäset nr 100*	591.84	March 20, 2023	
Malånäset nr 101*	687.77	March 28, 2021	
Sandfors nr 101	3,267.82	June 9, 2021	
Vidmyran nr 100	1,197.50	March 10, 2023	
Vorsberget nr 1	804.73	May 25, 2021	
<b>Total</b>	<b>16,815.31</b>		

Note. \* Permit held by Explor Björkdalsgruvan AB



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The Björkdal deposit is located on Häbbersfors exploitation concessions.

## EXPLOITATION CONCESSIONS

Key facts for exploitation concessions are:

- An exploitation concession is valid for 25 years based on an application fee.
- The concession period can be extended for ten years at a time without special application if regular exploitation operations are in progress when the period of validity expires.
- An additional fee is sometimes paid to some landowners for a safety zone for blasting. This is an agreement between the Mine and landowners, and is not due to any legal obligations.

## EXPLORATION PERMITS

Obligations to retain exploration permits include:

- An application fee of SEK500, or approximately US\$70, per every 2,000 ha area.
- Annual fees for exploration total approximately SEK500,000, or approximately US\$70,000 per annum.
- Compensation for damage and encroachment to landowners upon completion of the operation.

## SURFACE USAGE/LAND LEASE

Mandalay has indicated to RPA that all land required for the Björkdal mining concessions has been designated to the company. Some of the land is owned by Mandalay, while some is still owned by landowners with long term surface leases to the company. If the Mine activity is shut down for some reason, land is returned to the landowners after reclamation work is completed.

Björkdal is located in reindeer habitat belonging to the Sami village Mausjaure in the west and to the Sami village Svaipa in the east. The habitats are not active and there are no issues with the indigenous Sami population.

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## **ENVIRONMENTAL LIABILITIES AND PERMITTING**

Mandalay reports that Björkdal is fully permitted in accordance with Swedish environmental and health and safety legislation. The latest environmental permit was issued in December 2018 and is in good standing. The permit is valid for 10 years and allows for expansion of the tailings management facility (TMF) for a mill throughput of 1.7 Mtpa. A mining permit is included in the environmental permit.

## **ROYALTIES, BACK-IN RIGHTS, PAYMENTS OR OTHER ENCUMBRANCES**

The holder of an exploitation concession must pay an annual minerals fee to the landowners of the concession area and to the State. The fee is 0.2% of the average value of the minerals mined from the concession, 0.15% of which is paid to the landowners in proportion to their share of ownership of the concession area. The remaining 0.05% is paid to the State to be used for research and development in the field of sustainable development of mineral resources. The fee is estimated after consideration of the amount of mined ore, the amount of minerals in the ore, and the average price of the mineral during the year or by use of an equivalent value.

## **DISCUSSION**

RPA is not aware of any environmental liabilities on the property and Mandalay has confirmed that it is in possession of, or in the process of obtaining, all required permits to conduct the proposed work on the property. RPA is not aware of any other significant factors and risks that may affect access, title, or the right or ability to perform the proposed work program on the property.

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

### ACCESSIBILITY

The Björkdal property is located approximately 40 km by road northwest of the municipality of Skellefteå (population of 72,000) and is accessible via Swedish national road 95 or European highway route E4 followed by all-weather paved roads. Norrberget is located approximately four kilometres east of the Björkdal Mine and is accessible via a forest road.

On the Björkdal property, gravel roads link the main site gate entrance to the surface infrastructure. Gravity concentrates are trucked from the Mine to Skellefteå where they are loaded on ships for delivery to smelting customers in Europe. Sulphide flotation concentrates are trucked to nearby processing facilities. The nearest airport, located in Skellefteå, has regular daily service to Stockholm.

### CLIMATE

This area of Sweden has a subarctic climate with mild summers and cold snowy winters. The climate is, however, moderated by proximity to the Gulf of Bothnia, so that while winters are cold, they are much less so than winters at similar latitudes in other parts of the world. The average low temperature for January is -14°C. The short summers are also reasonably warm for latitudes near the Arctic Circle. The average daily high temperature in July is 19°C, although, in recent years, temperatures above 30°C have been recorded. Yearly precipitation is low at less than 600 mm, with August being the wettest month at over 71 mm. Precipitation is quite low near the coast, but snow may lie on the ground for up to four months. Due to its high latitude, July is typified by an average of 21 hours of daylight while the average for December is four. Climatic conditions do not affect Björkdal's or Norrberget's exploration activities, and the Björkdal Mine and processing operations function year round.



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## LOCAL RESOURCES

The Västerbotten region has a long history of mining activity and Skellefteå is an industrial town. The region is home to several competence centres and two universities with the bulk of Sweden's academic and vocational units related to mining, metallurgy, and geology located within a radius of 130 km. There are also a number of specialized companies, suppliers, and contractors linked to the mining industry including world-class manufacturers of mining equipment and machinery. Both experienced and general labour is readily available within the region. Björkdal has had success in hiring experienced staff and personnel with good mining expertise. The Mine enjoys the support of local communities as mining is accepted as a socially responsible and necessary contributor to the local economy.

## INFRASTRUCTURE

### BJÖRKDAL

The Björkdal Mine site hosts extensive surface and underground infrastructure, including the following:

- Well-kept gravel site roads,
- An administrative building consisting of office space, kitchen facilities, and a mine dry,
- An open pit with ramp access to the underground operations,
- Underground development consisting of ramps and sub-levels,
- Raw ore stockpile facility containing eleven 5,000 tonne to 7,000 tonne capacity raw ore stockpiles,
- Primary jaw crushing facility with 400 tonne coarse ore stockpile,
- Secondary crushing facility,
- 5,000 tonne fine ore stockpile and reclaim facility,
- 3,600 tpd mill, gravity gold plant, and flotation plant,
- An internal metallurgical assay laboratory,
- Company and contractor maintenance facilities,
- A core logging facility with covered storage, sample preparation laboratory, and grade control assay laboratory,
- 250 ha TMF,
- Raw water supply and storage,
- Water treatment plant,
- Explosive magazine and mixing facilities,

- 
- Storage facilities for chemical reagents and bulk supplies,
  - An off-site covered core storage facility,
  - Swedish grid electrical power,
  - Fresh water access.

## **NORRBERGET**

Currently, there is no infrastructure at the Norrberget deposit other than forest access roads and exploration drill pads. Water for drilling is obtained from surface streams, or pumped from previous drill holes.

In RPA's opinion, there are sufficient surface rights for mining operations and related infrastructure.

## **PHYSIOGRAPHY**

The Björkdal property is located at an average elevation of 140 MASL. The terrain around Björkdal is relatively subdued with low hills and numerous shallow lakes. Glacial till forms the main soil cover over the area. The vegetation around Björkdal is dominated by managed forests of spruce and birch with some areas of cultivated land.

## 6 HISTORY

### PRIOR OWNERSHIP

#### BJÖRKDAL

The Björkdal deposit was originally discovered in 1983 by Terra Mining AB (Terra Mining) during a till sampling program which discovered anomalous gold values in the glacial till profile. Anomalous gold values in bedrock were discovered in 1985 and a definition drilling program began in early 1986.

The definition drilling program was coincident with a metallurgical test work program, and feasibility studies that were completed in May 1987. The feasibility studies returned a positive outcome and Terra Mining commenced mining operations at Björkdal in July 1988. In 1996, Terra Mining was purchased by William Resource Ltd. (William). William continued to operate the Mine until the end of June 1999, when it was petitioned into bankruptcy. The assets were bought through public auction in June 2001 by International Gold Exploration, which operated the Mine from September 2001 until 2003 when it was acquired by Minmet plc (Minmet).

In 2006, Gold-Ore Resources Ltd. (Gold-Ore) acquired an option from Minmet to purchase the holding company for the Mine. On December 31, 2007, Gold-Ore exercised its option and acquired all the shares of Björkdalsgruvan AB. During exploration and development of the Mine, Gold-Ore generated cash flow from gold sales from the operation of the plant at the mine, fed by stockpiled material, open pit mining of new material, and underground development operations, which commenced on a full scale in mid-2008. In January 2009, Gold-Ore's management concluded that there were sufficient mineral reserves and resources at the Mine for at least a five year mine life and declared commercial production.

In May 2012, Elgin Mining Inc. (Elgin) acquired all of the issued and outstanding common shares of Gold-Ore. Gold-Ore's common shares were delisted from the TSX and Elgin graduated from a TSX Venture listed company to a TSX listed company.

On June 4, 2014, Mandalay announced that it had entered into an arrangement agreement pursuant to which Mandalay would acquire all the outstanding common shares of Elgin. The transaction was completed on September 10, 2014.

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## **NORRBERGET**

The Norrberget deposit was discovered by COGEMA in 1994 and drilling occurred until 1996. In 1997, COGEMA withdrew from Sweden and disposed of all assets in the region. The exploration permits around the Björkdal dome and covering the Norrberget deposit were taken up by NAN.

On September 28, 2007, Gold-Ore purchased exploration permits surrounding the Björkdal property from NAN. The property was acquired by Elgin and subsequently passed to Mandalay through the acquisition process described above.

## **PREVIOUS MINERAL RESOURCE AND MINERAL RESERVE ESTIMATES**

A detailed description of the Mineral Resource and Mineral Reserve estimates prepared by Minmet, Gold-Ore, and Elgin was presented in previous Technical Reports by RPA (2015, 2017, and 2018) and is not reproduced here. The previous year-end estimates of Mineral Resources and Mineral Reserves were prepared by RPA for Mandalay in 2014, 2016, 2017 and 2018.

A summary of the Mineral Resource estimates for the Björkdal property as of December 31, 2018 is presented in Table 6-1. A summary of the Mineral Reserve estimates for the Björkdal property as of December 31, 2018 is presented in Table 6-2. These Mineral Resource and Mineral Reserve estimates are superseded by the current estimates contained in Sections 14 and 15, respectively, of this Technical Report. Mineral Resource and Mineral Reserve estimates completed for prior years are presented in RPA (2018) and RPA (2017).

**TABLE 6-1 MINERAL RESOURCES AT THE BJÖRKDAL MINE AND  
NORRBERGET DEPOSIT AS OF DECEMBER 31, 2018  
Mandalay Resources Corporation – Björkdal Gold Mine**

Location	Area	Tonnage (kt)	Grade (g/t Au)	Contained Au (koz)
<b>Indicated Mineral Resources</b>				
Björkdal	Open Pit	2,947	2.30	218
	Underground	7,416	2.98	711
	Stockpile	2,700	0.64	56
	Sub-total	13,063	2.36	985
Norrberget	Open Pit	144	3.29	15
<b>Total, Indicated</b>		<b>13,207</b>	<b>2.36</b>	<b>1,000</b>
<b>Inferred Mineral Resources</b>				
Björkdal	Open Pit	2,516	1.32	107
	Underground	1,922	2.63	162
	Subtotal	4,438	1.89	269
Norrberget	Open Pit	3	4.03	0.5
<b>Total, Inferred</b>		<b>4,441</b>	<b>1.89</b>	<b>270</b>

Notes:

1. Björkdal Mineral Resources are estimated using drill hole and sample data as of September 30, 2018 and depleted for production through December 31, 2018.
2. Norrberget Mineral Resources are estimated using drill hole and sample data as of September 30, 2017.
3. CIM (2014) definitions were followed for Mineral Resources.
4. Mineral Resources are inclusive of Mineral Reserves.
5. Mineral Resources are estimated using an average gold price of \$1,400/oz and an exchange rate of 9.0 SEK/US\$.
6. Bulk density is 2.74 t/m<sup>3</sup>.
7. High gold assays were capped to 30 g/t Au for the Björkdal open pit mine.
8. High gold assays for the Björkdal underground mine were capped at 60 g/t Au for the first search pass and 40 g/t Au for subsequent passes.
9. High gold assays at Norrberget were capped at 24 g/t Au.
10. Interpolation was by inverse distance cubed utilizing diamond drill, reverse circulation and chip channel samples.
11. Björkdal open pit Mineral Resources are estimated at a cut-off grade of 0.35 g/t Au and constrained by the resource pit design.
12. Björkdal underground Mineral Resources are estimated at a cut-off grade of 0.95 g/t Au.
13. A nominal two metres minimum mining width was used to interpret the Björkdal veins using diamond drill, reverse circulation, and underground chip sampling.
14. Stockpile Mineral Resources are estimated at a cut-off grade of 0.40 g/t Au and are based upon surveyed volumes supplemented by production data.
15. Mineral Resources that are not Mineral Reserves do not have demonstrated economic viability.
16. Numbers may not add due to rounding.

**TABLE 6-2 MINERAL RESERVES AT THE BJÖRKDAL MINE AND  
NORRBERGET DEPOSIT AS OF DECEMBER 31, 2018  
Mandalay Resources Corporation – Björkdal Gold Mine**

Location	Area	Tonnage (kt)	Grade (g/t Au)	Contained Au (koz)
<b>Probable Mineral Reserves</b>				
Björkdal	Open Pit	3,768	1.23	149
	Underground	4,754	2.36	360
Norrberget	Open Pit	162	2.80	15
Stockpile	Stockpile	2,700	0.64	56
<b>Total, Probable</b>		<b>11,384</b>	<b>1.58</b>	<b>580</b>

Notes:

1. Mineral Reserves are estimated using drill hole and sample data as of September 30, 2018 and depleted for production through December 31, 2018.
2. CIM (2014) definitions were followed for Mineral Reserves.
3. Open Pit Mineral Reserves are based on mine designs carried out on an updated resource model, applying a block dilution of 100% at 0.1 g/t Au for blocks above 1.0 g/t and 100% at 0.6 g/t Au for blocks between 0.4 g/t and 1.0 g/t. The application of these block dilution factors is based on historical reconciliation data. A cut-off grade of 0.4 g/t Au was applied. Open Pit Mineral Reserves for Norrberget are based on 15% dilution at zero grade and 100% extraction.
4. Underground Mineral Reserves are based on mine designs carried out on an updated resource model. Minimum mining widths of 3.5 m for stopes (after dilution) and 3.8 m for development were used. Dilution was applied by adding 0.5 m on each side of stopes as well as an additional 10% overbreak dilution. Further dilution, ranging from 10% to 100%, was added on a stope by stope basis depending on their proximity with other stopes. An overall dilution factor of 14.5% was added to development. Mining extraction was assessed at 95% for contained ounces within stopes and 100% for development. A cut-off grade of 1.00 g/t Au was applied. An incremental cut-off grade of 0.4 g/t Au was used for development material.
5. Stockpile Mineral Resources are estimated at a cut-off grade of 0.40 g/t Au and are based upon surveyed volumes supplemented by production data.
6. Mineral Reserves are estimated using an average long-term gold price of US\$1,200/oz, and an exchange rate of 9.0 SEK/US\$.
7. Tonnes and contained gold are rounded to the nearest thousand.
8. Totals may appear different from the sum of their components due to rounding.

## PAST PRODUCTION

### BJÖRKDAL

Table 6-3 shows Björkdal's annual gold production since 1988.

**TABLE 6-3 BJÖRKDAL ANNUAL GOLD PRODUCTION (1988-2019)**  
Mandalay Resources Corporation – Björkdal Gold Mine

Year	Production (kt)	Feed Grade (Au g/t)	Recovery (%)	Gold Production (oz)
1988	148	2.29	89.1	9,683
1989	475	2.86	90.9	39,727
1990	613	2.56	89.9	45,350
1991	765	2.64	89.8	58,270
1992	872	2.94	89.9	74,133
1993	840	3.33	90.7	81,549
1994	877	2.62	92.0	67,980
1995	1,157	2.11	90.0	70,646
1996	1,276	2.31	91.0	86,210
1997	1,288	2.49	89.6	92,416
1998	1,317	1.77	89.7	67,227
1999	635	1.50	89.8	27,500
2000	-	-	-	-
2001	303	1.09	84.1	8,922
2002	1,190	1.02	86.4	33,723
2003	1,198	1.30	86.4	43,274
2004	1,194	0.94	85.0	30,665
2005	1,197	0.68	84.7	22,172
2006	1,210	0.61	86.8	20,591
2007	1,109	0.63	85.5	19,214
2008	1,170	0.89	87.5	29,288
2009	1,064	1.24	88.4	37,568
2010	1,155	1.23	89.0	40,729
2011	1,215	1.17	88.6	40,358
2012	1,385	1.20	87.8	46,808
2013	1,261	1.32	87.8	46,941
2014	1,318	1.24	88.2	46,292
2015	1,303	1.22	88.1	44,920
2016	1,289	1.35	87.9	49,140
2017	1,262	1.75	89.1	63,186
2018	1,249	1.29	90.0	46,662
2019	1,289	1.43	88.8	52,514
<b>Total</b>	<b>32,624</b>	<b>1.65</b>	<b>88.5</b>	<b>1,443,658</b>

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## **NORRBERGET**

There has been no production from the Norrberget deposit.



## 7 GEOLOGICAL SETTING AND MINERALIZATION

The following discussion and figures were provided by Mr. Samuel Miller, Mandalay, Björkdalsgruvan Senior Exploration Geologist.

### REGIONAL GEOLOGY

The Skellefteå region consists of Paleoproterozoic-aged rocks that host several world-class volcanogenic massive sulphide (VMS) copper, zinc, and lead deposits that have been worked for nearly a century. The Skellefteå district lies within a large and ancient cratonic block named the Fennoscandian shield. The Fennoscandian shield spans much of Finland and northwestern Russia, extending further westward throughout Sweden and Norway.

Mineralization in the Skellefteå region is focused within and around a regionally extensive, west to northwest trending structural feature named the Skellefteå belt (Figure 7-1). The Skellefteå belt is 120 km long and 30 km wide and consists of deformed and metamorphosed volcanic, sedimentary, and igneous rocks that are all Paleoproterozoic in age. Deformation and metamorphism is attributed to the Paleoproterozoic-aged Svecokarelian orogeny that occurred around 1.88-1.8 Ga. Metamorphism associated with the Svecokarelian orogeny ranges in intensity from greenschist to amphibolite facies.

### REGIONAL STRATIGRAPHY

The stratigraphy of the Skellefteå area consists of Paleoproterozoic-aged volcanic, volcanoclastic, and sedimentary rocks. The stratigraphy is divided into two large lithostratigraphic groupings that are named the Skellefte Group (lower division) and the Vargfors Group (upper division) as defined by Allen et al. (1996). The Skellefte Group is dominated by extrusive volcanic successions that are interbedded/intercalated on a large scale with clastic sediments, with volcanic rock-types within the Skellefte Group classified as rhyolite, dacite, andesite, and basalt rock-types. Sedimentary lithologies consist of black coloured pyritic mudstone and shale, volcanoclastic rocks, breccia conglomerates, and minor carbonates.

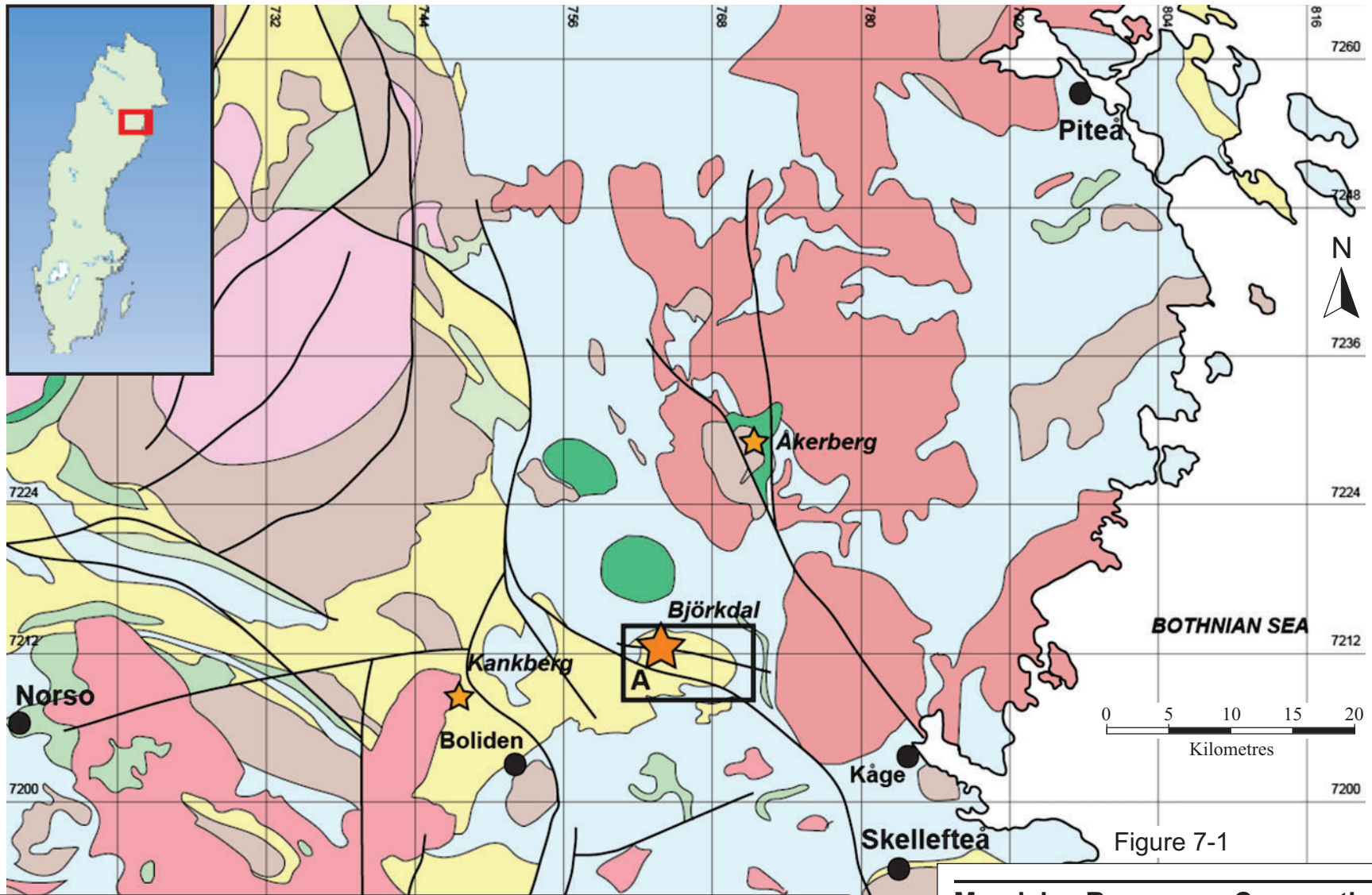


Figure 7-1

**Legend:**

Skellefte Group Mafic - Intermediate Volcanic Succession	Gabbro Intrusions (Early Sveco-karelian Age)	Granitic-Monzonite Intrusions (Late Sveco-karelian Age)
Vargfors Group Intermediate - Felsic Volcanic And Sedimentary Succession	Granodiorite-Tonalite Intrusions (Early Sveco-karelian Age)	Regional Shear Fault Zones
Vargfors Group Mafic Volcanic Succession	Granite Intrusions (Late Sveco-karelian Age)	Significant "Low-Sulphide" Gold Deposits

**Mandalay Resources Corporation**

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**Björkdal Gold Mine**  
Västerbotten, Sweden

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**Regional Geology**

The overlying Vargfors Group is dominated by clastic sedimentary rocks with lesser mudstone and carbonates, sporadically interbedded with thin volcanic successions. The lower portions of the Vargfors Group consist of abundant conglomerate and sedimentary breccia. Locally, rare carbonate beds are observed interbedded within these conglomerates, while the finer-grained siliciclastics may contain a carbonate-rich matrix (Allen et al., 1997). Total stratigraphic thickness of the entire Skellefte and Vargfors groups is in the order of seven kilometres (three and four kilometres respectively; Allen et al., 1996).

The stratigraphic successions are locally intruded by igneous rocks thought to belong to the Jörn granitoid suite. Relative ages of these intrusive bodies are constrained through radiometric dating and field relationships indicate a contemporaneous emplacement age with the volcanic rocks belonging to the Skellefte Group, with lithic intrusive clasts found within the overlying Vargfors Group (Lundberg, 1980; Claesson, 1985; Wilson et al., 1987). Compositions of these intrusive rocks of the Jörn granitoid suite range considerably from felsic to mafic with end-member compositions respectively represented by gabbros and granites.

## **REGIONAL STRUCTURE**

The rocks of the Skellefteå belt are observed to have undergone two major shortening events and metamorphism during the Svecokarelian orogeny. The first of the major shortening events resulted in folding and shearing; folding consists of vertical to upright isoclinal folds with east to northeast striking axial planes, while shear zones are oriented sub-parallel to the axial planes of the folds. The later shortening event produced structures mainly dominated by shearing, with only minor folding coaxially overprinting the earlier generation of folding (Weiher et al., 2003).

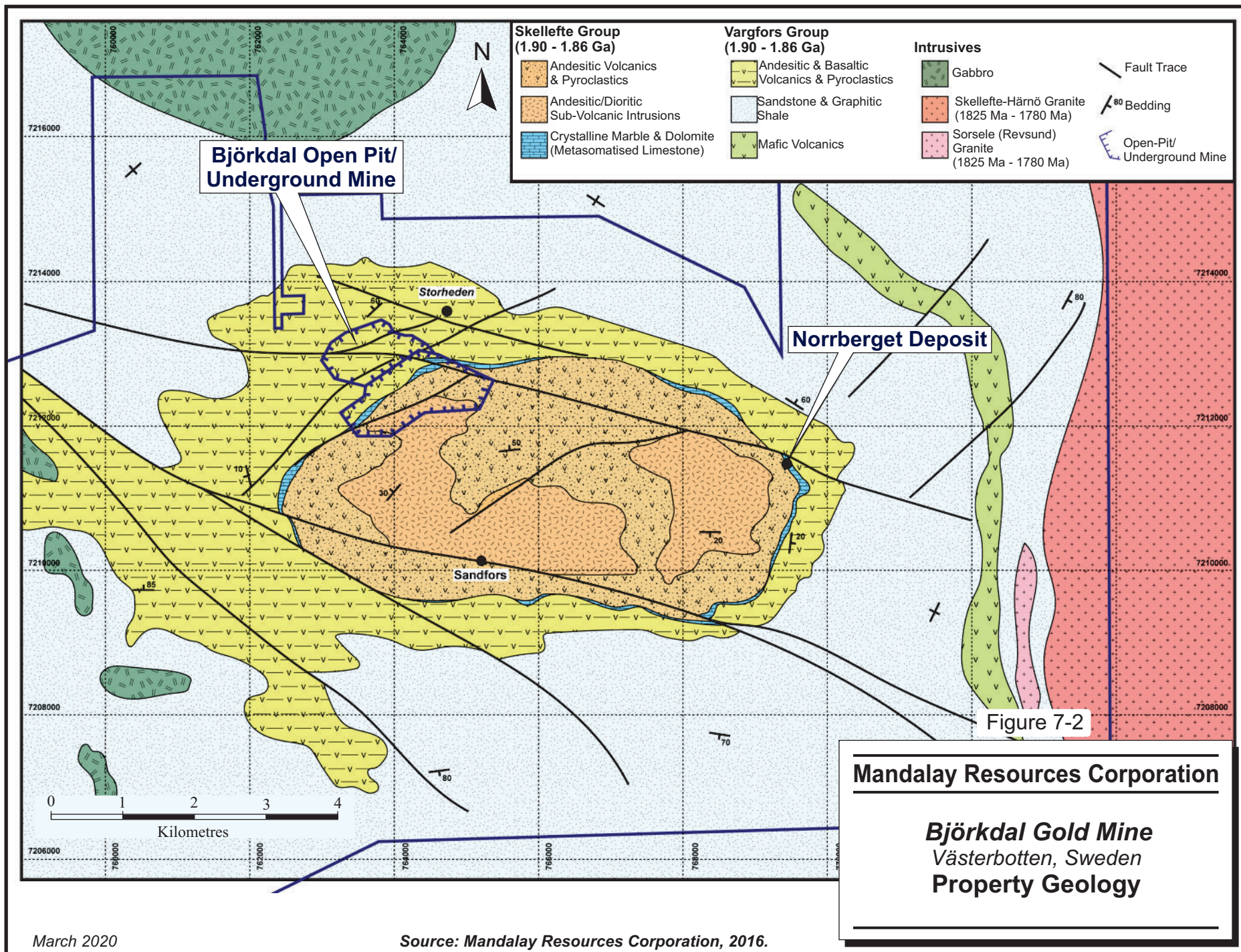
## **PROJECT GEOLOGY**

Existing literature on the geological setting of the Björkdal gold deposit describes auriferous veins hosted within the outer margin of a large quartz-monzodiorite or tonalitic intrusion that is surrounded by supra-crustal rocks. The contact between the intrusion and surrounding rocks is represented by a “major thrust duplex”, which also serves to truncate the mineralized vein-system (Bergström and Weiher in Kathol and Weiher, 2005, and references within). Radiometric dating of zircons extracted from the Björkdal host rocks (Lundström and Anthal, 2000) return ages of 1,905 Ma (although many zircon forming events are apparently observed) that are considered to represent the emplacement age of the intrusion. The oldest intrusive

rocks within the Skellefteå district are the Jörn granitoids which are documented to post-date the Björkdal intrusive rocks dating between 1,890 and 1,870 Ma (Kathol et al., in Kathol and Weihed, 2005). The 1,905 Ma emplacement age corresponds to the reported depositional age of the Bothnian Basin sediments in which the Björkdal intrusion is hosted (Claesson and Lundqvist, 1995). Therefore, the formational interpretations of geological features in the Björkdal area (such as Björkdal dome) do not really align well with the regional chronological framework presented in literature. The property-scale geological setting is presented in Figure 7-2.

## LOCAL GEOLOGY

As a result of detailed litho-stratigraphic mapping, petrological observations, and geochemical analysis undertaken by Mandalay/Björkdalsgruvan geologists have observed that host rock geology, metamorphism, and alteration styles are much more complex and variable than previously documented. Instead of a large, massive plutonic-type intermediate intrusion occupying the domal structure observed within the Björkdal area, a variable and complex alteration signature overprints many different rock-types including pyroclastic, volcano-sedimentary, tuffaceous, extrusive-volcanic (andesitic to basaltic compositions), sub-volcanic intrusive (andesitic compositions), and sedimentary (silici-clastics, shales and carbonates) lithologies. Common alteration and metasomatic styles include silicification, carbonatization, calc-silicate (actinolite) alteration, albitization, chloritization, potassic (biotite and K-feldspar), epidotization, pyritization, tourmalinization, with various skarn-type alteration assemblages common in areas where a calcareous host rock is present (including actinolite, tremolite, pyroxene, and minor garnet). While alteration and metasomatic zonation of these various styles is present, the spatial distribution has not clearly been defined. A major control on the alteration zonation appears to be host rock lithology (protolith composition) and proximity to major fluid driven heat sources (i.e., hydrothermal systems).



**Mandalay Resources Corporation**

**Björkdal Gold Mine**  
 Västerbotten, Sweden  
 Property Geology

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## LOCAL STRATIGRAPHY

A litho-stratigraphic column of geologic units observed in the Björkdal area is presented in Figure 7-3. The lowest succession found at the Mine and in the surrounding area consists of a unit of volcanoclastic sandstones and conglomerates, interbedded with lavas, ignimbrites, tuffs, bedded sandstone, and mudstone/shales. A large sub-volcanic intrusion (interpreted as an andesitic laccolith) locally intrudes this volcanic succession in the south and southwestern margins of the current open pit, but has not yet been encountered elsewhere within the Mine area.

A massive unit of crystalline marble sharply overlies these lower volcanic and clastic units. Overlying the crystalline marble is a thin pyroclastic unit (characterized by abundant “fiamme” clasts), which is then abruptly overlain by a basaltic lava containing abundant amygdaloids (defined by actinolite and carbonate in-fill). Above this basalt, the stratigraphy appears to become increasingly marine in genesis, with the overlying units consisting of laminated and interbedded tuffs and mudstone (basaltic geochemical composition), finely laminated mudstones and siltstone, and poorly sorted sandstone. Gradationally overlying these clastic sediments is a monotonous series of graphitic and pyritic shale (pyrite is often altered to pyrrhotite), interbedded with poorly sorted siltstone and sandstone with minor coarse-sand/grit beds. Partial Bouma sequences are observed within the more clastic intervals of this upper shale succession.

The local stratigraphy at the Mine is related with the upper and lower portions of the Skellefte and Vargfors groups, respectively (as defined in Allen et al., 1997). The units present below the upper contact of the crystalline marble are interpreted to correlate with the upper portions of the Skellefte Group. These carbonate units are interpreted to represent the eastward, deeper-water, lateral-equivalent of Kautsky’s (1957) “Menstäsk conglomerate”, described as consisting of lime-cemented marine conglomerate and sedimentary breccia. As such, the upper contact of this calcareous unit is here defined as an approximate stratigraphic position of the Skellefte-Vargfors Group boundary.

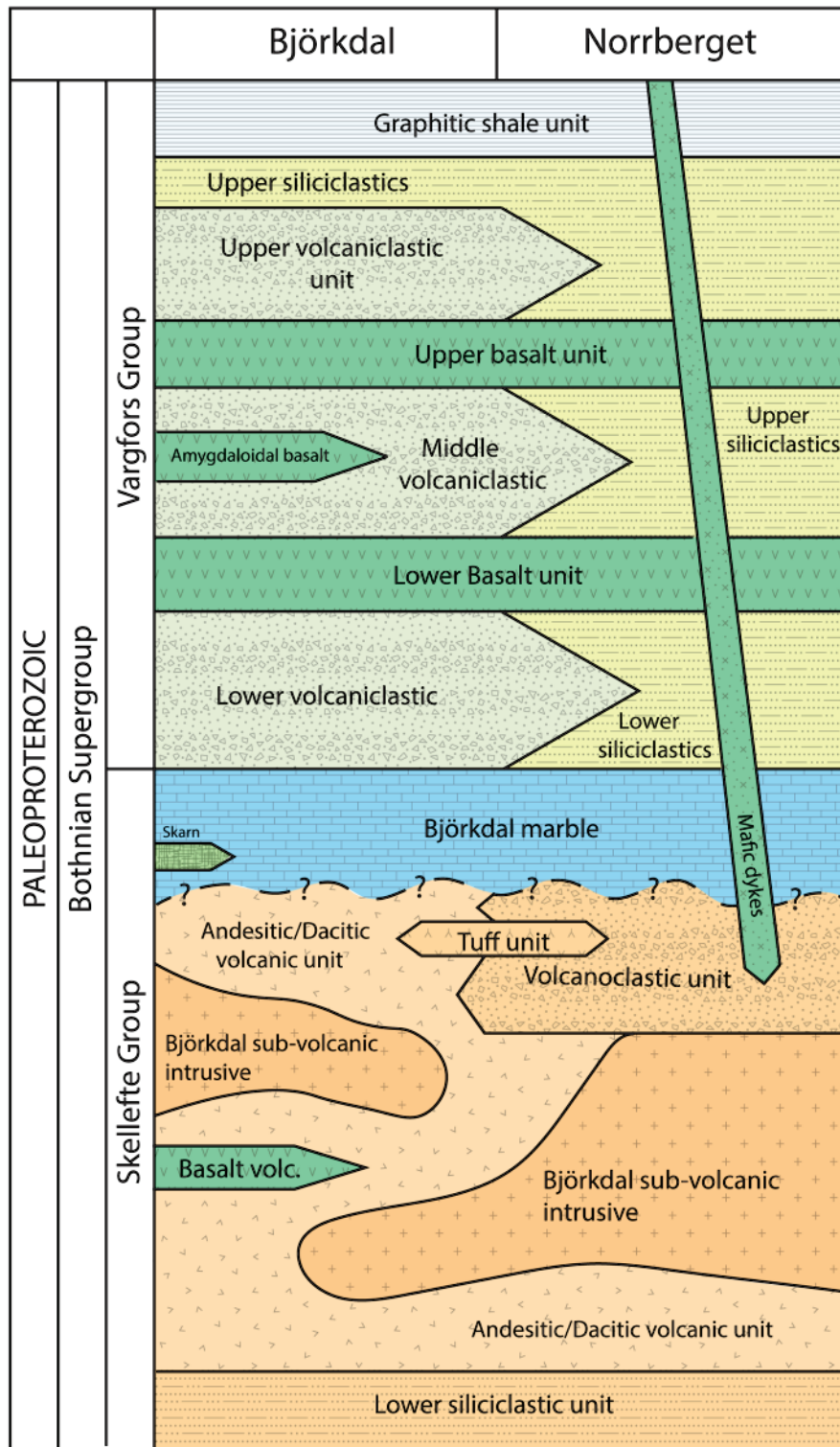


Figure 7-3

**Mandalay Resources Corporation**

***Björkdal Gold Mine***  
*Västerbotten, Sweden*  
**Björkdal Stratigraphy**

## LOCAL STRUCTURE

The local structure of the Björkdal deposit is dominated by a number of shallow, north to northeast-dipping brittle-ductile faults and shears. The dominant structure, which can be traced along the full length of the Mine, is referred to as the Björkdal shear (Figure 7-4). The majority of the kinematic indicators identified along these structures appear to be dominantly oblique strike slip. The brittle structures consist of fault-gouge that has undergone sporadic rehealing and “cementation” by carbonate, silica, and sericite. Brittle-ductile structures consist of highly-sheared fabrics and/or rotated and boudinaged quartz veins (Figure 7-5) that may include masses of very mildly foliated biotite. This latter set of structures are sometimes significantly mineralized in gold in economic quantities. The relationship between mineralized quartz veins and the structures appears to be complex, with a number of cross cutting relationships, suggesting multiple phases of deformation throughout the emplacement of the mineralization.

**FIGURE 7-4 STEREONET PLOTS (POLES TO PLANES) OF SHEARS AND BRITTLE FAULTS**

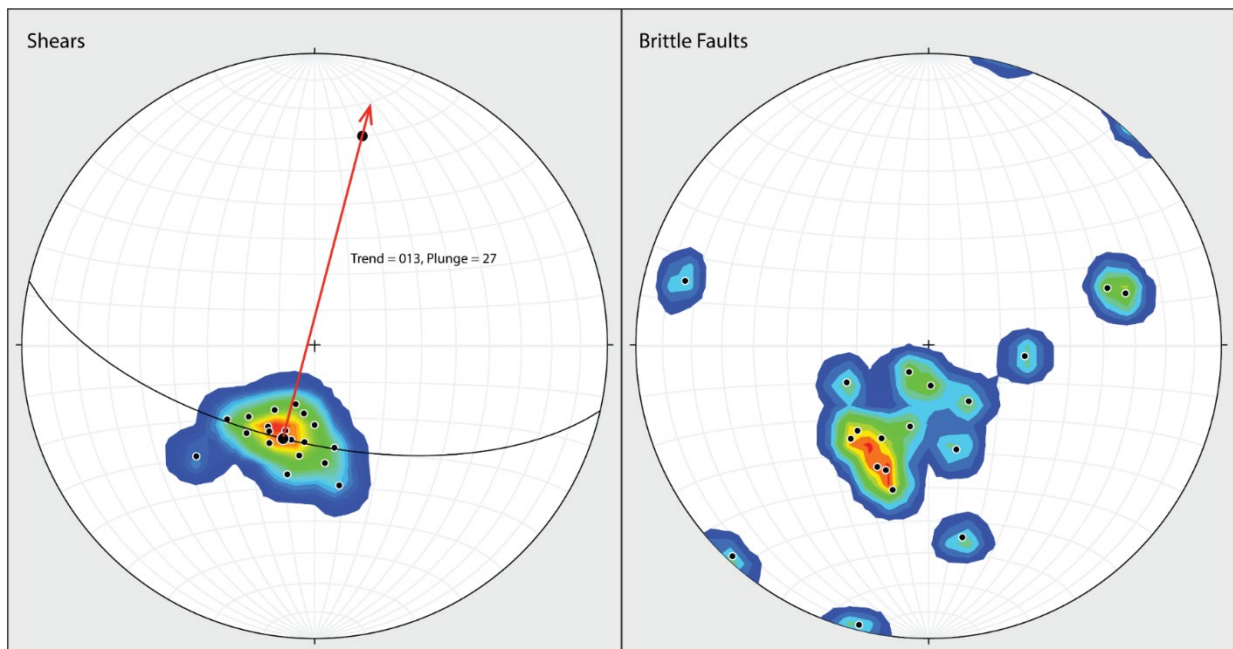






Figure 7-5

**Mandalay Resources Corporation**

***Björkdal Gold Mine***  
*Västerbotten, Sweden*  
**Shear Hosted Mineralization**

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## MINERALIZATION

### BJÖRKDAL GOLD MINERALIZATION

The Björkdal gold deposit is a lode-style, sheeted vein deposit hosted within the upper portions of the Skellefte Group sediments. Gold is found within quartz veins that range in thickness from less than a centimetre to over several decimetres. These veins are usually observed as vertical to sub-vertical dipping veins that strike between azimuth 000° and azimuth 090°, with the majority of veins striking between azimuth 030° and 060°. The veining is locally structurally complex, with many cross-veining features observed and thin mineralized quartz veinlets in the wall rocks proximal to the main quartz veins (Figure 7-6).

Gold-rich quartz veins are most often associated with the presence of minor quantities of sulphide minerals such as pyrite, pyrrhotite, marcasite, and chalcopyrite alongside more common non-sulphide minerals such as actinolite, tourmaline, and biotite. Scheelite and bismuth-telluride compounds (i.e., tellurobismuthite and tsumoite) are also commonly found within the gold-rich quartz veins and are both excellent indicators of gold mineralization.

Gold occurs dominantly as free gold, however, gold mineralization is also associated with bi-telluride, electrum, and pyroxenes. Silver is seen as a minor by-product of the Björkdal processing plant, however, very little is known about its deportment within the deposit, although it is assumed to be associated with electrum.

### BJÖRKDAL SKARN MINERALIZATION

Skarnification occurs commonly within the Björkdal Mine, especially in the limestone/marble unit as discreet patches and lenses. However, similar calc-silicate alteration has taken place in areas where local shearing has affected the volcanoclastic host rock. The altered rock texture appears sheared and mottled to a varying degree; locally the rock can have a folded appearance. In places where the skarnification is the strongest, the precursor rock texture has been completely overprinted. The skarnified rock has been divided to prograde and retrograde phases based on their dominant mineralogy. Prograde skarn is light green and is dominated by clinopyroxene patching with partial to complete breakdown of the pyroxene patches to amphiboles (actinolite/tremolite), chlorite, calcite, and, to minor degree, serpentine and talc. The retrograde skarn is finer grained and darker green in colour than the prograde skarn and consists primarily of amphiboles, chlorite, and calcite (Figure 7-7). It is likely that the retrograde skarn represents patches of alteration where the calc-silicification did not progress as far as it

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did in the prograde skarn. The limestone can also be dolomitic and silicified as well as containing irregular quartz patches, quartz veins, and overprinting calcite veins.

Shearing is a known mechanism of skarnification. The skarnification here is most likely due to fluid influx where shears and faults interacted with the limestone/marble unit or calcite banded volcanoclastic rocks. The limestone/marble unit is predisposed to accommodate strain and be exploited by structures (both large and smaller scale) due to the rheological difference between the limestone/marble and the surrounding volcanic and volcanoclastic rocks. It is more ductile, prone to folding on varying scales and the calcium carbonate is reactive enough to interact with infiltrating fluids and more importantly, provide calcium for the calc-silicification. The large scale structures function as channels for the fluids that alter the host rocks in the Björkdal area. Where the Björkdal shear or its smaller conjugate faults intersect with the limestone/marble unit, the retrograde skarnification and low grade gold mineralization can occur (Figure 7-8). Where two or more structures interact with each other and the limestone/marble unit, the skarnified lenses consist of prograde skarn and carry higher grades (Lake Zone north skarn lens).



Figure 7-6

**Mandalay Resources Corporation**

***Björkdal Gold Mine***  
*Västerbotten, Sweden*  
**Complex Veining Styles  
Observed Underground**

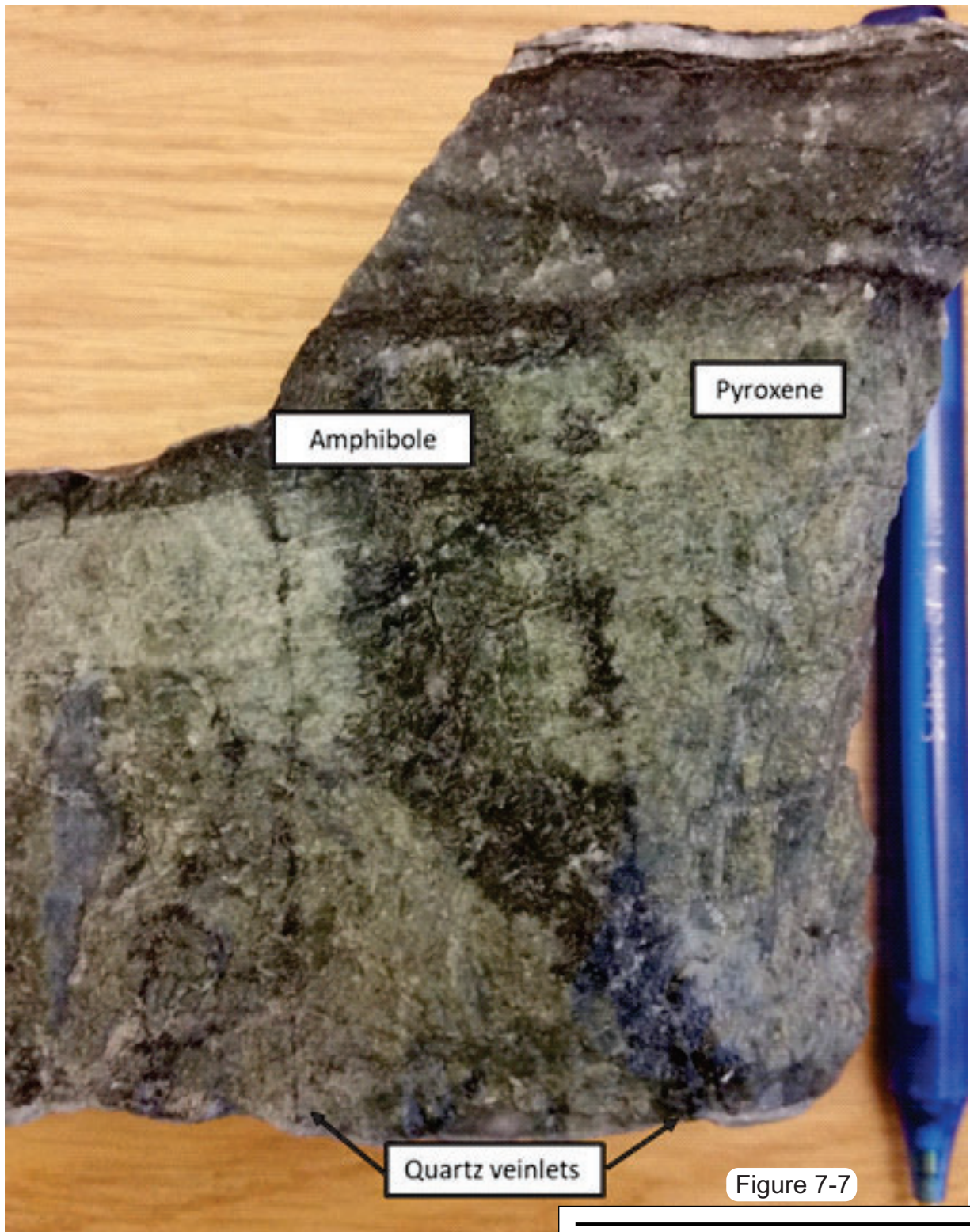


Figure 7-7

**Mandalay Resources Corporation**

***Björkdal Gold Mine***

*Västerbotten, Sweden*

**Example of Retrograde  
Alteration of Lake Zone Skarn**

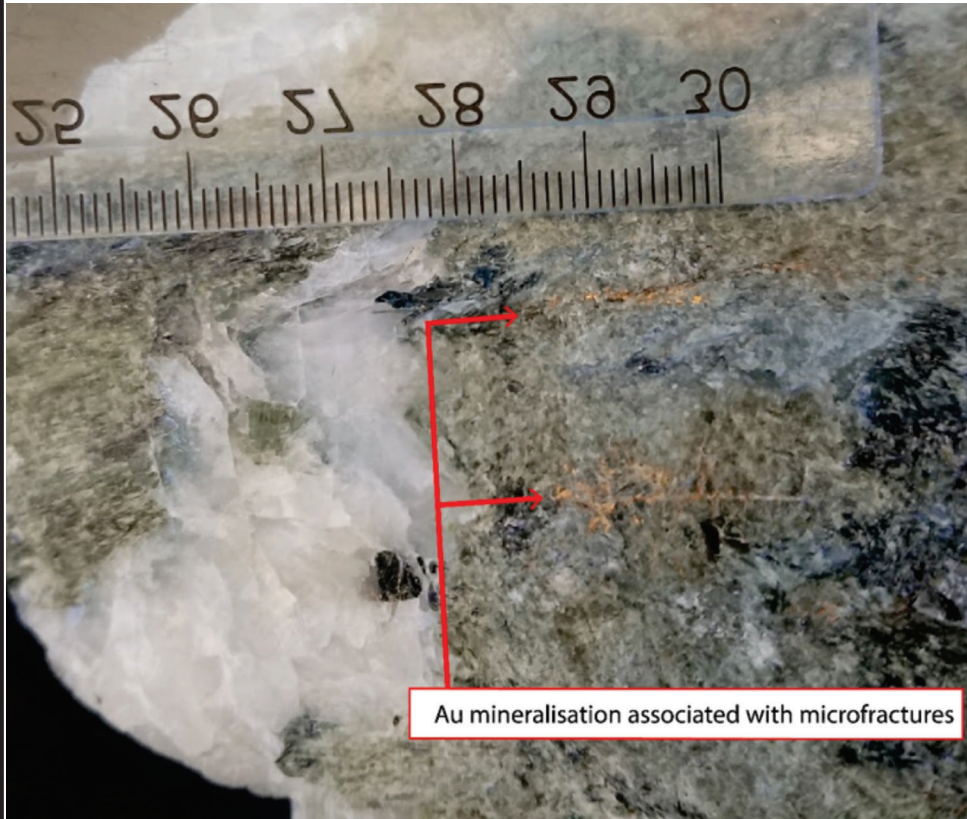


Figure 7-8

**Mandalay Resources Corporation**

***Björkdal Gold Mine***

*Västerbotten, Sweden*

**Example of Skarn-Hosted  
Gold Mineralization**

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## **NORRBERGET**

The primary mineralization at Norrberget is observed to be associated with amphibole alteration bands and veinlets, and where mafic tuffs and volcanoclastic rocks are interbedded, contrary to what is observed at Björkdal (Figure 7-9). The mineralization is preferentially emplaced where there is a structural change to the rock such as at lithological contacts, altered bands and where shearing interacts with the interbedded sequences, due to the changing in the rheological characteristics of the unit. Zones where pyrrhotite and pyrite occur and are absent appear to be lithological controlled within the volcanoclastic package which can indicate a differing redox based upon temperature change and fluid evolution.

The mineralization at Norrberget is limited to 50 m stratigraphically below the lower marble contact, which is believed to be a result of the cooling and redox changes of the fluid as it passes through the units.

The gold is very fine grained and rarely visible. Where gold grains have been observed, they are found to be on the boundary or in the interstitial material between grains. High grade gold is mostly found in areas with low to no pyrite.



7-16

Figure 7-9

**Mandalay Resources Corporation**

***Björkdal Gold Mine***  
*Västerbotten, Sweden*  
**Norrberget Mineralization**



## 8 DEPOSIT TYPES

### BJÖRKDAL

The most striking feature of the Björkdal Au system is the anastomosing, sheeted quartz-vein network in which the majority of gold is hosted. This epigenetic vein network appears structurally controlled, consisting of more than a thousand sub-parallel quartz veins (typically striking 030° to 090° from true-north). Such strong structural-geological influences over geometry of any quartz vein hosted mineralization clearly suggest a strong spatial and temporal relationship with orogenic/tectonic processes (i.e., mesothermal/greenstone gold systems). However, the mineralogical associations with gold mineralization, and the larger alteration signature of the Björkdal area, could also suggest that alternative depositional mechanisms are responsible for the mineralization at Björkdal as there are some similarities with skarn and/or porphyry systems.

#### STRUCTURAL DEVELOPMENT OF MINERALIZATION

The relationship between mineralized veins and the local structures appears complex; various cross cutting relationships are observed in the Mine suggesting multiple phases of deformation throughout the emplacement of the mineralization. A total of 25 major, north to northeast (true) dipping, strike-slip shears have been identified within the Björkdal deposit, with numerous, localized systems observed throughout (Figure 8-1). The majority of the significant gold grades observed within the deposit is hosted proximal (approximately 30 m) to the shear zones. A cross sectional view is presented in Figure 14-4.

The most significant structure within the deposit is the Björkdal shear, which can be traced along the full length of the Mine and appears to be part of the larger, regional structural network. The shear is sigmoidal in nature and is observed to “kink” towards the north, allowing for the formation of a high density fracture horizon above the marble unit. This kinematic evolution, along the strike length of the shear, has caused the relationship to the mineralization to change. In the southern region of the Mine, the shear represents the hangingwall of the mineralization, whereas in the north, the shear represents the footwall of the mineralization.

A detailed kinematic study within the deposit suggests that the smaller, more localized structures are second order structures to the Björkdal shear.

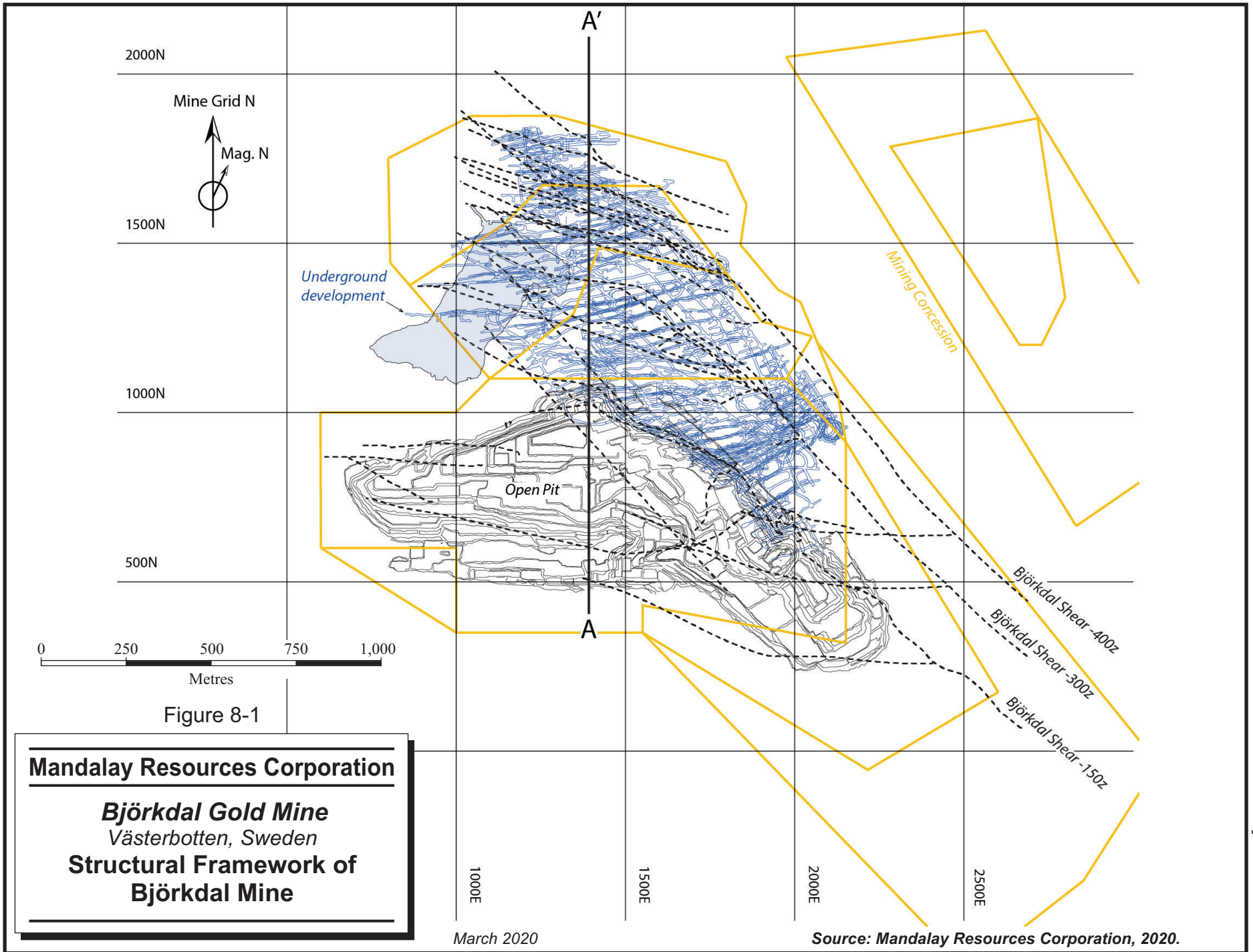


Figure 8-1

**Mandalay Resources Corporation**

***Björkdal Gold Mine***  
*Västerbotten, Sweden*  
**Structural Framework of Björkdal Mine**

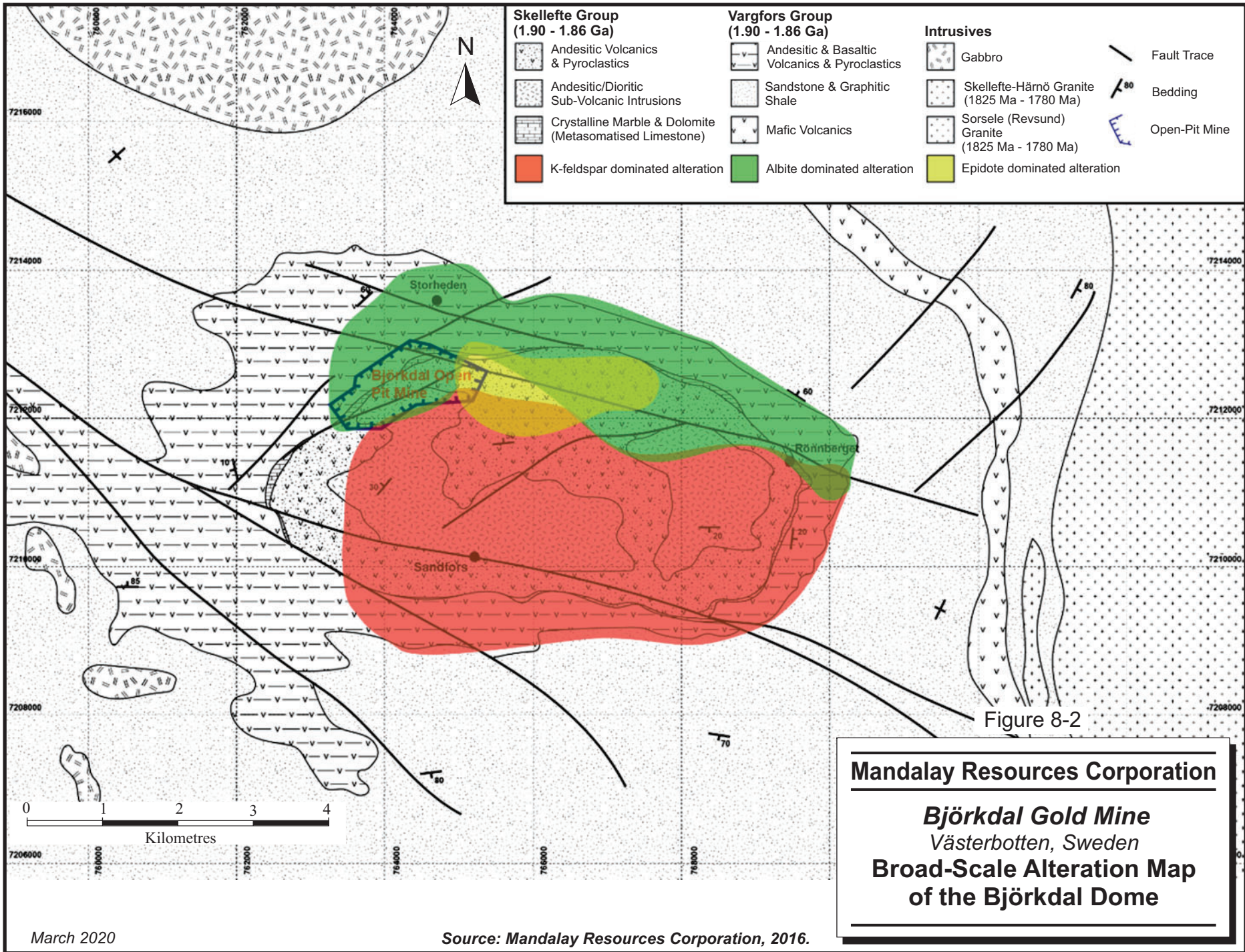
March 2020

Source: Mandalay Resources Corporation, 2020.

Veins of the Björkdal system can generally be described as sub-vertical in dip and generally strike between 020° and 090° from true north. A minor set of veins occur that are also sub-vertical dipping, but strike in a 330° from true north orientation. All veins sets appear to carry gold mineralization to various extents, with higher grades occurring where veins of different orientations intersect one another. Slip-orientation of slickenside lineations in vein walls (030° to 090° vein set) indicate strike-slip movement, with both sinistral and dextral features present within a single vein.

## **ALTERATION**

Alteration assemblages at Björkdal are varied and complex with both regional and local scale alteration systems observed. The regional-scale alteration can be loosely defined in terms of certain key minerals such as albite, epidote, and k-feldspar. While silica, carbonate, actinolite, chlorite, and biotite are often more abundant than albite, epidote, and k-feldspar, they are very widespread and too common to be used to define any clear spatial zonation. As such, alteration zonation around the Björkdal structural dome can be generally described as follows: the southern portions are dominated by significant K-feldspar assemblages, the northern portion is dominated by albite, and part of the central to north-central portion of the dome contains noticeable amounts of epidote (Figure 8-2). The genetic and chronological relationships between the gold mineralization and alteration are unclear, however, known gold mineralization has much more intensive associated silicification, particularly in areas of faulting and shearing, suggesting a close relationship between alteration intensity and gold mineralization.



**Mandalay Resources Corporation**

*Björkdal Gold Mine*  
Västerbotten, Sweden

**Broad-Scale Alteration Map of the Björkdal Dome**

Alteration at Björkdal typically consists of silicification and albitization of the wall rock that extend up to one metre from the vein walls. Areas of intense silicification and albitization are observed to have completely recrystallized the wall rock in some cases. Disseminated actinolite, chlorite, sericite, and pyrite, with rarer occurrences of epidote, pyroxene, garnet, and sphene occur within these vein wall alteration halos.

In areas of the Mine where the most intense alteration is in contact with the Björkdal marble unit, strong skarnification occurs. This skarnified marble unit consists of silica, chlorite, amphibole, actinolite, hornblende, pyroxene, and clinopyroxene. Gold mineralization in these areas is related with silica-pyrrhotite-actinolite clotted disseminations of 1 cm to 2 cm diameters.

## **MINERALOGY**

The main type of mineralization found in the Björkdal gold system is dominated by vertical to sub-vertical dipping quartz-filled veins. Common accessory minerals contained within these veins are (in approximate order of occurrence): tourmaline, calcite, biotite, pyrite, pyrrhotite, actinolite, scheelite, chalcopyrite, bismuth-tellurides (pilsenite and tsumoite), gold, and electrum. Gold mineralization is most closely related to the bismuth-telluride minerals, and is also more reliably encountered in veins with high abundances of pyrrhotite, pyrite, scheelite, and/or chalcopyrite. In general, veins of pure quartz and free of the accessory minerals listed above are generally quite poor hosts for significant quantities of gold mineralization. As such, the informal terminology of “clean veins” and “dirty veins” has been adopted at the mine site in order to quickly describe vein-fill characteristics. Structural analysis of these two distinct vein-fill types from the Main Zone -325 and -340 levels suggests that the “cleaner” veins will more often strike between 030° and 040° from true north, while the “dirty”, inclusion-rich veins are more likely to strike between 050° and 090° from true north. This structural-geochemical relationship suggests that vein development in the Björkdal deposit occurred as more than a single “vein-forming” event, and that the fluids responsible for the vein-fill and mineralization were evolving with time.

## **NORRBERGET**

### **STRUCTURAL DEVELOPMENT OF MINERALIZATION**

The major controls on the mineralization at Norrberget include the large scale shear zone that marks the base of the marble unit, the rheological differences between different stratigraphic

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units, the variation in the lithological and porosity of the volcanic package, and the development of the fluid system which utilized the shear zone.

These large scale shear zones run extensively through the area along the base of the marble unit which extends beyond the Björkdal Mine and across Norrberget. The mineralization occurs principally within a package of heterogeneous volcanoclastics containing interbedded ash falls, flows, and tuffs which have varying composition along with differing porosity and rheological characteristics.

Where the Norrberget volcanoclastics are not sheared, they are packaged conformably between metasedimentary rocks and mafic volcanic rocks above and medium grained subvolcanic intrusions and volcanic rocks below.

## **ALTERATION**

The fluid system is believed to have utilized the shear contact at the base of the marble. A strongly silicified unit sits on top of the volcanoclastics which themselves are sheared throughout with a pervasive amphibole-albite-silica+carbonate alteration assemblage. The contact between the silicified and amphibole altered packages is gradual over a short distance. Lower in the package, K-feldspar/hematite and epidote can be observed, however, the underlying volcanic/subvolcanic rocks are not sheared to the same extent.

The evolution of the fluid system is believed to have first formed a pervasive silica-biotite+actinolite alteration which took advantage of the porous groundmass of the unaltered volcanoclastic package. The variable grain size and large angular fragments observed in drill core of the units below the lower marble contact resulted in a higher porosity and therefore a more substantial level of silicification. When additional shearing along with albite and actinolite alteration fluids were present at a later stage, the more robust silicified units were subjected to less shearing and alteration. This later stage of actinolite and albite alteration (where gold forms along their contacts) occurred primarily within the upper package of interbedded volcanoclastic rocks and crystalline tuffs, which is immediately below the upper pervasively silicified unit. The steeper quartz-amphibole veins, some of which contain gold and associated minerals, utilized the same association as the mineralized altered bands.

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## VEINING

Although not as prevalent as at Björkdal, quartz veining occurs across Norrberget. A significant proportion of the veins occur in a similar orientation to the altered bands with quartz patches being associated with the alteration banding indicating that these are syngenetic to the alteration. A separate set of quartz veins can be observed to cross-cut the predominant fabric at a steeper dip between 65° and 85°, although with variable directions. A small proportion of these can be identified as being gold-bearing with a limited selection containing very high grades. The high grade veins do not appear to have similar orientation to one another. The mineralogy of these steeper veins is similar to the shallower veins indicating that they were formed in the latter stages of the same fluid system.

## MINERALIZATION

The mineralization at Norrberget is stratabound within an interbedded altered volcanoclastic package that sits unconformably below a 30 m to 40 m thick marble unit. Gold mineralization has been observed up to 50 m below this contact. Gold mineralization is principally hosted in an amphibole-albite banded alteration and is also common where volcanoclastics are interbedded with crystalline tuff units. These alteration bands vary between one centimetre and 50 cm in thickness, are typically fine to medium grained, and appear to be sheared. Trace sulphides and minor quartz/carbonate are associated with the bands.

Gold is also associated with the amphibole veinlets with the mafic crystalline tuff associated with carbonate and minor sulphides. Lesser amounts of gold can also be found within the heavily silicified volcanoclastics where minor amphibole is observed. Where visible gold can be identified within alteration banding, it is observed to be between or on the contact of grains.

Although veining is common, gold mineralization is rarely associated with the quartz veins. Visible gold has been identified in veins consisting of grey fractured quartz along with amphibole, carbonate, silver, minor chalcopyrite, pyrrhotite, and galena. Veins consisting of quartz, carbonate, and albite with euhedral amphibole crystals can also carry gold mineralization, however, the gold grade is not consistent along them. These veins can be intermixed and individual veins can continue for up to 50 m.

## 9 EXPLORATION

### BJÖRKDAL

RPA reviewed the historical exploration work and found that pre-Mandalay work programs were not well documented. In general, it would appear that no significant regional exploration had taken place since the original Terra Mining ownership (ca. 1983-1999). Since acquiring ownership, Mandalay has conducted both underground and surface diamond-core and reverse circulation (RC) drilling, both within and near the active production areas, in addition to regional prospects.

Geophysical studies have also been carried out in order to identify the “geophysical fingerprint” of Björkdal-style mineralization with the ultimate aim of developing exploration targets beneath the significant till cover that blankets the majority of the Björkdal property. Geological mapping has also been conducted on the limited surface exposure of bedrock over the property, in addition to compiling and assessing all known and relevant documentation and results from various exploration efforts by several past owners of the Mine and the surrounding exploration permits held by Mandalay through Björkdalsgruvan (and its subsidiary, Björkdal Exploration).

During the summer of 2019, an airborne magnetic survey was completed by Thomson Aviation over the full tenement package in collaboration with Boliden AB. Björkdalsgruvan received the raw data from the flyover and Geovista AB processed the results. Raw data consisted of a digital terrain model, levelled radiometric data, and levelled magnetic data. The survey direction was east-west with 50 m line spacing and 500 m tie line spacing. It has been established that areas of significant mineralization have detectable effects on both magnetic (ground magnetics) and electrical (chargeability) properties of the host geology. As such, these surveys are being incorporated with geochemical and structural geological data with the objective to identify highly prospective ground. The targets that have been generated will be prioritized and then systematically tested in the immediate future.

### UNDERGROUND DRILLING

For the period of January 2015 to September 2019, Mandalay completed a total of approximately 131,600 m of diamond-core drilling from underground stations at the Björkdal Mine. Prior to the discovery of the Aurora Zone, the drilling focussed mainly on outlining the



strike and dip extensions of known mineralized vein systems (mostly in the Main, Central, and Lake zones).

In 2019, the drilling focussed on searching for the strike and dip limits of the Aurora Zone discovered in 2017, as well as defining the limits of the high grade skarn-hosted mineralization discovered in 2018. The drilling also focussed on the area to the north of the known mineralized zones, with the goal of searching for new vein systems that may lie proximal to the underground mine. These drilling programs have been successful in achieving their goals.

## **SURFACE DRILLING**

For the period of January 2015 to September 2019, Mandalay has drilled a total of approximately 21,500 m of exploration diamond-core drilling and 100,100 m of exploration RC drilling from surface-based setups at the Björkdal Mine. Similar to the underground exploration strategy, the surface drilling was prioritized around the margins of the current open pit mine in order to estimate Inferred and Indicated Mineral Resources in the near-mine environment and for grade control purposes. The majority of this drilling took place in the vicinity of the Quartz-Mountain, East Pit, and Nylund areas.

## **NORRBERGET**

The Norrberget area was extensively drilled from 1994 to 1996 by COGEMA before interest in the prospect declined under subsequent owners. After the area was purchased by Gold-Ore in 2007, some sporadic drilling campaigns were undertaken without significant discovery.

After Mandalay acquired Elgin, a program of relogging and reassaying the existing core from the prospect was undertaken. This resulted in renewed interest in the area and in 2016, a 2,542 m diamond-core drilling program confirmed the historical results and extended the limits of mineralization. A 1,400 m RC drill program in-filled and further extended the resource down-dip in 2017. No exploration drilling was carried out in 2018 or 2019.

## **REGIONAL EXPLORATION**

During the summer months of 2015, 2,492 m of diamond-core drilling was completed around the greater Björkdal region in order to test a number of geochemical and structural targets.

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Significant mineralization was intersected in two drill holes, DDE2015-001 and DDE2015-008, in the Storheden and Morbacken areas respectively.

The potential of Storheden area was further tested with 2,136 m of diamond-core drilling and 1,408 m of RC in 2016 and 2017. These drilling programs have confirmed the existence of a mineralized system of shear hosted quartz veins extending below the current site of the TMF.

Target generation completed in 2015 and 2016 consisted of geophysical surveys and reinterpretation of existing geophysical magnetic and electric surveys. These surveys ranged from regional scale airborne surveys to high resolution downhole electric logging and had the objective to establish some geophysical characteristics indicative of mineralized rock systems in the greater Björkdal exploration land package. It has been established that areas of significant mineralization have detectable effects on both magnetic (ground magnetics) and electrical (chargeability) properties of the host geology. As such, these surveys are being incorporated with geochemical and structural geological data with the objective to identify highly prospective ground. The targets that have been generated will be prioritized and then systematically tested in the immediate future.

In 2017, ground magnetic surveys and till sampling programs were expanded across high potential areas within the tenement package. High resolution outcrop mapping and sampling was also carried out to further develop the macro-scale understanding of the property's potential.

In 2018, two small scale (~5 km<sup>2</sup>) ground magnetic surveys were carried out in highly prospective areas within the tenement package. Outcrop mapping and sampling was also carried out in the northern region of the tenement package in order to build upon the continuously growing regional geological model.

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## EXPLORATION POTENTIAL

In RPA's opinion, the geological setting and terrains of the Björkdal area present excellent exploration potential, as a number of targets have already been identified within a five kilometre radius of the mining operation. The deposit models currently being formulated and tested by Mandalay geologists are proving successful, with near-mine exploration efforts being well rewarded of late. To date, the lateral limits of the Björkdal deposit have not been reached, with mineralization remaining open to the north, east, and west of the current mine.

Although the existing underground development layout is not ideally suited to target the various geometries of mineralized systems at Björkdal, the efficiency of exploration drilling is high, as several economic targets can be intersected in a single drill hole. Once potential in-mine targets are identified, suitable drill platforms should be designed that can be developed from existing and planned footwall access systems.

There is high likelihood of further discoveries being made in the Björkdal area, as much of the held ground remains either unexplored or under-explored.

# 10 DRILLING

## BJÖRKDAL

Drilling has been carried out on a periodic basis as exploration and development progressed at the Mine. The Mineral Resource drill hole database cut-off date was September 30, 2019. All holes completed before September 2014 were completed by previous owners.

### HISTORICAL DRILLING

#### **1986 TO 2004**

It is reported that during the period between 1986 and 2004, a total of 1,148 holes were completed at Björkdal (Table 10-1).

**TABLE 10-1 HISTORICAL DRILL HOLE TYPE SUMMARY - BJÖRKDAL  
Mandalay Resources Corporation – Björkdal Gold Mine**

<b>Drill Hole Type</b>	<b>Number of Drill Holes</b>
Direct Circulation	343
Diamond Drill Hole	128
Reverse Circulation	677
<b>Total</b>	<b>1,148</b>

An additional 6,110 historical direct circulation (DC) grade control holes were also drilled for mine planning purposes in the open pit. However, problems were identified with downhole sampling and grade contamination issues in these drill holes. Consequently, these holes have not been used in subsequent Mineral Resource estimates.

#### **2006 TO 2014**

In March 2006, Gold-Ore collared a portal for the Eastern Tunnel at Björkdal. The tunnel was designed to provide access for diamond drill rigs to test for the along-strike extension of the orebody mined in the open pit (northern extension). Drilling from the surface was considered a less attractive option as it required drilling through several hundred metres of country rock until the mineralized zones were intersected. The underground excavation also provided access for mapping, bulk sampling, and some feed for the processing plant.

Underground diamond drilling for exploration, development, and grade control was essentially continuously carried out from 2006 to 2014 (Table 10-2). RC drilling was initiated in the open pit in 2010 for grade control purposes.

**TABLE 10-2 SUMMARY OF DRILLING FROM 2006 TO 2014 - BJÖRKDAL**  
**Mandalay Resources Corporation – Björkdal Gold Mine**

Year	Drill Hole Type	Underground		Open Pit	
		Number of Drill Holes	Metres (m)	Number of Drill Holes	Metres (m)
2006	Core	91	7,954	-	-
2007	Core	109	10,454	19	3,303
2008	Core	40	2,577	-	-
2009	Core	43	5,892	9	469
2010	Core	30	5,112	37	2,756
	RC	-	-	76	2,978
2011	Core	52	10,271	15	1,325
	RC	-	-	127	3,862
2012	Core	48	8,490	34	4,685
	RC	-	-	258	9,904
2013	Core	42	9,178	14	1,631
	Core (In-fill)	43	2,812	-	-
	RC	-	-	317	10,006
2014	Core	43	9,218	-	-
	Core (In-fill)	23	2,308	-	-
	RC	-	-	225	6,982
	Core	14	3,864	3	622
<b>Total</b>		<b>578</b>	<b>78,130</b>	<b>1,134</b>	<b>48,523</b>

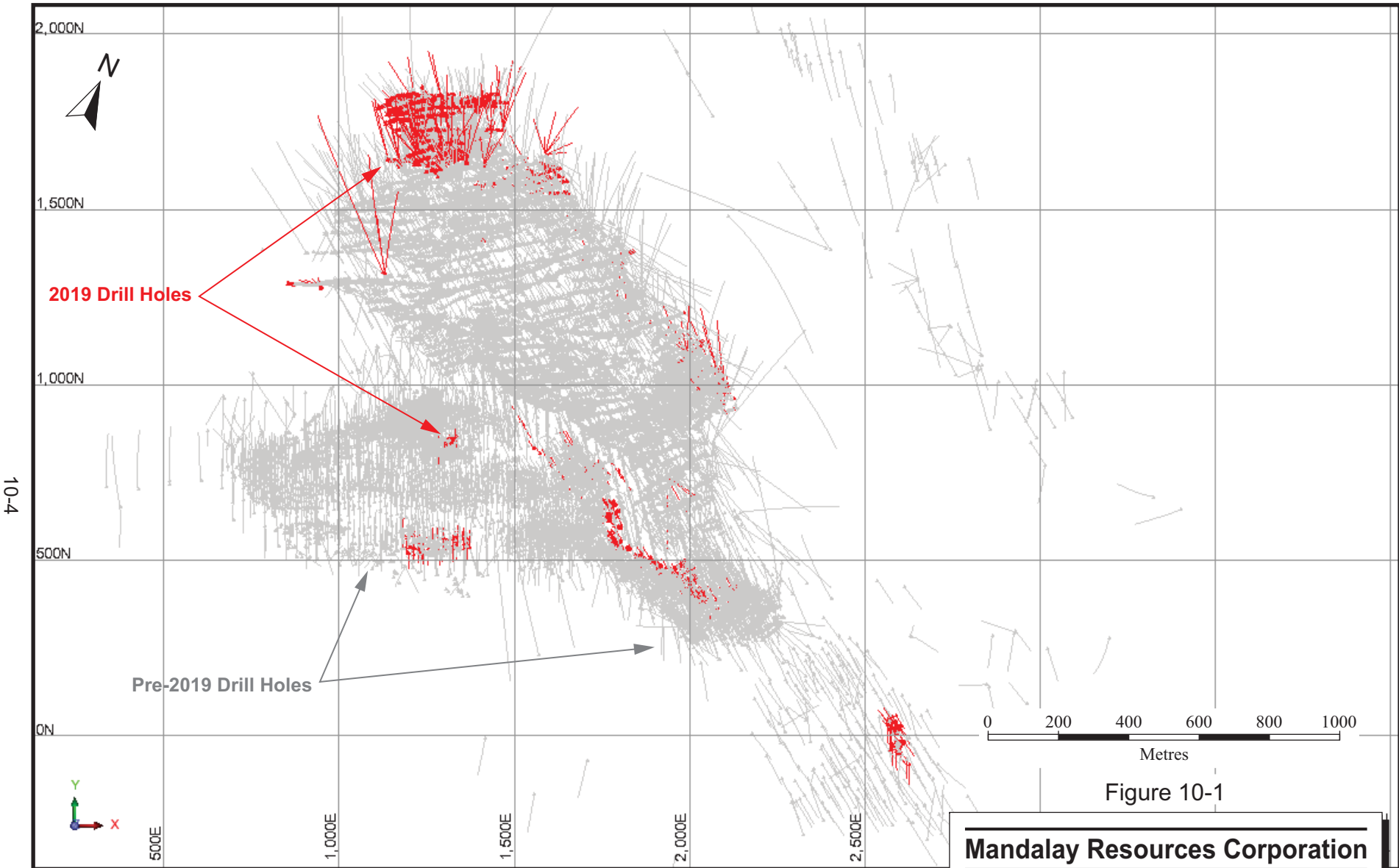
### MANDALAY 2014-2019 DRILLING

A summary of the drilling programs performed by Mandalay from September 2014 to September 2019 is provided in Table 10-3. The location of the drill holes completed at the Björkdal Mine in 2019 are shown in Figure 10-1.

**TABLE 10-3 SUMMARY OF DRILLING COMPLETED FROM 2014 TO 2019 -  
BJÖRKDAL  
Mandalay Resources Corporation – Björkdal Gold Mine**

Year	Drill Hole Type	Underground		Open Pit	
		Number of Drill Holes	Metres (m)	Number of Drill Holes	Metres (m)
2014	Core (In-fill)	19	1,614		
	RC			65	2,103
	Core	12	3,302	5	632
2015	Core (In-fill)	150	11,880		
	RC			439	13,959
	Core	58	14,151	56	9,145
2016	Core (In-fill)	280	32,252		
	RC			558	28,468
	Core			14	4,087
2017	Core (In-fill)	211	23,839		
	RC			597	24,924
	Core			13	2,377
2018	Core (In-fill)	211	24,309		
	RC			621	22,138
	Core	43	9,995	44	8,674
2019*	Core (In-fill)	98	11,784		
	RC			194	10,649
	Core	16	3,422		
<b>Total</b>		<b>1,098</b>	<b>136,548</b>	<b>2,606</b>	<b>127,156</b>

Note \* 2019 drilling includes drill holes completed to September 30, 2019.



10-4

Figure 10-1

**Mandalay Resources Corporation**

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***Björkdal Gold Mine***  
*Västerbotten, Sweden*

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**2019 Drill Hole Location Map**

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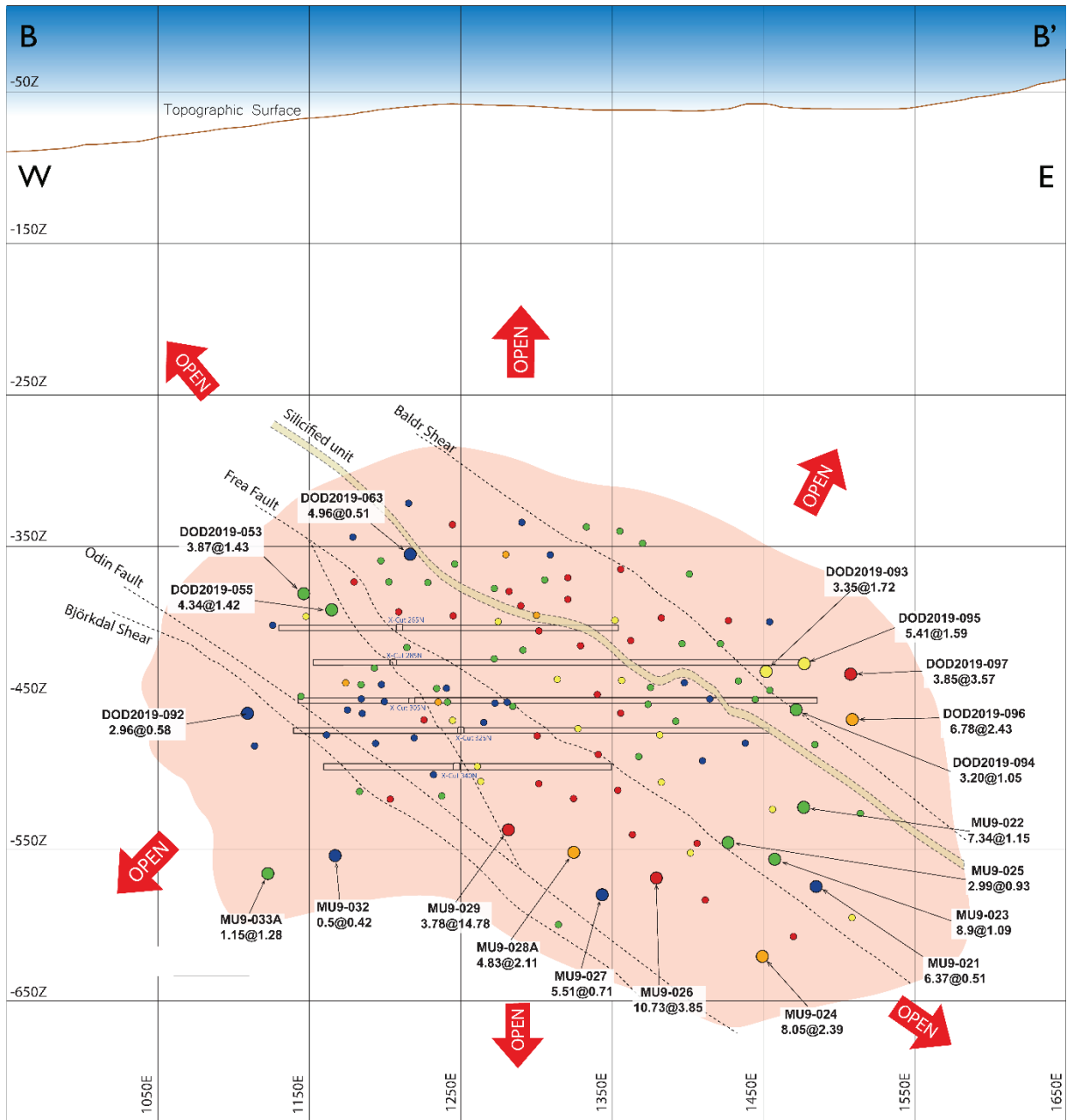
The main focus of the drilling completed in 2019 was to continue to outline the strike and dip limits of the Aurora Zone and to define the limits of the high grade, skarn-hosted mineralization discovered in 2018. Selected secondary targets in the immediate vicinity of the open pit mine were also evaluated for their potential to host potentially economic grade gold mineralization. A small number of drill holes were also completed to begin the evaluation of the area to the north of the Aurora Zone for the presence of gold mineralization.

The drilling programs were successful in extending the known limits of the Aurora Zone, for outlining the limits of the high grade, skarn hosted zones, and for the discovery of additional gold mineralization in the area to the north of the Aurora Zone. As of September 30, 2019, the Aurora Zone has been outlined by drill hole and channel sample information along a strike length of approximately 500 m and along a dip length of approximately 400 m. As of September 30, 2019 the limits of the mineralization in the Aurora Zone have not been defined by drilling (Figure 10-2).

A selection of the significant intersections returned from the Aurora Zone is provided in Table 10-4. A listing of the significant intersections returned from the Northern Target is provided in Table 10-5 (Mandalay, 2020).



Looking North



**Mineralisation sampling**

● DDH comp. >2.5 g/t Au	● Intercept post September 2019
● DDH comp. 2.0 to 2.5 g/t Au	● Intercept pre September 2019
● DDH comp. 1.5 to 2.0 g/t Au	○ Drilled, awaiting assays
● DDH comp. 0.9 to 1.5 g/t Au	□ DOD/POD-XXX Production DDH
● DDH comp. 0.4 to 0.9 g/t Au	□ MU9-XXX Exploration DDH
True Width(m)@Au grade (g/t)	

Note: Grades are diluted to 3m minimum mining width

**Mining and Geology**

□	Underground Developments
- - -	Faults and shears
○	Current limits of Aurora mineralised zone

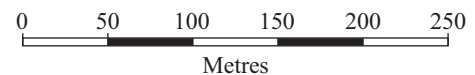


Figure 10-2

**Mandalay Resources Corporation**

*Björkdal Gold Mine*  
*Västerbotten, Sweden*

**Aurora Zone Drill Holes,  
 January 2020**

**TABLE 10-4 SUMMARY OF 2019 SIGNIFICANT INTERSECTIONS, AURORA ZONE**

**Mandalay Resources Corporation – Björkdal Gold Mine**

Hole ID	From	To	Core Length (m)	Au (g/t)
DOD2018-170	155.01	168.54	13.53	3.50
DOD2018-171	139.96	144.29	4.33	5.28
DOD2018-172	124.52	132.56	8.04	0.54
DOD2018-173	125.97	133.24	7.27	0.94
DOD2019-002	127.87	136.28	8.41	0.64
DOD2019-004	123.88	130.00	6.12	2.54
DOD2019-005	120.41	125.20	4.79	1.11
DOD2019-008	158.55	165.44	6.89	0.29
DOD2019-009	186.35	201.78	15.43	0.10
DOD2019-010	163.96	168.40	4.44	0.47
DOD2019-011	146.88	153.16	6.28	0.36
DOD2019-016	54.73	66.58	11.85	2.07
DOD2019-018	69.85	89.55	19.70	0.27
DOD2019-019	134.89	140.81	5.92	0.98
DOD2019-050	110.38	115.35	4.97	0.20
DOD2019-052	114.73	118.72	3.99	0.02
DOD2019-053	104.16	114.15	9.99	0.73
DOD2019-054	111.54	119.49	7.95	0.73
DOD2019-055	102.75	110.52	7.77	0.22
DOD2019-058	81.01	84.79	3.78	6.87
DOD2019-062	76.93	85.14	8.21	1.11
DOD2019-063	67.16	73.19	6.03	0.43
DOD2019-064	77.13	84.74	7.61	1.23
DOD2019-065	81.44	84.70	3.26	1.02
DOD2019-071	92.71	100.53	7.82	1.89
DOD2019-072	92.36	95.35	2.99	0.66
DOD2019-073	114.42	118.79	4.37	0.78
DOD2019-074	70.44	77.16	6.72	0.83
DOD2019-075	78.41	82.67	4.26	1.50
DOD2019-076	74.82	78.62	3.80	4.74
DOD2019-077	77.91	85.79	7.88	2.57
DOD2019-078	81.15	87.74	6.59	2.25
DOD2019-079	75.30	79.18	3.88	6.35
DOD2019-086	0.00	10.68	10.68	0.48
DOD2019-087	0.00	13.59	13.59	0.37
DOD2019-092	129.98	135.64	5.66	1.64
MU8-042	95.85	100.25	4.40	0.31
MU8-043	130.52	137.01	6.49	0.12
MU8-044	224.19	234.97	10.78	2.79
MU8-046	231.65	240.43	8.78	0.02
MU9-001A	317.69	331.90	14.21	0.33

Hole ID	From	To	Core Length (m)	Au (g/t)
MU9-004	329.03	341.27	12.24	0.31
MU9-019	148.43	159.23	10.80	1.11
MU9-020	204.13	220.61	16.48	1.54
MU9-021	174.61	187.72	13.11	0.46
MU9-023	152.66	166.56	13.90	1.01
MU9-024	223.76	235.54	11.78	2.35

**TABLE 10-5 SUMMARY OF 2019 SIGNIFICANT INTERSECTIONS,  
NORTHERN TARGET  
Mandalay Resources Corporation – Björkdal Gold Mine**

Hole ID	From	To	Core Length (m)	Au (g/t)
MU9-015	1.65	2.10	0.45	60.00
MU9-015	18.70	19.25	0.55	26.20
MU9-016	2.60	3.10	0.50	26.00
MU9-016	203.60	204.00	0.40	33.50
MU9-016	476.40	476.90	0.50	10.50
MU9-016	500.35	501.25	0.90	27.65
MU9-017	12.85	13.75	0.90	4.84
MU9-017	21.50	23.30	1.80	1.31
MU9-017	44.10	44.90	0.80	2.59
MU9-017	67.20	68.20	1.00	2.87
MU9-017	178.30	178.75	0.45	3.24
MU9-017	313.25	313.90	0.65	2.81
MU9-018	143.40	143.85	0.45	5.72

**DIAMOND DRILLING**

All underground exploration drilling since September 2014 has been conducted with wireline diamond-core drilling methods by experienced Swedish drilling contractors Protek Norr AB and Styrod Arctic AB. Drilling has been carried out with dedicated underground exploration drill rigs in the Hagby series WL66 and WL76 sizes (50.5 mm and 57.5 mm diameter core, respectively). All drill holes are surveyed with modern computerized gyroscopic tools at hole completion, while also being regularly check-surveyed for unexpected deviation as the drilling progresses using modern multi-shot “camera” downhole tools. Core orientation tools are used on all holes in order for geologists to measure the orientation of all geological structures identified. Contractors work two shifts per day (nine hour shift), seven days per week and average approximately 1,000 m per month.

Surface exploration since September 2014 has been carried out with wireline diamond-core drilling methods by experienced Swedish and Finnish drilling contractors Styrod Arctic AB, Katie OY, and Arctic Drilling Company OY and experienced international drilling operator

Mason & St John; based in the UK. Various drilling equipment sizes have been used depending on project needs and are as follows: WL66 (50.5 mm core diameter), NQ2 (50.7 mm core diameter), and WL76 (57.5 mm core diameter). All drill holes are surveyed with modern computerized gyroscopic tools at hole completion, while also being regularly check-surveyed for unexpected deviation as the drilling progresses using modern multi-shot “camera” downhole tools. Core orientation tools are used on all holes in order for geologists to measure the orientation of all geological structures identified. Contractors work two shifts per day (12 hour shift), seven days per week and average approximately 1,200 m per month. Drill holes that are collared in unconsolidated materials (i.e., soil and till) are cased with traditional methods with either Boart Longyear, or Hagby series casing rods and bits.

Due to the degree of silicification and alteration of the deposit and regional geology, rock quality is generally excellent, reflected in core recovery values generally in excess of 95%.

Production and development optimization holes are primarily drilled with Mandalay-owned and operated drill rigs and drilling staff, although contractors have been used at times when extra capacity is required (Styrud Arctic AB and Protek Norr AB). Starting in 2013, in-fill underground diamond drilling programs using WL46 drill string (28.8 mm diameter core) were implemented, the rig has been decommissioned as of May 2018. In March 2016, an Atlas Copco model Diamec U4 data rig was purchased. The rig is operated by three drillers working single shifts using a WL56/39 drill string (39.0 mm diameter core). They work seven days a week, producing 25 m per shift. In December 2018, a fourth shift was added to this rig. This rig is primarily used for development optimization (DOD-series drill holes).

All drilling is designed and supervised by Mandalay/Björkdalsgruvan geologists. Drill hole layouts are designed with the aid of the GEOVIA Surpac 3D software.

#### **REVERSE CIRCULATION DRILLING**

Exploration RC drilling was undertaken during the summer of 2016 in order to quickly provide in-fill information for the Nylund surface deposit. The drilling was undertaken by an experienced international drilling operator Mason & St John based in the UK, and local Swedish drilling contractors Styrud Arctic AB. Drilling was undertaken with a multi-purpose drilling rig equipped with 5.5 in. RC diameter bit on 6 m rods (Mason and St John) and 5.5 in. RC diameter bit on 3 m rods (Styrud Arctic AB). Holes are surveyed at completion with modern computerized gyroscopic tools. Samples are taken every one metre of drilling where they are

split directly out of the cyclone in a riffle-splitter. Two samples are collected; one is sent directly to the laboratory for analysis while the other is sieved and washed in order for geological logging to take place. A booster compressor is used on deeper holes (150 m + hole depth) to maintain dry samples when water ingress increases with depth, or water bearing fracture networks are intercepted. Drilling is conducted in either one or two shifts per day, seven days per week where up to 100 m of drilling is possible per shift.

RC drilling has been utilized for grade control in the open pit since 2010 to define the gold bearing quartz veins which can vary in scale from one centimetre to greater than one metre. The standard drill pattern is approximately a 7.5 m by 15 m by 18 m grid where holes are planned to intersect perpendicular to the quartz vein orientation. The number of planned drill holes also depends upon the location of historical drill holes. In the western part of the mine, holes are drilled 0°/180° (mine grid) with a dip of -40° and in the eastern part, 330°/150° with a dip of -40°. This is due to the general orientation of mineralized zones (quartz veins) in these respective areas of the surface deposit. Each grade control hole generally covers three or four benches, or approximately 20 m vertical depth for a 32 m long hole. Longer holes (up to 70 m long) are occasionally drilled in order to condemn areas by confirming that they are barren of gold mineralization. These longer holes are surveyed at hole completion in order to ascertain their deviations.

Drilling is performed by drill contractors Styruud Arctic AB utilizing five-inch RC diameter bit on three metre rods. Drill cuttings are sampled every one metre via a cyclone. RC drilling is performed year-round. RPA recommends that Björkdal geologists also record any water intersections encountered during RC drilling operations.

All RC drill holes are planned by Mandalay/Björkdal geologists using the GEOVIA Surpac 3D software.

#### **UNDERGROUND CHIP SAMPLING**

Each on-vein development (OVD) face has been mapped, photographed, and sampled since 2015. The geologists first mark up the area to be sampled with spray paint (Figure 10-3). The sampler then uses a hammer and bucket to collect representative samples from shoulder to knee height and across the entire face. While this methodology does not strictly follow a channel sample line, it may in fact better represent the variability within the mineralized zone.

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After the sample is taken, the sample number is recorded on the face map, together with the date and name of the OVD. The sample is then placed into a plastic sample bag and closed with a sample tag inside. The bucket is either washed out if water is available or replaced with a clean one, in order to conduct the next sample. A standard and blank is inserted every 50<sup>th</sup> sample.

The samples are delivered by the sampler directly to the on-site laboratory facility located next to the core processing facility.

The chip sample location paint marks are later surveyed by the mine surveyors. Samples are entered into an Excel spreadsheet to calculate a final grade for the cut taken and later into an Access database using GeoSpark.

RPA recommends that, for the purposes of Mineral Resource estimation, efforts be continued to enter all chip sample information into the drill hole database as pseudo-drill holes that span the full width of the face of the development heading.

**FIGURE 10-3 UNDERGROUND CHIP SAMPLING, AURORA ZONE**



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**UNDERGROUND SLUDGE SAMPLING**

Sludge sampling of the development drill hole cuttings (approximately 70 holes) is carried out for every round of the OVD. Sludge samples are not used for Mineral Resource estimation but are used to assist in stope design, production grade estimates, and reconciliation exercises.

After a round is drilled off, the sampler draws a line, and using a pick axe, alongside the drilled face, fills about half a bucket with the collected material (approximately 7 kg). To be as representative as possible, the sample is collected throughout the height of the sludge pileover. The sample is taken approximately one metre away from the drilled face. When rounds are drilled at +17% gradient, the drill cuttings usually flow away from the face, and when rounds are drilled at a -17% gradient, the drill cuttings flow towards the face. On such occasions, the sampler seeks to find the place where the drill cuttings are "constant" all the way from side to side. Rocks greater than five centimetres in diameter are removed before the cuttings are put in the bucket.

After the sample is taken, the bucket number is recorded, together with the date and name of the drive, on a patch in the bucket. The bucket is transported up from the underground by the sampler and taken to the on-site laboratory.

While the underground sludge sampling is generally not useful due to reliability of the sample collection and assaying, the results do in fact appear to highlight high grade gold domains.

**SURVEYS*****SURVEY GRIDS***

The coordinate system used at Björkdal is the Mine Grid. The Mine Grid is rotated 29.67° west of true north. The 0 RL elevation was based upon the highest point in the vicinity of the Mine ("Quartz Mountain"), an area which is now mined out.

***DIAMOND DRILLING***

Currently, all diamond drill hole collars are surveyed. Downhole surveys are also carried out to record hole azimuth and dip of holes. Exploration drill holes are orientated and single shot surveyed with EZ Shot as they are being drilled, while also surveyed every three metres with a Gyro Smart downhole surveying tool.



Prior to 2010, only limited numbers of drill holes were downhole surveyed using a Maxibor instrument. Since 2015, downhole surveys have been carried out using a Gyro Smart tool surveying every three metres upon completion of the hole.

### **REVERSE CIRCULATION DRILLING**

All RC drill hole collars are surveyed. No downhole surveys are taken for grade control holes less than 70 m in length. All exploration drill holes are surveyed along their full length on completion of drilling.

The open pit grade control technician uses spray paint as well as wooden sticks to mark planned hole locations. The technician adjusts the X and Y positions as there will be differences in planned Z-coordinate and actual ground level. To ensure the correct azimuth, a marked wooden stick is placed approximately seven metres in front of the collar.

Upon completion of drilling, the technician measures the collar and direction of the drill hole with a Trimble TSC3. Unannounced visits are randomly performed during drilling operations to ensure that the dip and azimuth of the drill hole is correct. The azimuth is measured with total station and the reported measured deviations have not been greater than  $\pm 1^\circ$ .

### **UNDERGROUND CHIP SAMPLING**

All underground channel chip samples are based on surveyed points in relation to the Mine Grid. The Mine Geologist paints up sample locations. The chip sample locations are then turned into pseudo-drill holes for entry into the drilling and sampling database using a pseudo-collar location and calculated azimuth, dip, and length.

Underground surveying is also used to map the trace of vein contacts along the face and back of the sill drifts. This data is incorporated in geological mapping and vein wireframing and is captured in full three-dimensional space into the GEOVIA Surpac software system.

## **NORRBERGET**

Drilling at Norrberget has been carried out across three distinct periods in line with the priorities of the previous holders of the exploration concessions. The Mineral Resource drill hole database cut-off date was September 30, 2017. All holes completed before September 2014 were drilled by previous owners.

**HISTORICAL DRILLING**

**1994-1996 DRILLING**

The Norrberget deposit was first drilled by COGEMA in 1994 as part of a program investigating the margins of the Björkdal dome and assess the potential for further significant gold deposits in the area. Further diamond drilling campaigns were carried out in 1995 and 1996 to define and extend the potential resource in this area (Table 10-6).

**TABLE 10-6 SUMMARY OF HISTORICAL DRILLING COMPLETED FROM 1994 TO 1996 – NORRBERGET DEPOSIT  
Mandalay Resources Corporation – Björkdal Gold Mine**

Year	Drill Hole Type	Number of Drill Holes	Metres
1994	Core	16	3,324
1995	Core	32	4,480
1996	Core	35	3,333
<b>Total</b>		<b>83</b>	<b>11,137</b>

**2009-2014 DRILLING**

A hiatus in drilling occurred while the exploration concessions were under the ownership of NAN, no significant work was carried out on the deposit between 1997 and 2009. After the regional tenement package was purchased by Gold-Ore, there was renewed interest in the area surrounding Björkdal. Several small diamond drilling campaigns were carried out at Norrberget and the immediate surrounds by Gold-Ore and their successors Elgin between 2009 and 2014 (Table 10-7).

**TABLE 10-7 SUMMARY OF HISTORICAL DRILLING COMPLETED FROM 2009 TO 2014 – NORRBERGET DEPOSIT  
Mandalay Resources Corporation – Björkdal Gold Mine**

Year	Drill Hole Type	Number of Drill Holes	Metres
2009	Core	11	1,028
2010	Core	1	200
2011	Core	6	1,391
2014	Core	6	1,757
<b>Total</b>		<b>24</b>	<b>4,376</b>

**MANDALAY 2015-2017 DRILLING**

After the 2014 acquisition of the property by Mandalay, much of the core from previous drilling campaigns was relogged and reassayed to confirm the accuracy of historical results and test the geological model for the area. In 2016, a diamond drilling program was undertaken to

confirm the historical drilling and extend the resource. A small RC drilling campaign took place in the summer of 2017 to in-fill the known mineralization.

A summary of the drilling programs performed by Mandalay from 2015 to September 2017 is provided in Table 10-8.

**TABLE 10-8 SUMMARY OF MANDALAY DRILLING COMPLETED FROM 2016 TO 2017 – NORRBERGET DEPOSIT**  
**Mandalay Resources Corporation – Björkdal Gold Mine**

Year	Drill Hole Type	Open Pit	
		Number of Drill Holes	Metres
2016	Core	24	2,542
2017	RC	12	1,400
<b>Total</b>		<b>36</b>	<b>3,942</b>

**DIAMOND DRILLING**

Diamond drilling at Norrberget since 2016 has been carried out with wireline diamond-core drilling methods by experienced Finnish drilling contractors Oy Kati AB. Drilling equipment has been appropriate to produce core to the WL76 (57.5 mm core diameter) standard. All drill holes are surveyed with modern computerized gyroscopic tools at hole completion, while also being regularly check-surveyed for unexpected deviation as the drilling progresses using modern multi-shot “camera” downhole tools. Core orientation tools are used on all holes in order for geologists to measure the orientation of all geological structures identified. Contractors work two shifts per day (12 hour shift), seven days per week and average approximately 1,200 m per month. Drill holes that are collared in unconsolidated materials (i.e., soil and till) are cased with traditional methods with either Boart-Longyear, or Hagby series casing rods and bits.

All drilling is designed and supervised by Mandalay/Björkdal geologists. Drill hole layouts are designed with the aid of Surpac 3D software.

**REVERSE CIRCULATION DRILLING**

Exploration RC drilling was undertaken at Norrberget during the summer of 2017 in order to quickly provide in-fill information for the deposit. The drilling was undertaken by an experienced international drilling operator, Mason & St John, based in the UK. Drilling was undertaken with a multi-purpose drilling rig equipped with 5.5 in. RC diameter bit on 6 m rods. Holes are surveyed at completion with modern computerized gyroscopic tools. Samples are

taken every one metre of drilling where they are split directly out of the cyclone in a riffle-splitter. Two samples are collected; one is sent directly to the laboratory for analysis while the other is sieved and washed in order for geological logging to take place. A booster compressor is used on deeper holes (150 m + hole depth) to maintain dry samples when water ingress increases with depth, or water bearing fracture networks are intercepted. Drilling is conducted in either one or two shifts per day, seven days per week where up to 100 m of drilling is possible per shift.

All RC drill holes are planned by Mandalay/Björkdal geologists using Surpac 3D software.

## **SURVEYS**

### ***SURVEY GRIDS***

The coordinate system used at Norrberget is SWEREF99.

### ***DIAMOND DRILLING***

Currently, all diamond drill hole collars are surveyed. Downhole surveys are also carried out to record hole azimuth and dip of holes. Exploration drill holes are orientated and single shot surveyed with EZ Shot as they are being drilled, while also surveyed every three metres with a Gyro Smart downhole surveying tool.

Prior to 2010, only limited numbers of drill holes were downhole surveyed using a Maxibor instrument. From 2015 onwards, downhole surveys were carried out using a Gyro Smart tool surveying every three metres upon completion of the hole.

### ***REVERSE CIRCULATION DRILLING***

All RC drill hole collars are surveyed. All holes are surveyed along the full length of hole, at completion with modern computerized gyroscopic tools.

## 11 SAMPLE PREPARATION, ANALYSES AND SECURITY

Samples from Björkdal and Norrberget were prepared and analyzed at ALS Minerals, an independent, ISO-accredited laboratory located in Piteå, Sweden, and on-site at Björkdal. Samples were also analyzed by CRS Minlab Oy (CRS), an independent, ISO 9001:2008 certified laboratory located in Kempele, Finland. Whole core samples and RC samples were sent directly to the laboratories for sample preparation and assaying. Assaying was conducted utilizing the PAL1000 test machine and the LeachWELL process. Quality assurance and quality control (QA/QC) included the use of standard reference samples, blanks, duplicates, repeats, and internal laboratory quality assurance procedures. Underground chip and sludge samples were collected by geological technicians and delivered directly to the on-site laboratory. The on-site laboratory with a PAL1000 unit was established in June 2016 and was run by CRS until April 2018. Since April 2018, the on-site laboratory has been run by ALS Minerals. The mine sludge samples have not been used for the Mineral Resource estimation.

Mandalay procedures and standards are applied to both Björkdal and Norrberget sample preparation, analyses, and security.

### DIAMOND DRILL CORE SAMPLING

The standard Björkdal procedure requires diamond drill rig personnel to place the recovered drill core into wooden trays labelled at the drill site with the drill hole number and meterage values. End-of-run meterage markers are placed in the core tray between the end and start of each recovered drill run. For underground drilling, the core trays are placed on a pallet containing up to 24 boxes, strapped, and then brought up to surface where they are delivered to the Björkdal on-site core processing facility. During surface drilling operations, the core is delivered each day to the Björkdal on-site core processing facility by the drilling company.

Upon receipt, the boxes are sorted out sequentially by hole number and the core is oriented in the box. Then the core is cleaned with fresh water, measured to check meterage and each core box is marked with meterage values. Any discrepancies are reported back to the drill foreman for confirmation.

The geologist generally logs twelve boxes at a time. The core is visually inspected, logged for rock quality designation (RQD), structure, lithology, alteration and sampling, where samples are separated and bounded by geological contact such as lithological, alteration and veining contacts. Criteria for sampling include:

- All veins (for example, quartz, carbonate, sulphides, tourmaline, calc-silicates, etc.). Sampling intervals of either side of veined material are taken based on geology, and are between 0.15 m and 1.0 m in length.
- Lithological and alteration contacts.
- All faults.
- Highly fractured or altered segments, and other interesting areas (abundant sulphides).

Core logging data captured is entered directly into a local GeoSpark database. Geological data collected includes:

Lithology:

- rock code grain size, foliation, texture name and texture intensity fields, and general description

Alteration:

- types and degree of alteration

Veining:

- only for quartz veins  $\geq 5$  cm in width including comments of visible minerals observed (i.e., sulphides, visible gold, tourmaline, etc.) as well as the number of veins in the interval. For veins less than 5 cm in width, this information is captured by an entry in the structural table using a zero width.

Structures:

- type of structure (for example, bedding, foliation, fault, vein, etc.)
- measuring data from oriented core

Geotechnical:

- Calculation of RQD for a maximum length of one metre

After every table of boxes is logged, digital photos of wet drill core are taken. These are saved to and stored on the Björkdal file server.

Sample tags are placed in the boxes before taking a photograph to make sure they do not move before sampling. The minimum sample length varies from 15 cm for WL66 and NQ2

core to 30 cm for WL46 (drill rig decommissioned in 2018) and WL 56 core to ensure reasonable minimum sample weights. The maximum sample length is 1.2 m.

A geological technician samples the whole core (unless the drill core is WL76 in which case it is halved and then sampled), carefully breaking the core with a hammer at the sample locations. The samples are placed into plastic bags with a sample tag and sample number written on each bag with a permanent marker pen. The plastic bags are twisted closed and sealed with a zip tie. The sample is then placed into a wooden palletized box which contains a Fabrene bailer bag for transport to a laboratory.

The Björkdal analytical quality control program includes blanks and standards. Protocol calls for blanks to be inserted in the sample stream at a rate of approximately one in 20 samples and after every sample containing visible gold. Blank material is obtained from a dimension stone outlet (Granitti Natursten AB of Piteå, Sweden) that sourced the rock from a granite quarry in Finland. A 500 g blank sample is used. Björkdal inserts 100 g certified reference material (CRM) samples at a rate of one in a 20 sample batch. Björkdal purchased the bulk CRMs from Geostats Pty Ltd, Western Australia. The geological technician weighs and bags CRM at the sample preparation laboratory (SPL). The blanks and CRMs are inserted into the bailer bags stream prior to shipment. Once full, the bailer bag is tied shut with security tags, and the pallet receives a timber lid, and thick plastic is then draped and stapled shut over the top of the box in order to protect it from the elements during loading and transport.

## **DIAMOND DRILL CORE SAMPLE PREPARATION AND ANALYSIS**

The majority of the samples have been assayed by CRS, which represents Activation Laboratories Ltd. (Actlabs) in Scandinavia under the name of Actlabs Finland. CRS is an ISO 9001:2008 certified company with an internal quality management system. Actlabs, founded in 1987, is an ISO 17025 accredited laboratory company, which has 30 different laboratories in 14 countries. CRS' main laboratory is located in Kempele, Finland, directly east of Björkdal across the Baltic Sea (or approximately 410 miles by road). The samples are shipped to CRS by Savikko Oy, a Finnish trucking company.

In April 2018, ALS Minerals took over the on-site laboratory in Björkdal from CRS. The laboratory mainly analyses grade control samples such as chip samples and sludge samples,

but also RC samples and drill core samples from development and production optimization drilling.

## **SAMPLE PREPARATION**

### **CRS PROCEDURES**

- Drying of wet samples in drying ovens.
- Weighing (received weight) and listing preparation of received samples.
- Crushing of samples until >80% < 2 mm. The crusher is cleaned with pressurized air after every sample and run through with blank stones between batches.
- Splitting to 500 g subsample with rotating sample divider for PAL1000. The sampler divider is cleaned with pressurized air between every sample. There are two duplicate split samples in a PAL1000 pulverization run.

### **ALS PROCEDURES**

ALS Piteå and ALS Björkdal are accredited laboratories in accordance with the International Standard ISO/IEC 17025:2005. The ALS sample preparation facility in Piteå and Björkdal has internal standard procedures and quality controls for sample preparation in place to ensure that samples are prepared in compliance with industry standards. The laboratory also has a digital Laboratory Management Information System (LIMS).

The sample preparation procedures carried out on Björkdal's diamond drill core samples at the Piteå facility consisted of the following:

- Logging each sample upon arrival in the LIMS system and attaching a bar code label.
- Drying of wet samples in drying ovens.
- Fine crushing of samples to better than 70% of the sample passing two millimetres.
- Splitting sample using rotary splitter.
- Pulverizing a sample split of up to 1,500 g to better than 85% of the sample passing 75 µm.

The sample preparation procedures carried out on Björkdal's diamond drill core samples at the Björkdal facility consisted of the following:

- Logging each sample upon arrival in the LIMS system and attaching a bar code label.
- Drying of excessively wet samples in drying ovens.
- Fine crushing of samples to better than 70% of the sample passing two millimetres.
- Splitting to 500 g subsample using rotary splitter.

The ALS Piteå sample preparation flowchart is shown in Figure 11-1.



Flow Chart – Sample Preparation Package – PREP-32  
Fine Sample Preparation: Dry, Crush, Split and Pulverize (1500 g)

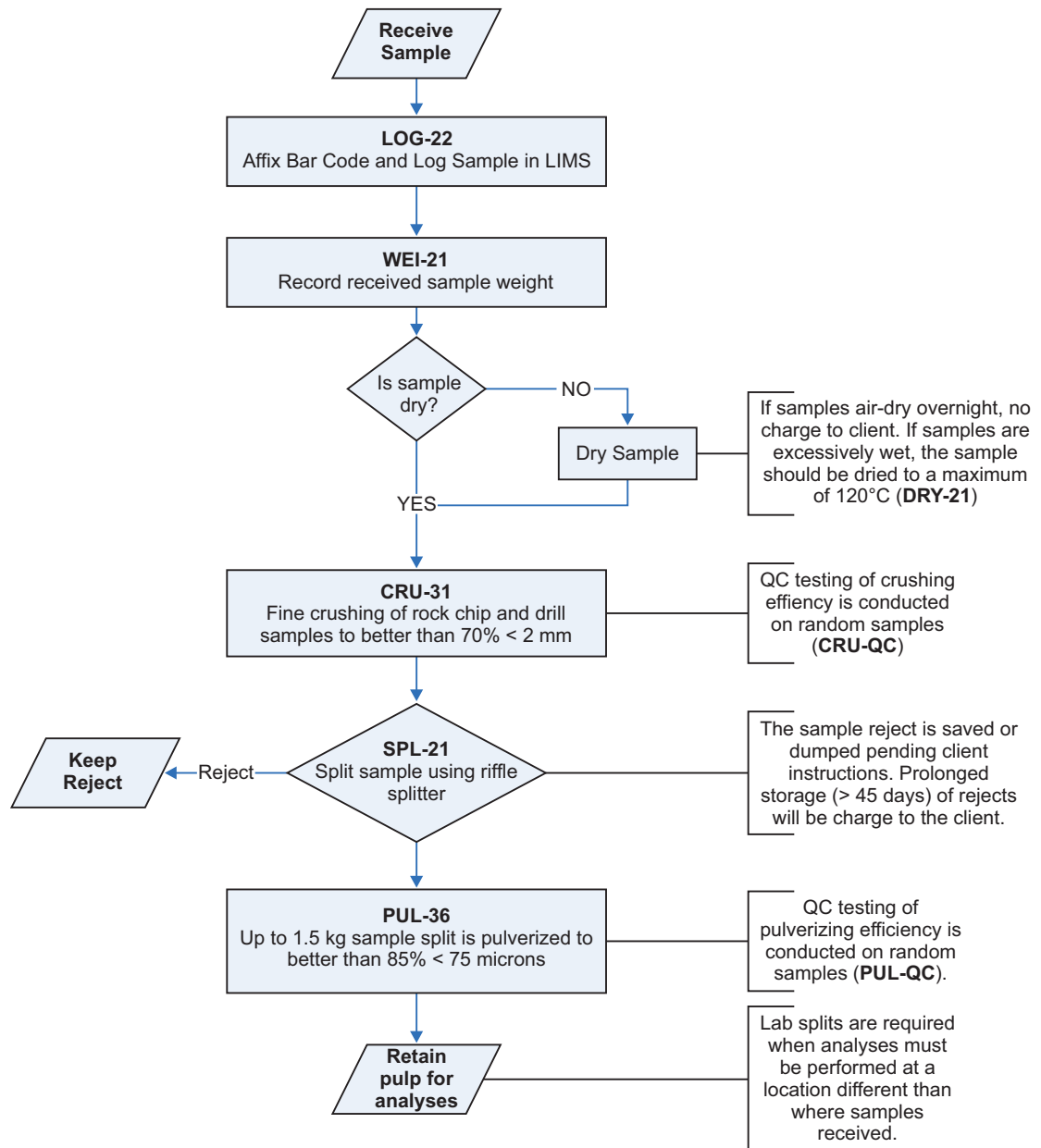


Figure 11-1

**Mandalay Resources Corporation**  
**Björkdal Gold Mine**  
 Västerbotten, Sweden  
**ALS Minerals**  
**Sample Preparation Flowchart**

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## SAMPLE ANALYSIS

### ALS

Some resource definition drill core is analyzed at ALS Piteå by ALS procedure code Au-AA15 consisting of gold analysis by accelerated cyanide leach using LeachWELL Assay Tabs with an atomic absorption spectroscopy (AAS) finish. The analysis method has a lower limit of 0.01 g/t Au and an upper limit of 300 g/t Au.

The ALS process for cyanide extractable gold using the LeachWELL accelerant includes:

- A 500 g pulverized sample is weighed into a reaction vessel (plastic lidded bottle).
- One litre of water, hydrated lime, and a LeachWELL 60x/cyanide mixture are added.
- The container is sealed and rolled for a minimum of two hours.
- The vessel is subsequently left to stand for one to two hours before a 10 mL aliquot of the supernatant liquid is analyzed by AAS.

ALS reports that the plastic bottles are cleaned after every use. The test tubes are only used one time. A photograph of the ALS Piteå LeachWELL laboratory is shown in Figure 11-2.

### CRS

Most drill core is analyzed at the CRS laboratory in Kempele, Finland using PAL1000 with an AAS finish. The analysis method has a lower limit of 0.05 g/t Au and an upper limit of 300 g/t Au, or a lower limit of 0.01 g/t Au if the gold from the sample solution is extracted into Di-isobutyl Ketone (DIBK) prior to AAS-measurement (usual method for exploration drill-core). The PAL1000 machine contains 52 steel pots, each having the maximum capacity of 1,000 g sample, 1,000 mL water, and grinding media (steel balls). Samples are completely pulverized (typically to better than 90% < 75 µm) and simultaneously leached with cyanide. The solution is analyzed for gold by AAS (Figure 11-3).



Figure 11-2

**Mandalay Resources Corporation**

***Björkdal Gold Mine***

*Västerbotten, Sweden*

**ALS Pietå LeachWELL  
Assay Laboratory**

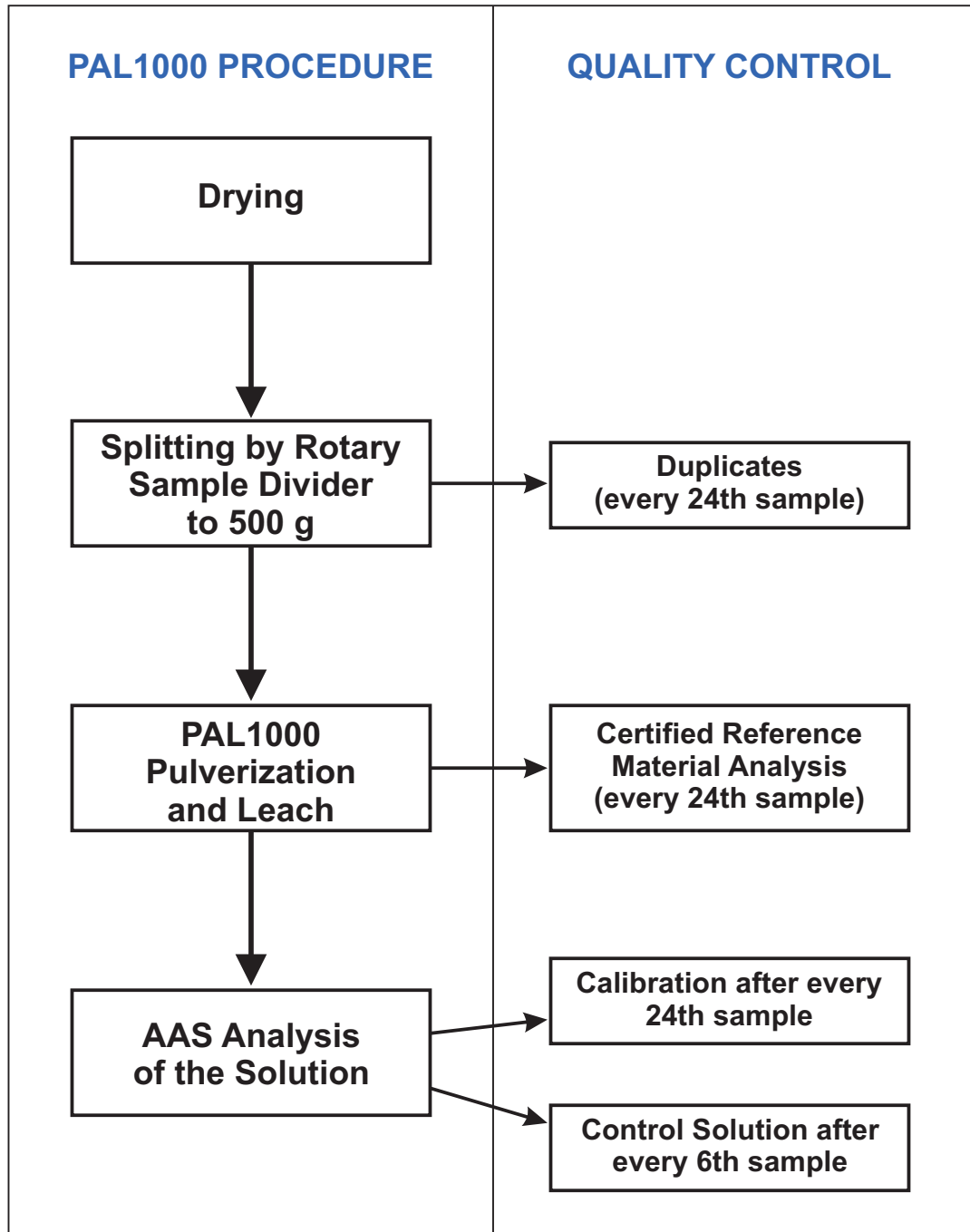


Figure 11-3

**Mandalay Resources Corporation**

***Björkdal Gold Mine***  
*Västerbotten, Sweden*

**CRS Sample Preparation Flowchart**

Check assaying is done to evaluate the level of precision, accuracy, and analytical errors that may be present at the primary assay laboratory.

Samples are reanalyzed if the results of the quality control for a batch are deemed unsatisfactory (i.e., more than three standard deviations from the expected value).

## **REVERSE CIRCULATION SAMPLE PREPARATION AND ANALYSIS**

### **SAMPLE PREPARATION**

Exploration RC drilling consists of 5.5 in. diameter RC holes that are sampled every metre. Drill cuttings are dropped out of the cyclone through a large riffle splitter at the completion of a one metre drilling interval. Two samples are collected, one sample of approximately three to four kilograms in a single calico bag, and a further sample of 20 kg or more collected in a large green nylon bag. Both bags have sample numbers written on them, and a ticket number is placed inside each bag. The calico bag samples are placed within a boxed pallet for transport directly to the laboratory, while the larger nylon bags are neatly placed in an ordered row for later chip sampling from a site geologist. These chips are sieved, washed, and placed in chip-trays for later lithological, alteration, and mineralogy (i.e., quartz, carbonate, sulphide, etc.) logging. Data from logging is entered directly into the GeoSpark database program. Standards and blanks are alternately inserted approximately every 20 samples into small sealed plastic bags, and then within numbered calico bags (with their corresponding numbered sample tag) and inserted among the samples that are placed within the boxed pallet.

RC grade control drilling in the open pit consists of five inch diameter holes with one metre samples on approximately 15 m spacing with 7.5 m in-fill spacing where possible. Drill cuttings are divided by a rotary splitter and collected in calico bags and a sample tag is added after removal from the drilling rig. The amount of sample collected is approximately three to four kilograms. The drillers then take a further sample, sieve it so the fine content is removed, and place it in an RC Lithology Sample Tray. The RC chips are then logged in the same way as the exploration RC samples.

Samples that are placed in a large boxed pallet are transported to the on-site laboratory. At the on-site laboratory, the RC samples are poured on a metal tray and dried at 90°C until the samples are dry (approximately 24 hours). The samples are then placed in numbered plastic

bags. The blanks and CRMs are inserted into the bailer bags prior to shipment at a rate of one standard and one blank sample for each hole. Once full, the bailer bag is secured with a security zip tie.

## **SAMPLE ANALYSIS**

Historically, RC samples were sent to ALS Piteå for LeachWELL assaying. In 2014, Björkdal sent a limited number of RC samples to the Svartliden Mine Laboratory (Svartliden), located approximately 200 km west of Björkdal. RC samples are currently assayed at the on-site laboratory run by ALS or at the CRS laboratories in Kempele, Finland with PAL1000.

The PAL1000 machine contains 52 steel pots, each having the maximum capacity of 1,000 g sample, 1,000 mL water, and grinding media (steel balls). Samples are completely pulverized (typically to better than 90% < 75 µm) and simultaneously leached with cyanide. The solution is analyzed for gold by AAS. Assay limits are 0.05 g/t Au to 300 g/t Au.

Check assaying is done to evaluate the level of precision, accuracy, and analytical errors that may be present at the primary assay laboratory.

Samples are reanalyzed if the results of the quality control for a batch is deemed unsatisfactory (i.e., more than three standard deviations from the expected value). All RC rejects are stored for one year after all assays have been received, checked, and inserted into the master database (GeoSpark Source) by the database geologist. After one year, 90% of the rejects are discarded.

All RC data is reviewed and then stored in the secure network GeoSpark drill hole database system. RPA recommends that standard protocols and written procedures for QA/QC review be implemented by a designated Database Manager.

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## CHIP AND SLUDGE SAMPLE PREPARATION PROCEDURES

### CHIP SAMPLE PREPARATION

The in-mine chip samples are prepared and analyzed at the on-site ALS laboratory. Chip samples are generally approximately five kilograms in weight and are poured onto a tray and dried at 100°C until the sample is dry (approximately three hours). The entire sample is then crushed in a jaw crusher until 70% of the material is less than two millimetres. The jaw crusher is cleaned with blank stones and pressurized air after every sample. The sample is then split into a 500 g subsample with a rotary splitter and the leftover amount of sample is archived. The rotary splitter is cleaned with pressurized air after every sample. The samples are placed into numbered plastic bags and moved over to the laboratory.

### SLUDGE SAMPLE PREPARATION

The in-mine sludge samples are prepared and analyzed at the on-site ALS laboratory. The collected drill cutting sample is poured on a tray and dried at 100°C until the sample is dry (approximately six hours).

The sample is split into a 500 g subsample with a rotary splitter and the left over sample is archived. The rotary splitter bins are cleaned with compressed air after each sample. Samples are then placed into numbered plastic bags and moved over to the laboratory.

### CHIP AND SLUDGE SAMPLE ANALYSIS

Assaying of the in-mine chip and sludge samples are conducted at ALS's on-site laboratory using the PAL1000. Samples are completely pulverized (typically to better than 90% < 75 µm) and simultaneously leached with cyanide. The solution is analyzed for gold by AAS. Assay limits are 0.05 g/t Au to 300 g/t Au.

Check assaying is done to evaluate the level of precision, accuracy, and analytical errors that may be present at the primary assay laboratory.

Samples are reanalyzed if the results of the quality control for a batch are deemed unsatisfactory (i.e., more than three standard deviations from the expected value). The samples are assayed using PAL1000 cyanide leaching and the jars are cleaned with quartz sand and water after every run. Two CRMs, two duplicates, and a blank sample are inserted in every run.

The following standard procedures are undertaken for mine chip and sludge samples at the ALS on-site laboratory:

1. The 500 g sample is placed in a numbered plastic sample bag.
2. The sample is inserted into the PAL1000 machine jars together with a cyanide pill and 500 mL of water.
3. The jars are sealed and machine is run for 1.5 hours.
4. 10 mL of fluid is extracted from the jars with an auto-pipette into a numbered single-use test-tube in a rack. The tip on the autopipette is changed regularly and always cleaned with water.
5. The rack with the test-tubes is moved to the AAS-machine.
6. Analysis of the solution is performed by AAS.

Blank tests are run daily throughout the process in order to rule out the possibility of contamination in any of the various analysis steps. The AAS analysis is calibrated before each measurement with standard solutions containing known gold grades. Once all the QA/QC has passed and the assays have been reported, the PAL machine is thoroughly cleaned with water.

## **QUALITY ASSURANCE AND QUALITY CONTROL**

No QA/QC data is available for historical drilling prior to 2004. RC drilling for grade control purposes carried out from 2006 to 2013 and assayed at ALS did not include any QA/QC insertions into the sample stream. From 2013 to 2014, standard and blank samples were inserted into the sample stream with one blank and one standard sample inserted per RC drill hole. In 2014, RC samples were sent to the uncertified CRS and Svartliden laboratories.

A full description of the details and results of the QA/QC programs carried out prior to Mandalay's acquisition of the Björkdal Mine in 2014 can be found in RPA (2015).

Following Mandalay's acquisition of the Björkdal Mine in 2014, the QA/QC protocols were updated to include the regular insertion of blanks and multiple standards within each 30 sample batch. A blank sample was also inserted after every sample containing visible gold. All samples collected from the regional exploration programs, the underground and near-mine surface-based exploration programs, and the grade control sampling during 2015 and January to September 2016 were included in the QA/QC program. A summary of the QA/QC samples taken from 2015 to September 30, 2019 is provided in Table 11-1.



**TABLE 11-1 SUMMARY OF QA/QC SAMPLING  
Mandalay Resources Corporation – Björkdal Gold Mine**

Year	Blanks	Standards	Other	Total
2015	105	464		569
2016	1,732	2,359	233	4,324
2017	1,768	2,357	222	4,347
2018	1,454	2,052	243	3,749
2019*	2,155	2,375	167	4,697

\*Note: statistics for 2019 are up to September 30.

Mandalay manages the results of the QA/QC program by compiling all of the results from the blank samples and CRMs into an Excel spreadsheet where the grades of the sample in question are compared to the second and third standard deviation results.

Starting in 2016, control charts are also prepared by the laboratory on a routine basis during the normal course reporting of the analytical results from the LeachWELL assays. As the LeachWELL process reports the recovered portion of the gold within any given sample, a comparison of the LeachWELL results with the stated recommended value of a CRM is not valid. Rather, the control charts for the CRMs are slightly modified to report and compare the recoveries of a sample to the certified standard. The results from the blank samples are graphically presented using conventional scatter plots. RPA examined the results of the CRM and blank samples processed in 2019 and found no material issues.

Examination of the results from a program of duplicate sample analysis where the precision of the analytical method is examined by means of two assays from the same pulp sample is not possible in this case, as the entire one kilogram of pulverized material is submitted to the LeachWELL analytical method. Consequently, no pulp material remains from which to extract a second sample for duplicate analysis.

## SECURITY

The Björkdal Mine site has not experienced any major security issues. Access to the open pit and underground is restricted to authorized personnel in mine or contractor vehicles.

Björkdal drill and mine samples, as well as Norrberget exploration samples, are transported from the site to the Björkdal on-site core logging and sample preparation facility, which is located within a secure area. All diamond drill core is logged into laptop versions of GeoSpark.

The stand-alone logging laptop computers are typically backed up on a daily basis. The GeoSpark database is located on the Björkdal server, with daily backups and access restrictions based on user level.

Only persons permitted by Björkdal are allowed to handle the samples, and measures are in place to limit and deny the access by persons not considered to be authorized.

Commercial freight companies are used to transport the samples to the appropriate independent sampling and assaying laboratories. Sample shipment lists are emailed to the assay laboratory.

## **DISCUSSION AND RECOMMENDATIONS**

In RPA's opinion, the sample preparation, analysis, and security procedures at Björkdal and Norrberget are adequate for use in the estimation of Mineral Resources.

Björkdal utilizes the PAL1000, or LeachWELL, cyanide leach assaying technique for all samples. RPA agrees that PAL1000 is suitable on large samples (>500 g) for deposits with coarse or particulate gold and, in Björkdal's case, should provide a reduction in sampling errors over FA techniques. RPA notes that PAL1000 assays report cyanide recoverable gold, and not necessarily total gold.

RPA recommends that a study be carried out wherein the gold grades of the PAL1000 assays be determined by conventional FA methods to quantify the amount of gold remaining in the LeachWELL residues.

In RPA's opinion, the QA/QC program as designed and implemented by Mandalay is adequate and the assay results within the database are suitable for use in a Mineral Resource estimate.

In 2016 and 2017, Mandalay undertook a program of collecting field duplicate samples and assaying both samples to extinction. This program has highlighted that variability is present both within a single sample and between field duplicates.

RPA recommends that Mandalay consider the preparation of a two kilogram pulp from the coarse reject material at a frequency of approximately one sample in 50, to permit a review of the precision of the analytical method.

## 12 DATA VERIFICATION

### BJÖRKDAL

RPA carried out a program of validating the assay tables in the drill hole databases by means of spot checking a selection of drill holes completed in 2019. RPA proceeded to carry out its drill hole database validation exercise by comparing the information contained within the assay tables of the digital database against the assays presented in the original laboratory certificates. While a small number of typographical errors were detected for the sample lengths in the assay table, no material discrepancies were noted.

Additional checks included a comparison of the drill hole collar locations with the digital models of the topographic surfaces and excavation models as well as a visual inspection of the downhole survey information. A small number of channel samples were identified for which the survey locations were not accurate.

RPA recommends that the validation procedures for the drill hole management protocol be reviewed and updated as appropriate.

RPA is of the opinion that the Björkdal drill hole and chip sample data are adequate for the purposes of Mineral Resource estimation.

### NORRBERGET

RPA carried out a site visit to the Norrberget site on September 24, 2017. RPA reviewed the drill program and inspected the drill rig and pad setup. No drilling was underway at Norrberget during the site visit, although active drilling was observed at Björkdal.

RPA received the Norrberget dataset in July 2017 as an Access database that contained all drilling up until the completion of the 2016 exploration program. Additional drilling was completed in 2017 and appended to the drill hole database later this year. The cut-off date for the drilling is September 30, 2017.

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RPA validated the database using standard software tools to check for errors within the database. One sample (un-mineralized) was observed as having an identical From and To value. This sample was reviewed by Björkdal staff and edited to reflect the true intercept width from neighbouring samples.

RPA also compared a selection of the values within the database assay table to the original certificates.

A check was undertaken to ensure that the drill hole elevation was comparable with the digital terrain model (DTM) surface. No material discrepancies were observed.

RPA is of the opinion that the Norrberget drill hole data are adequate for the purposes of Mineral Resource estimation.

# 13 MINERAL PROCESSING AND METALLURGICAL TESTING

## BJÖRKDAL

The mineral processing plant at Björkdal commenced operation in 1989. Since that time, it has processed approximately 32.6 million tonnes of ore from open pit and underground sources and produced approximately 1.4 million ounces of gold.

The original plant design was based on pilot plant data that was generated in 1987. Since then, numerous studies and metallurgical test programs have been carried out by mine staff, third party consultants, and Ph.D. students from the Mineral Engineering department at the University of Luleå. This work has included mineralogical characterization studies of the tailings, work index and abrasion index studies, and numerous internal studies on grinding/liberation/ recovery relationships.

Since the plant has been operating for an extended period of time processing ore from both the open pit and the underground mines, in RPA's opinion, the historical data provides the best estimates of the anticipated plant performance in the future. Figure 13-1 provides an overview of the plant recovery data for the gravity, flotation, and total plant recovery starting in 2002 and compares it to the estimated recovery from the life of mine (LOM) plan.

**FIGURE 13-1 PLANT RECOVERY DATA 2002 TO 2019**

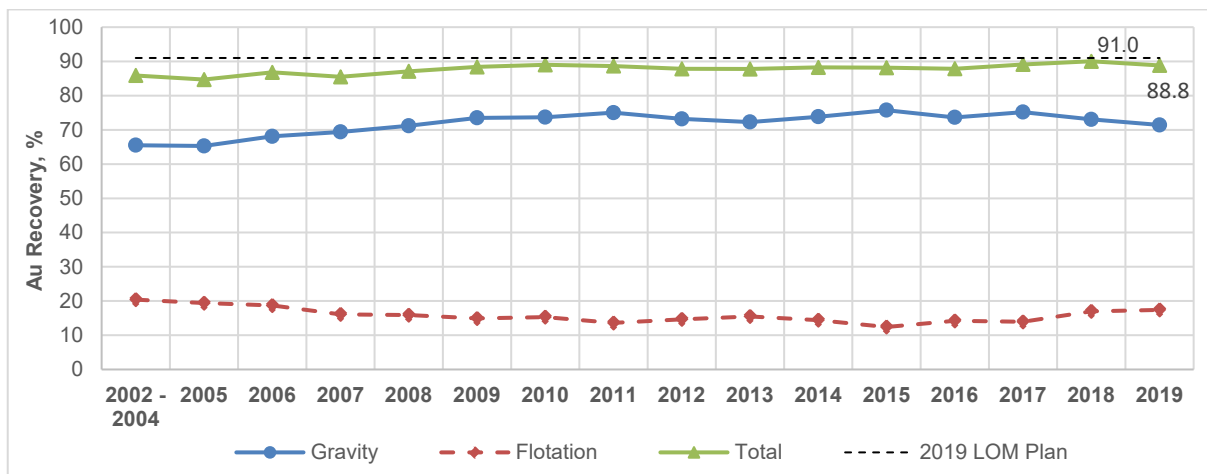


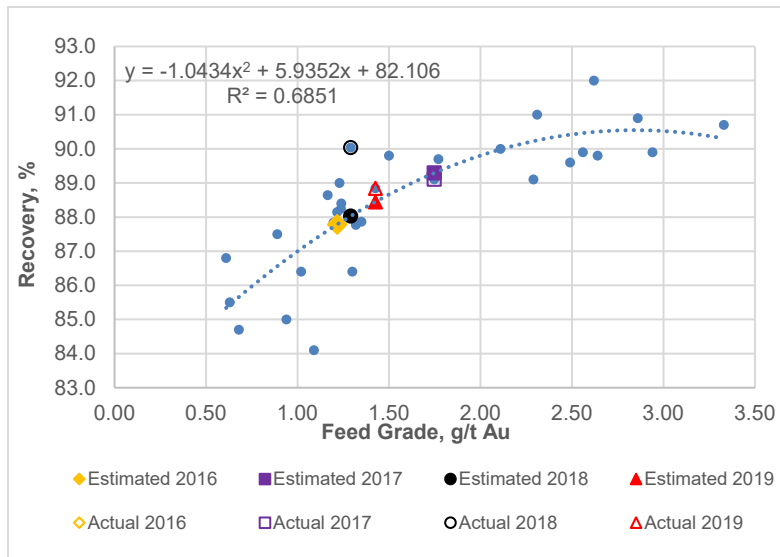
Table 13-1 summarizes the plant production data from 2011 through 2019.

**TABLE 13-1 PLANT PRODUCTION DATA**  
**Mandalay Resources Corporation – Björkdal Gold Mine**

Year	Throughput (kt)	Feed Grade (g/t Au)	Gravity Recovery (% of Total Au)	Flotation Recovery (% of Total Au)	Plant Recovery (% of Total Au)	Tailings (g/t Au)	Tailings (kg Au)	Production (oz Au)
2011	1,215	1.17	75.0	13.6	88.6	0.131	161	40,358
2012	1,385	1.20	73.2	14.6	87.8	0.146	202	46,808
2013	1,261	1.32	72.3	15.5	87.8	0.161	203	46,941
2014	1,318	1.24	73.8	14.4	88.2	0.145	192	46,292
2015	1,303	1.22	75.7	12.4	88.1	0.144	188	44,920
2016	1,289	1.35	73.6	14.3	87.9	0.164	211	49,140
2017	1,262	1.75	75.2	13.9	89.1	0.190	240	63,186
2018	1,249	1.29	73.1	17.0	90.0	0.129	161	46,662
2019	1,289	1.43	71.4	17.4	88.8	0.159	205	52,514
Total	11,571						1,763	436,845
<b>Average</b>	<b>1,286</b>	<b>1.33</b>	<b>73.7</b>	<b>14.8</b>	<b>88.5</b>	<b>0.152</b>	<b>196</b>	<b>48,538</b>

A new plant project designed to increase rougher flotation retention and to install a second stage of cleaner flotation was completed in 2017. In 2018, an Expert Process Control System was installed. The projects, along with changes to reagents and improvements to the processing strategy, increased gold recovery by approximately 2%. In 2018, the average feed grade was only 1.29 g/t Au and the gold recovery was 90%, which indicates that the plant modifications were successful in increasing gold recovery. A graph demonstrating the relationship between feed grade and recovery (i.e., 1988 through 2019) is provided as Figure 13-2. The recovery estimates based on feed grade for 2016, 2017, 2018, and 2019 and using the formula generated from historical data fall on the trend line, as well as the actual recoveries, whereas the actual recovery for 2018 is much higher than the estimate.

**FIGURE 13-2 HISTORICAL PLANT GRADE-RECOVERY DATA**



The correlations between feed grade and tailings grade for the total plant recovery, the gravity recovery, and the flotation recovery, as shown in Figure 13-3.

**FIGURE 13-3 2016-2019 GRADE TAILINGS GRADE RELATIONSHIPS**

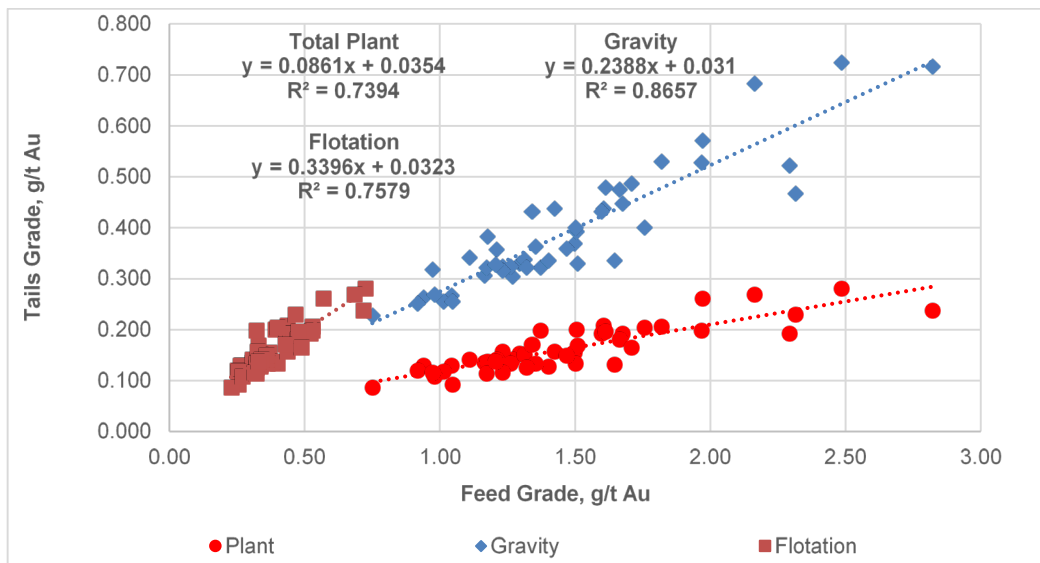


Figure 13-4 provides the monthly tonnages and feed grades for 2016, 2017, 2018, and 2019.

**FIGURE 13-4 2016-2019 OPERATING DATA**

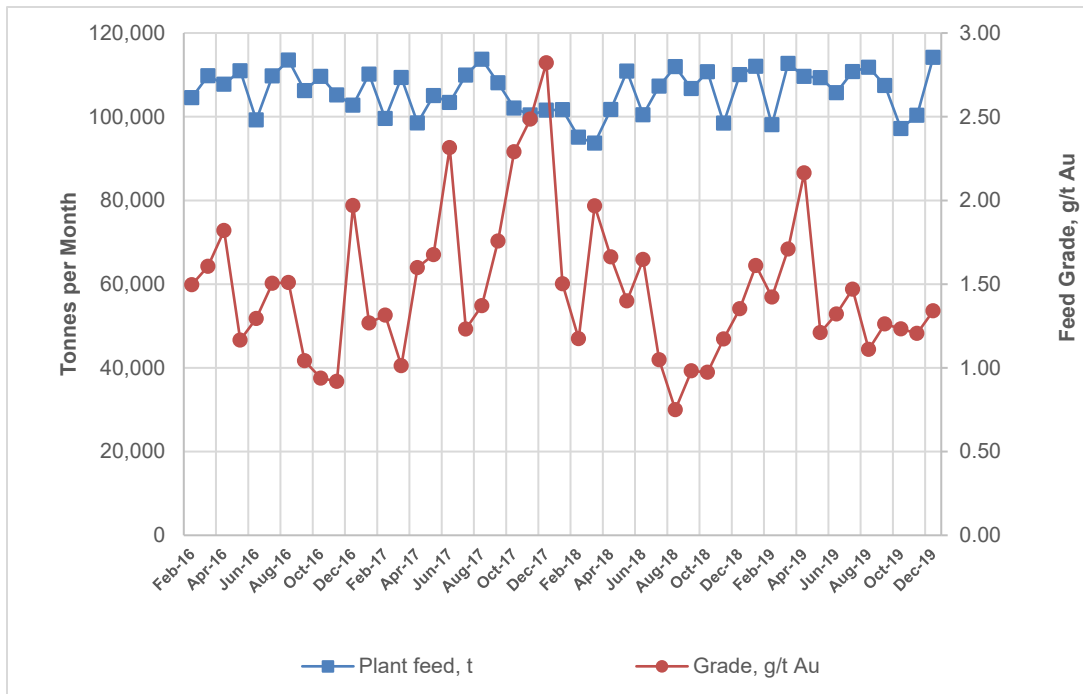


Figure 13-5 compares the 2019 recoveries for the various products with the 2020 LOM budget. Based on this data, the budgeted recovery should be possible.

**FIGURE 13-5 2019 GOLD RECOVERY DATA**

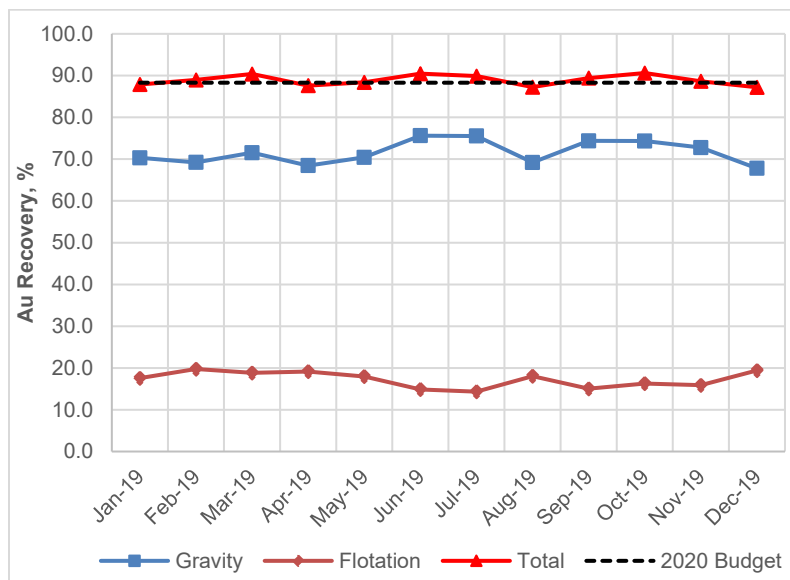
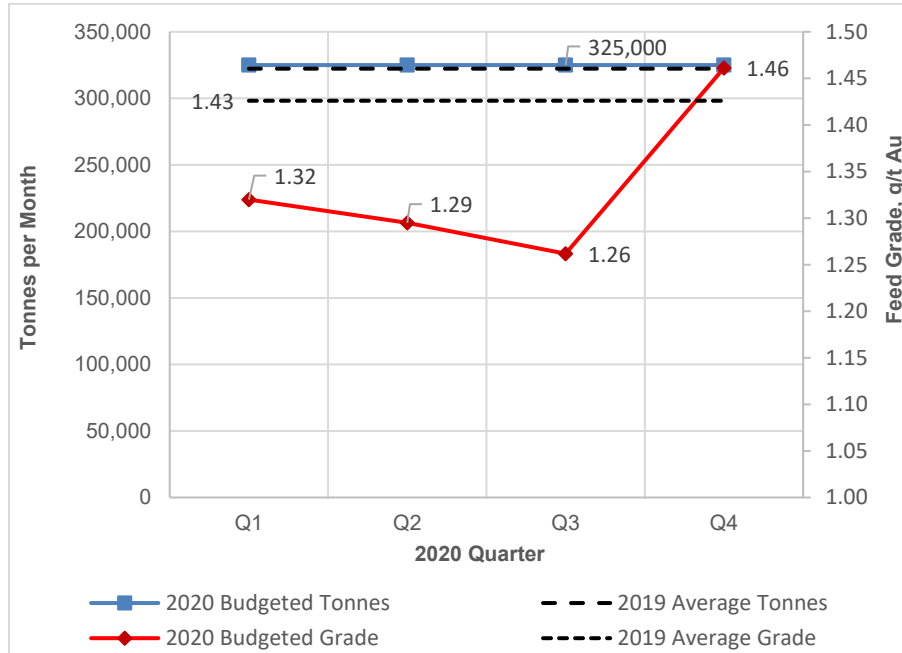


Figure 13-6 compares the 2020 budget to the 2019 averages for tonnage and grade. The average budgeted tonnage for 2020 is approximately 325,000 tonnes per quarter compared to



an average of 322,313 in 2019. The average budgeted head grade in 2020 is 1.33 g/t Au compared to an average of 1.43 in 2019.

**FIGURE 13-6 2020 BUDGET COMPARED TO 2019 AVERAGES**



In RPA’s opinion, the budgeted tonnages and recoveries for 2020 appear to be reasonable based on historical operating data. RPA notes that the total gold recovery for 2020 is reduced from 91% in 2019 to 88.3%. This is as a result of including skarn ore into the mill feed in 2020, from which a slightly lower recovery of gold is achieved. In the LOM plan, however, it increases to 90% in 2021, 90.2% in 2022, and 90.3% for the remainder of the mine life.

RPA is of the opinion that utilizing historical data to predict future performance in the processing plant is appropriate with some adjustments for changes in ore types and feed grade.

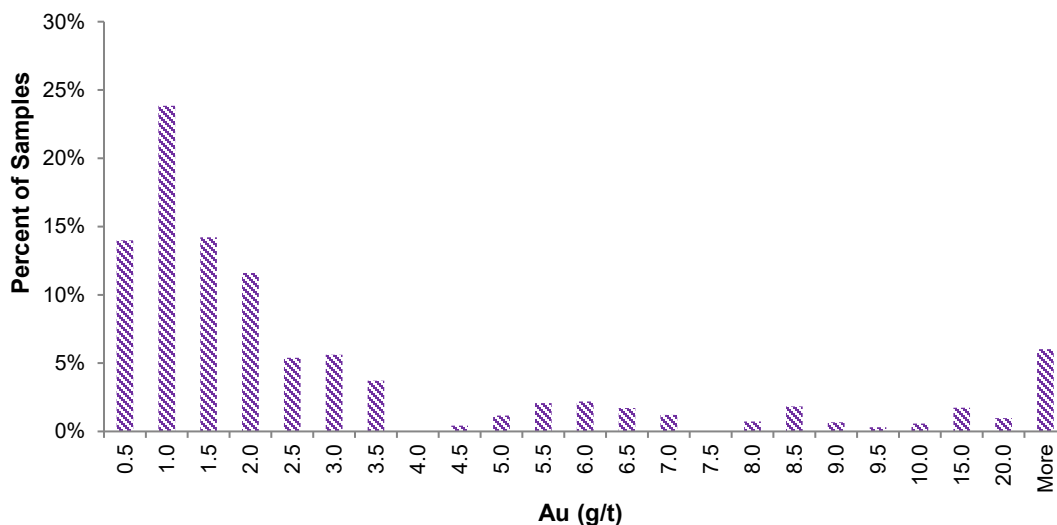
RPA is not aware of any processing factors or deleterious elements that could have a significant effect on economic extraction.

## NORRBERGET METALLURGICAL TEST PROGRAM

ALS Kamloops was commissioned in September 2017 to conduct a pre-feasibility level metallurgical testing program to support the Norrberget Mineral Resource and Mineral Reserve estimates for this Technical Report.

During the September 2017 site visit, RPA selected samples to complete the testing program using available quarter drill core. It was hoped that additional sample material would be available from the RC holes that were being drilled at the time of the site visit, however, upon review of the drill hole locations, it was determined that they fell outside of the areas that are expected to be mined. RPA selected material for three samples based on the grade distribution of the assay data base for samples above the cut-off grade, as shown in Figure 13-7, however, some of the material was below the cut-off grade because the intervals of lower grade material were small and it is anticipated that it will be mined since it is surrounded by higher grade material.

**FIGURE 13-7 NORRBERGET DEPOSIT GRADE DISTRIBUTION DATA**



The samples selected included a Master Composite sample that was estimated to be approximately the average grade of the deposit (i.e., 2.0 g/t Au), a Low Grade sample that was estimated to be near the cut-off grade for the Mineral Resource (i.e., 0.5 g/t Au), and a High Grade sample that was estimated to be approximately 5.0 g/t Au.

The locations of the drill holes are shown in Figure 13-8.

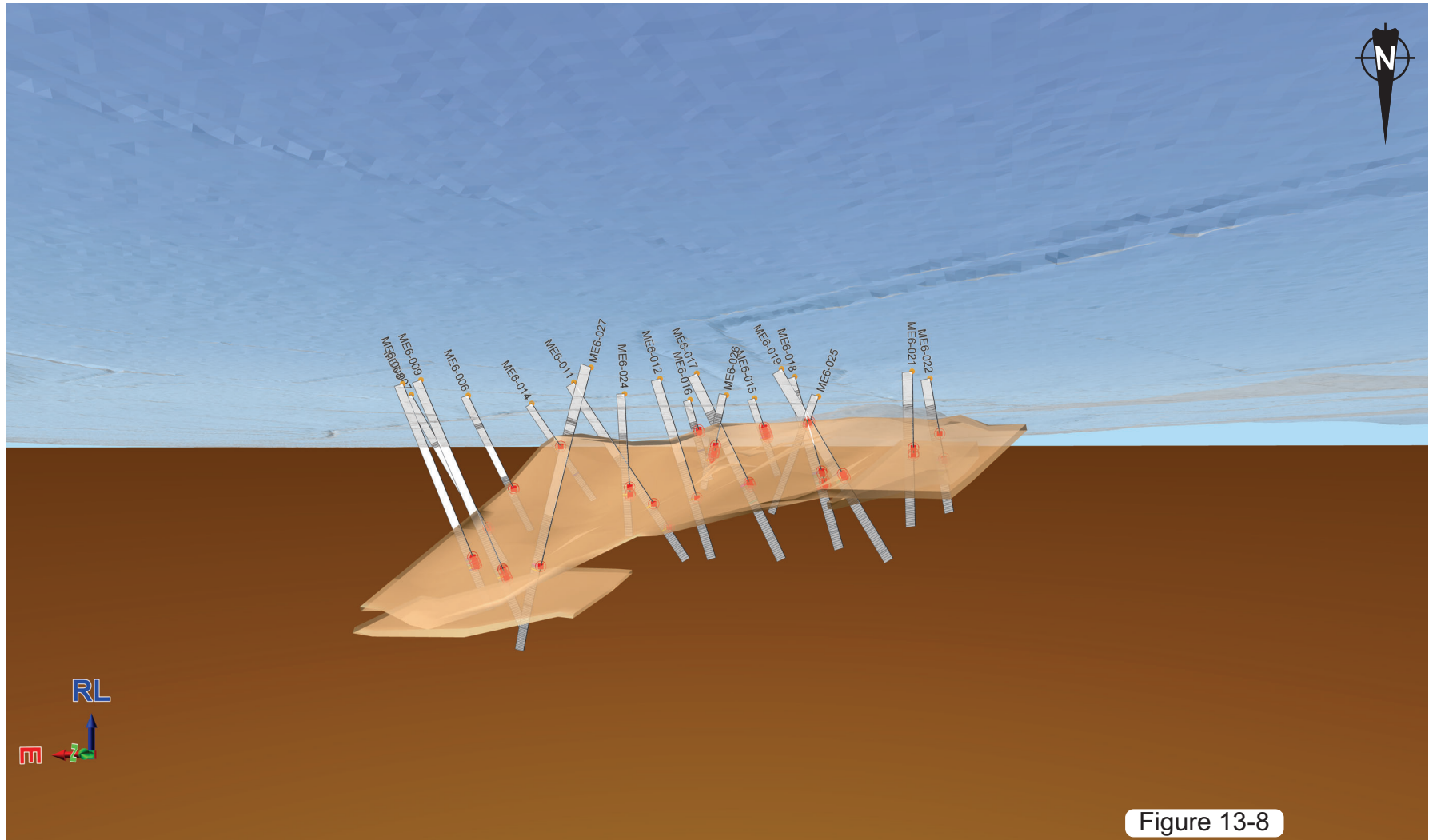
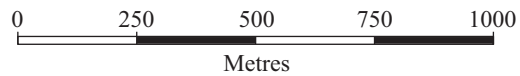


Figure 13-8



Mandalay Resources Corporation

***Björkdal Gold Mine***  
 Västerbotten, Sweden  
**Metallurgical Sample Locations**

## HEAD GRADES

The composite samples were assayed by fire assay. The results are shown in Table 13-2.

**TABLE 13-2 ALS COMPOSITE SAMPLE ASSAYS**  
Mandalay Resources Corporation – Björkdal Gold Mine

Sample	Au (g/t)	Fe (%)	S (%)
Master	6.17	1.90	0.08
Low Grade	0.79	1.77	0.07
High Grade	6.22	2.70	0.07

The Master Composite Au grade was three times higher than estimated from the geological data for the drill core intervals that were used. Since material from Björkdal is consistently difficult to assay due to the presence of coarse gold, it is anticipated that the calculated head grades from the metallurgical tests will be more accurate. Table 13-3 compares the assay data with the calculated head grades from the tests that have been completed at the date of this report.

**TABLE 13-3 ALS MASTER COMPOSITE HEAD GRADE COMPARISONS**  
Mandalay Resources Corporation – Björkdal Gold Mine

Data Source	Au (g/t)
Estimated	1.93
Assayed	6.17
KM5489-01	5.36
KM5489-02	5.17
KM5489-03	5.18
KM5489-04A	5.01
KM5489-05A	5.21
KM5489-06B	7.77
KM5489-07B	5.19
KM5489-08A	4.80
KM5489-09A	5.28
KM5489-12A	5.67
KM5489-20A	4.75
KM5489-21A	5.16
Assayed by Size Fraction	6.52

The calculated head grades are somewhat lower than the assayed head grades but still significantly higher than the estimated head grade. The assay procedure used by the Björkdal geological staff for drill-hole assays is the Cyanide Extractable Gold Using LeachWELL

accelerant on 500 g samples which has historically been more accurate than traditional fire assays due to the larger sample size. In order to evaluate whether the large difference is estimated grade and actual grade of the Master Composite was a sample preparation problem or an analytical problem, splits of the sample were sent to CRS and ALS in Piteå Sweden for analysis using the LeachWELL procedure. CRS completed the geological assays for Norrberget. The results are shown in Table 13-4.

**TABLE 13-4 MASTER COMPOSITE HEAD GRADE ANALYSIS USING LEACHWELL**  
Mandalay Resources Corporation – Björkdal Gold Mine

Laboratory	Au (g/t)
CRS	6.95
ALS Piteå	5.61
ALS Piteå QC	5.58

**BOND BALL MILL WORK INDEX**

One Bond ball mill work index test was completed using the Master Composite sample. The result is 12.2 kWh/t, which is similar to the Björkdal ore which is currently being processed.

**GRAVITY GOLD RECOVERY**

Gravity gold recovery tests were completed using three grind sizes to determine whether there is any relationship to gravity gold recovery and grind size. The results of the three tests and a fourth test that was used to prepare feed for a flotation test are provided in Table 13-5.

**TABLE 13-5 ALS MASTER COMPOSITE GRAVITY GOLD RECOVERY DATA**  
Mandalay Resources Corporation – Björkdal Gold Mine

Test	K <sub>80</sub> (µm)	Calculated Head (g/t Au)	Recovery (%)
KM5489-01	244	5.36	48.2
KM5489-02	180	5.17	50.5
KM5489-03	172	5.18	51.1
KM5489-04A	193	5.01	51.3

The gravity gold recovery is approximately 50% and appears to be independent of the particle size. Based on these results, the decision was made to conduct further tests at the standard

Björkdal particle size of 80% passing ( $K_{80}$ ) 206  $\mu\text{m}$ . Due to some discrepancies with the grind calibrations, this was subsequently changed to  $K_{80}$  193  $\mu\text{m}$ .

## FLOTATION TESTS

A series of flotation tests was conducted using the Master Composite sample in order to evaluate optimum flotation conditions for the Norrberget material. Four gravity plus rougher flotation tests and five gravity plus cleaner flotation tests were conducted. Following the optimization phase of the test program, one gravity plus rougher flotation test and one gravity plus cleaner flotation test was conducted using the High Grade sample and the Low Grade sample. The results are shown in Table 13-6. The selected conditions were used for tests KM5489-12A and KM5489-20A.

**TABLE 13-6 ALS FLOTATION TEST DATA**  
Mandalay Resources Corporation – Björkdal Gold Mine

Test	$K_{80}$ , ( $\mu\text{m}$ )	Gravity		Con Grade (g/t Au)	Rougher Flotation Recovery (%)	Cleaner Flotation Recovery (%)	Concentrate Grade (g/t Au)	Total Recovery (%)
		Calculated Head (g/t Au)	Recovery (%)					
<b>Master Composite</b>								
KM5489-04A	193	5.0	51.3	167.2	23.8		57.2	75.0
KM5489-05A	193	5.2	51.2	185.7	24.8		34.7	76.0
KM5489-06B	90	7.8	60.6	320.0	25.1		66.8	85.7
KM5489-07B	140	5.2	53.0	204.9	26.6		43.5	79.6
KM5489-08A	193	4.8	47.2	158.0		27.1	64.2	74.3
KM5489-09A	193	5.3	63.2	221.3		8.00	62.1	71.2
KM5489-12A	193	5.7	52.4	199.7		25.3	40.6	77.7
KM5489-20A	193	4.7	42.2	153.7		32.6	29.6	74.8
KM5489-21A	47	5.2	54.6	183.1		37.1	20.7	91.8
Average		5.4						
<b>Low Grade</b>								
KM5489-11A	214	0.57	38.2	14.8	29.5		5.4	67.7
KM5489-13A	214	0.66	41.1	17.5		26.1	4.7	67.2
Average		0.62						
<b>High Grade</b>								
KM5489-10A	189	5.9	37.7	140.7	25.2		52.6	62.9
KM5489-18A	189	6.9	37.6	157.0		37.7	52.3	75.3
Average		6.4						

## ESTIMATED RECOVERY

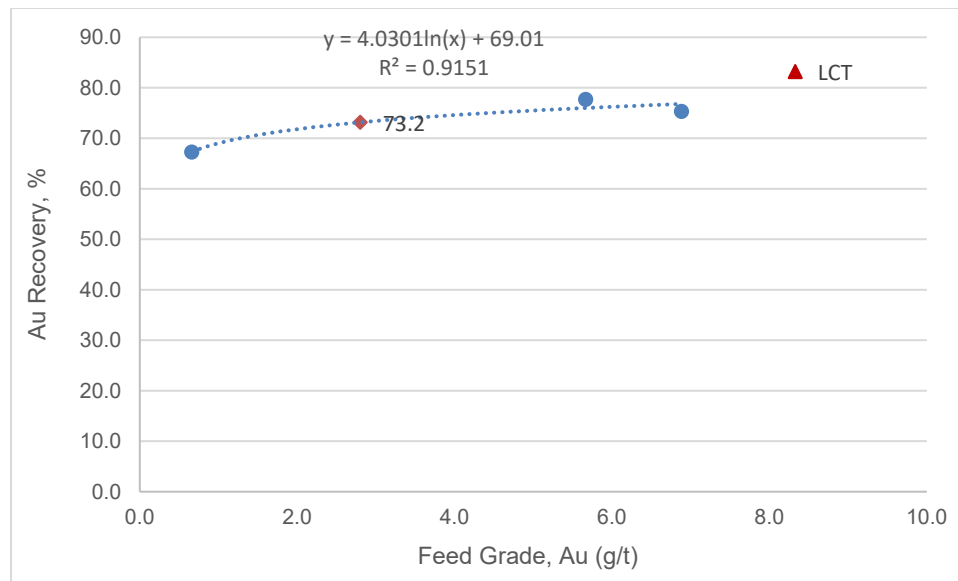
The Norrberget deposit has a metallurgical response that is different from the Björkdal ore. In order to achieve the 91% recovery that Björkdal has, it was necessary to grind to a particle size that has a  $K_{80}$  of 47  $\mu\text{m}$ . Due to the small size of the Norrberget deposit, it is not anticipated that it would be cost effective to modify the grinding circuit to achieve this recovery. Since it is expected that there is a relationship between grade and recovery, RPA analyzed the limited data that is available to estimate the recovery at the average grade that will be processed over the LOM (i.e., 2.8 g/t Au). The data used to estimate is provided in Table 13-7. RPA chose the results from KM5469-12A for the Master Composite and did not use the results from KM5489-20A because the calculated head grade was much lower than the calculated head grades for the majority of the tests.

**TABLE 13-7 TEST DATA USED TO ESTIMATE RECOVERY**  
Mandalay Resources Corporation – Björkdal Gold Mine

Sample	Au (g/t)	Recovery (%)	Gravity (%)	Flotation (%)
Master	5.7	77.7	52.4	25.3
Low Grade	0.66	67.2	41.1	26.1
High Grade	6.9	75.3	37.6	37.7

Figure 13-9 shows the graphical results of the recovery estimate.

**FIGURE 13-9 RECOVERY ESTIMATE FOR NORRBERGET**



As shown in Figure 13-9, a locked cycle test (LCT) using the Master Composite sample was also conducted by ALS. In general, LCT data is more accurate in estimating plant performance than the open circuit flotation tests and LCT recoveries are somewhat higher than recoveries from open circuit tests. In this case, the calculated head grade was excessively high, which, in RPA's opinion, skews the data. Based on the evaluation using limited data, RPA estimates that the average gold recovery will be a total of 75% with approximately 45% of the gold recovered in the gravity circuit and the remaining 28.2% recovered in the flotation circuit.

### **QEMSCAN AND DIAGNOSTIC LEACH**

In order to evaluate the differences in the mineralogy between Björkdal and Norrberget, diagnostic leach tests and QEMSCAN bulk mineral analysis (BMA) and trace mineral search (TMS) were completed using the bulk concentrate from test 20.

The diagnostic leach tests showed that the majority of the gold was cyanide leachable, which indicates that it was exposed. Very little of the gold was encapsulated in silicates. It is theorized that the particles may be too small to be recovered by flotation.

The mineral composition from the BMA is provided in Table 13-8 and the sulphide deportment is provided in Table 13-9.



**TABLE 13-8 ALS MINERAL COMPOSITION OF BULK CONCENTRATE**  
**Mandalay Resources Corporation – Björkdal Gold Mine**

Mineral	Mineral Content (wt. %)
Chalcopyrite	1.4
Molybdenite	0.1
Sphalerite	0.1
Galena	<0.1
Pyrrhotite	17.3
Pyrite	2.0
Iron Oxides	0.3
Feldspars	32.5
Amphibole	19.4
Quartz	9.1
Micas	6.2
Carbonates	3.9
Chlorite	1.8
Epidote	2.3
Sphene (Titanite)	1.7
Apatite	0.6
Bismuth Telluride	0.4
Others	0.8
<b>Total</b>	<b>100</b>

Notes:

1. Chalcopyrite includes trace amounts of Bornite, Chalcocite/Covellite and Tennantite/Enargite.
2. Iron Oxides includes Magnetite, Hematite and Goethite/Limonite.
3. Feldspars includes Feldspar Albite, Plagioclase Feldspar and K Feldspar.
4. Micas includes Biotite/Phlogopite and trace amounts of Muscovite.
5. Carbonates includes Calcite and trace amounts of Ankerite.
6. Others includes Nickel Iron Sulphide, Cobaltite(?), Gold/Electrum and unresolved mineral species.
7. A Particle Mineral Analysis was used for the data.

**TABLE 13-9 ALS SULPHUR DEPARTMENT OF BULK CONCENTRATE  
Mandalay Resources Corporation – Björkdal Gold Mine**

Mineral	Test 20 Bulk Concentrate (%)
Chalcopyrite	6.2
Molybdenite	0.6
Sphalerite	0.3
Galena	0.1
Pyrrhotite	79.6
Pyrite	12.9
Other Sulphur Bearing Minerals	0.5
<b>Total</b>	<b>100</b>

Notes:

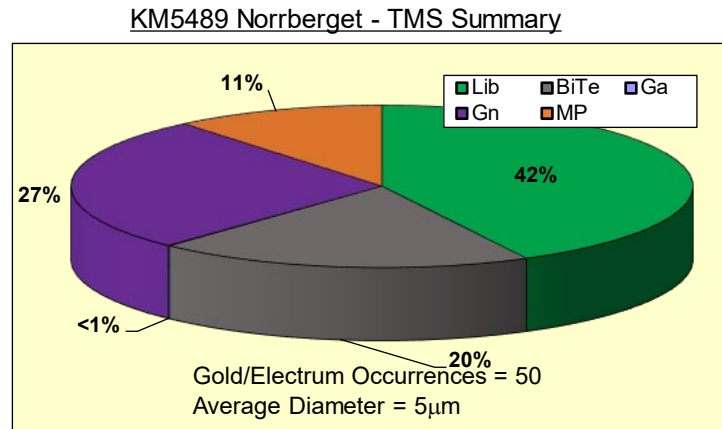
1. Chalcopyrite includes trace amounts of Bornite, Chalcocite/Covellite and Tennantite/Enargite.
2. Other Sulphur Bearing Minerals includes Nickel Iron Sulphide and Cobaltite(?).

Figure 13-10 compares the results of the TMS for Norrberget with results from an earlier Björkdal study.

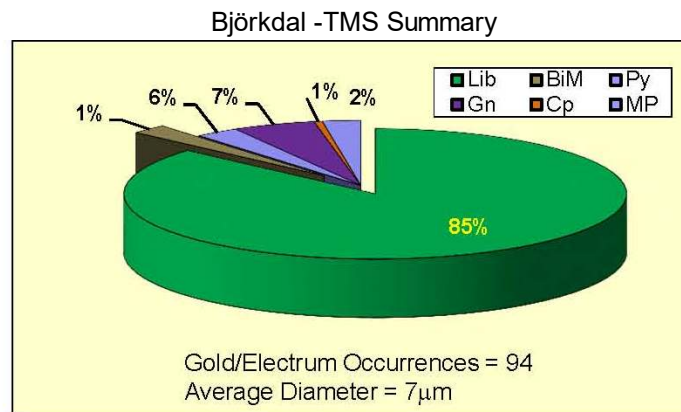
Fifty gold bearing particles were assessed. The electrum particles measured on average > 80% gold per the x-ray spectra. From the figure it can be seen that the gold/electrum occurrences identified for the Norrberget bulk concentrate appear to be more complex. A lower percentage of the gold surface area was identified as liberated gold/electrum particles, whereas a higher percentage was associated with either bismuth-telluride particles, non-sulphide gangue particles, or in multiphase form. The average mean projected diameter of gold bearing particles was also somewhat finer than that for the Björkdal bulk concentrate, at 5 µm versus 7 µm.

RPA is not aware of any processing factors or deleterious elements that could have a significant effect on potential economic extraction.

**FIGURE 13-10 QEMSCAN TMS RESULTS FOR NORRBERGET AND BJÖRKDAL**



Note: Lib - Liberated Gold particle; BiTe - Gold particle with Bismuth-Telluride; Ga - Gold particle with Galena; Gn - Gold particle with Non-sulphide Gangue; MP - Gold particle in Multiphase.  
Data above is shown on an adjusted gold particle surface area basis, where particles greater than 50 percent area are considered liberated.



Note: Lib - Liberated Gold particle; Cp - Gold particle with Chalcopyrite; Py - Gold particle with Pyrite; Gn - Gold particle with Non-sulphide Gangue; FeOx - Gold particle with Iron Oxides; MP - Gold particle in Multiphase.  
Data above is shown on an adjusted gold particle surface area basis, where particles greater than 50 percent area are considered liberated.

# 14 MINERAL RESOURCE ESTIMATE

## SUMMARY

Table 14-1 presents a summary of Björkdal and Norrberget Mineral Resources as of December 31, 2019.

**TABLE 14-1 MINERAL RESOURCES AT THE BJÖRKDAL MINE AND NORRBERGET DEPOSIT AS OF DECEMBER 31, 2019**  
Mandalay Resources Corporation – Björkdal Gold Mine

Location	Area	Tonnage (kt)	Grade (g/t Au)	Contained Au (koz)
<b>Indicated Mineral Resources</b>				
Björkdal	Open Pit	3,114	2.08	208
	Underground	9,656	2.58	799
	Stockpile	2,644	0.64	54
	Subtotal	15,414	2.14	1,062
Norrberget	Open Pit	144	3.29	15
<b>Total, Indicated</b>		<b>15,558</b>	<b>2.15</b>	<b>1,077</b>
<b>Inferred Mineral Resources</b>				
Björkdal	Open Pit	3,338	1.30	139
	Underground	2,143	2.36	163
	Subtotal	5,480	1.71	302
Norrberget	Open Pit	3	4.03	0.5
<b>Total, Inferred</b>		<b>5,483</b>	<b>1.71</b>	<b>302</b>

Notes:

1. Björkdal Mineral Resources are estimated using drill hole and sample data as of September 30, 2019 and account for production to December 31, 2019.
2. Norrberget Mineral Resources are estimates using drill hole and sample data as of September 30, 2017.
3. CIM (2014) definitions were followed for Mineral Resources.
4. Mineral Resources are inclusive of Mineral Reserves.
5. Mineral Resources are estimated using an average gold price of US\$1,500/oz and an exchange rate of 9.0 SEK/US\$.
6. High gold assays were capped to 30 g/t Au for the open pit mine.
7. High gold assays for the underground mine were capped at 60 g/t Au for the first search pass and 40 g/t Au for subsequent passes.
8. High gold assays at Norrberget were capped at 24 g/t Au.
9. Interpolation was by inverse distance cubed utilizing diamond drill, reverse circulation and chip channel samples.
10. Open pit Mineral Resources are estimated at a cut-off grade of 0.34 g/t Au for Björkdal and 0.35 g/t Au for Norrberget and constrained by the resource pit design.
11. Underground Mineral Resources are estimated at a cut-off grade of 0.80 g/t Au.
12. A nominal two metres minimum mining width was used to interpret veins using diamond drill, reverse circulation, and underground chip sampling.
13. Stockpile Mineral Resources are estimated at a cut-off grade of 0.40 g/t Au and are based upon surveyed volumes supplemented by production data.

- 
14. Mineral Resources that are not Mineral Reserves do not have demonstrated economic viability.
  15. Numbers may not add due to rounding.

RPA is not aware of any environmental, permitting, legal, title, taxation, socio-economic, marketing, political, or other relevant factors that could materially affect the Mineral Resource estimate.

## **BJÖRKDAL**

### **TOPOGRAPHY AND EXCAVATION MODELS**

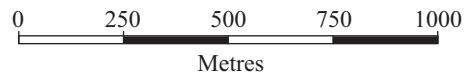
Mandalay carried out a LiDAR survey in July 2016 to provide a digital surface for rendering onto an aerial photograph that was taken at the same time (Figure 14-1). The digital surface created from that survey was edited by Mandalay to incorporate the topographic surface of the open pit mine following cessation of mining activities in the open pit on August 1, 2019. The resulting integrated model of the topographic surfaces was provided to RPA in a digital format that was suitable for use in coding the block models and estimating the Mineral Resources.

Access to the underground workings is by means of two adits that are located in the north wall of the open pit mine. Due to the shallow plunge of the mineralized vein system, each new level is accessed by means of ramp only. Excavation of the gold-bearing material is carried out using a blast hole sub-level retreat method.



14-3

Figure 14-1



**Mandalay Resources Corporation**

***Björkdal Gold Mine***

*Västerbotten, Sweden*

**Plan View of the LIDAR Topographic  
Surface as at September 30, 2016**

The excavated volume of development headings is determined by Mandalay staff on a weekly basis using a reflector-less total station unit that is able to measure the excavated volume of a given advance using reference survey spads that have been placed into the walls of a drive. The resulting digital data is downloaded into the Surpac software package which is then used to construct a three-dimensional model of the excavated volume. This three-dimensional model is then merged with the existing excavation volume. The resulting solid volume is checked for validity and is ultimately used to code the block model for the excavated material. The block model is coded for the development excavations using the stated sub-block resolution.

An area of uncontrolled subsidence has occurred in the upper reaches of the underground mine such that access to this area is no longer possible. A simple generalized wireframe model was created to encompass this area. All blocks within this volume were coded as depleted volumes for the long-term block model. As the mine staff consider that any mineralized wireframes within this volume have the potential for being recovered by means of open pit mining methods, this subsidence area was not considered as excavated for the open pit mining surface.

Mandalay is modifying the procedures by which the excavated volume of the stoped out material is determined. Under the new protocols, the excavated volume of a given stope is measured using a cavity monitoring system (CMS) survey once mining of the stope has terminated. The raw digital data that is produced from the initial survey is processed using the software package that accompanies the CMS unit to produce a reasonable three dimensional digital shape of the mined out volume. This data is then converted into the Surpac file format for use in estimating the amount of unplanned dilution (also referred to as overbreak) and mining losses (also referred to as underbreak).

Due to a number of uncertainties relating to the past quality of the shapes resulting from the CMS surveys and the exact location of the mineralization in three-dimensional space relative to the mineralized wireframe models, a slightly different method is used to code the excavated volumes of the stopes into the block model. For the 2019 Mineral Resource estimate, all parent blocks and sub-blocks that are either completely within or are touching a given stope excavation model are considered to have been excavated. The block model is coded accordingly. For the 2019 Mineral Resource estimate, the designed shapes of the stopes were

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used to code the block model rather than the three-dimensional shapes determined from the CMS surveys.

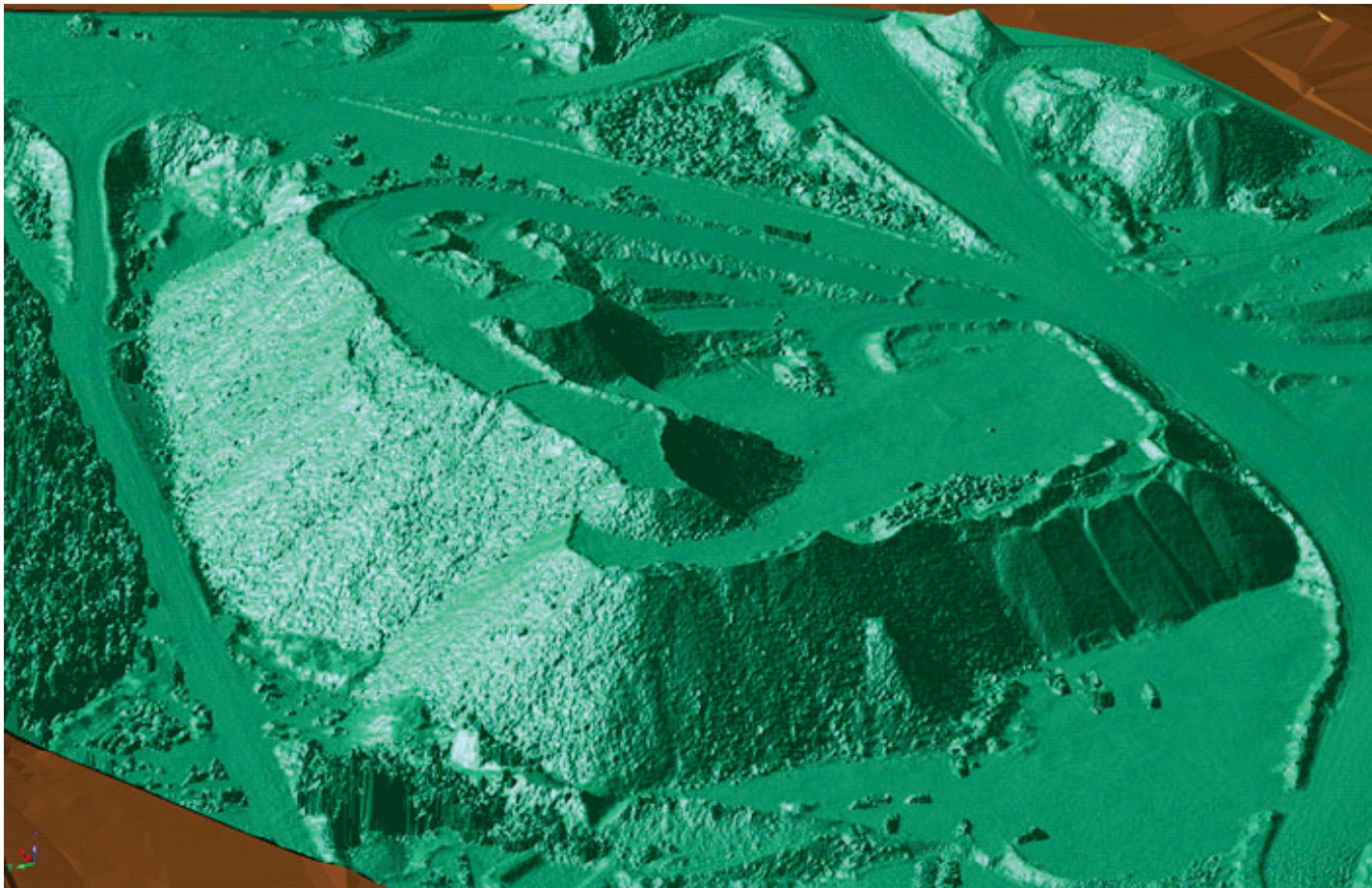
RPA recommends that the actual as-mined volumes as determined from the CMS surveys be used to code the block model rather than the design shapes. Use of the actual excavated volumes will improve the block model reconciliation results for those stopes which are accessed by means of a bottom drive only (i.e., the “blind” stopes).

Topographic surveys of those stockpile areas that were active in 2019 were conducted towards the close of 2019 using drone-mounted LIDAR surveying methods (Figure 14-2). The bases of the stockpiles were taken from earlier topographic surfaces that were completed prior to the commencement of building these piles. The volumes of the stockpiles were reported from the resulting merged surfaces and the tonnages were estimated using a bulk density of 1.80 t/m<sup>3</sup>, representing a swell factor of approximately 35%. The resulting tonnages were reconciled against the stockpile material flows for 2019.

As of December 31, 2019, the development had reached an elevation of approximately -500 m (approximately 400 m vertically from surface, Figure 14-3).



Looking North-West



14-6

Figure 14-2

*Not to Scale*

**Mandalay Resources Corporation**

***Björkdal Gold Mine***

*Västerbotten, Sweden*

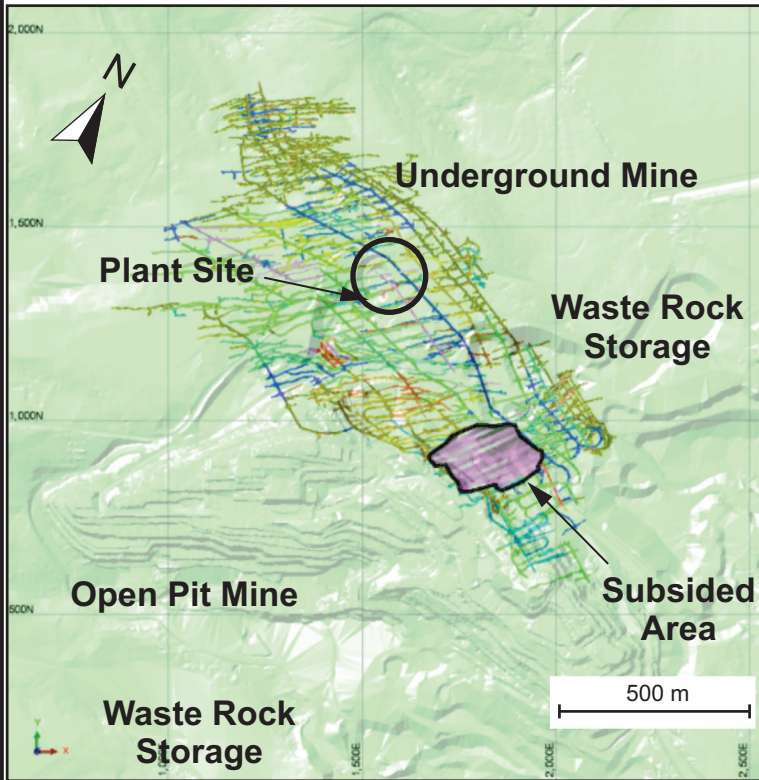
**Inclined View of the Norra Stockpile  
as at December 3, 2019**

March 2020

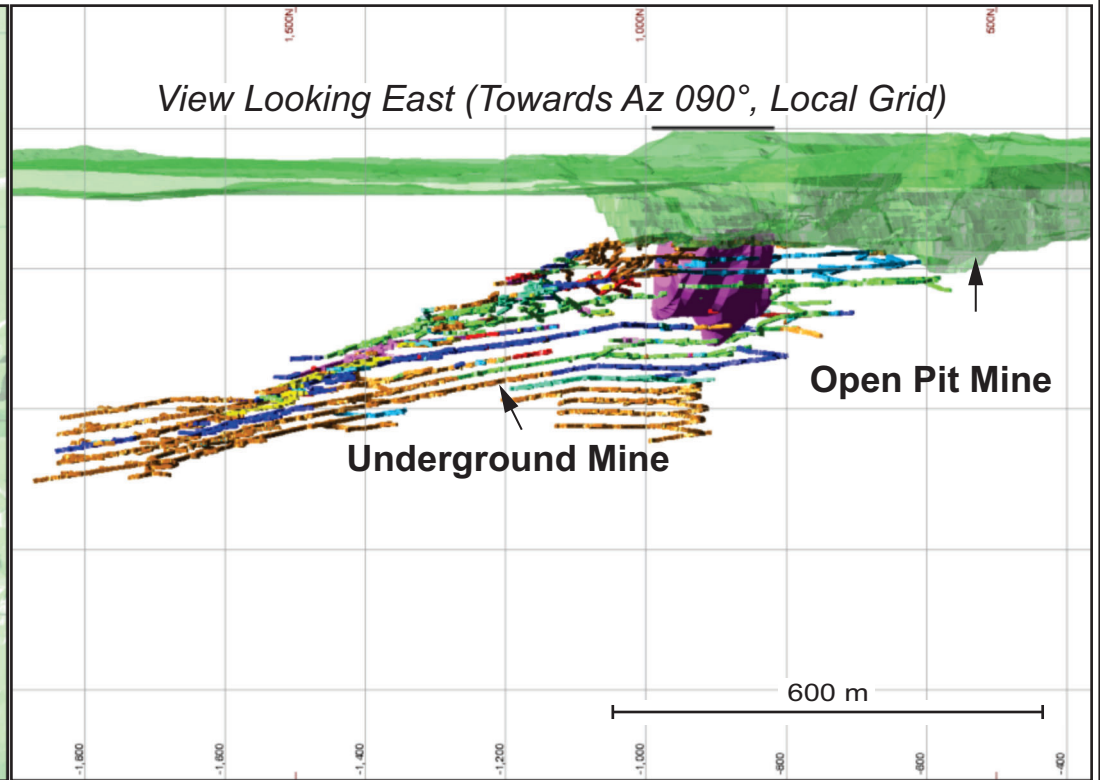
Source: RPA, 2020.

www.rpacan.com

Plan View



Sectional View



14-7

Figure 14-3

**Mandalay Resources Corporation**

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***Björkdal Gold Mine***  
*Västerbotten, Sweden*

**Plan and Section View of the Björkdal Mine Workings as at December 31, 2019**

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## DESCRIPTION OF THE DATABASES

The presence and distribution of the gold mineralization found at the Mine is defined by means of diamond drill holes (DDH), RC drill holes located in the open pit mine, chip/channel samples taken from underground faces, and channel samples taken of blasted rock in the open pit mine for grade control purposes. Samples of the sludge created from development drilling are also collected for information purposes but are not used for preparation of Mineral Resource estimates. All information is entered into the GeoSpark geological database management system. Information from the chip sampling programs is entered into the master database system as pseudo-drill holes to facilitate their use in the Mineral Resource estimation process.

The Mine operates on a metric local grid coordinate system wherein the local grid north is 29.67° west of true north (i.e., local grid north is approximately towards azimuth 330° true). All drill hole and sampling information is entered into the GeoSpark master database using this local grid coordinate system.

Subsets from this master database are extracted and used for estimations on an as-needed basis. For the preparation of the 2019 Mineral Resource estimate for the Mine, all of the drill holes contained within the master database were used to prepare the estimate. All of the drill hole data are in the MS Access database format and were modified for use by the GEOVIA Surpac 2019 (Refresh 1) mine modelling software package. Additional fields to store such information as the composited assay values and wireframe flags were created as required during preparation of the Mineral Resource estimate. A value of 0.01 g/t Au was inserted into the database by means of a computer script for any unsampled intervals. A search of the database revealed a number of samples with very short lengths. These were viewed as representing grab samples collected for information purposes and were removed from the database. A total of 505 samples were removed from the database during this process.

RPA recommends that a new category be created for the Confidence Interval of the drill hole collar table of the drill hole database. This new category will be used to identify grab samples or other sample information that do not have a meaningful sample length associated with them.

The cut-off date for the drill hole database is September 30, 2019, and the database includes all drilling carried out at the Storheden deposit. The location of the drill holes which were used to prepare the 2019 Mineral Resource estimate were shown in Figure 10-1. A summary of the database is provided in Table 14-2.

**TABLE 14-2 SUMMARY OF THE BJÖRKDAL DRILL HOLE DATABASE AS OF SEPTEMBER 30, 2019**  
**Mandalay Resources Corporation – Björkdal Gold Mine**

Hole Type	No. Holes	Total Length (m)
<b>Surface</b>		
CH	528	289.3
DDH	399	57,572.4
GP	7,258	6,546.4
RC	4,452	232,355.4
<b>Total, Surface</b>	<b>12,637</b>	<b>296,763.5</b>
<b>Underground</b>		
CH	23,092	29,473.7
DDH	1,631	205,305.6
<b>Total, Underground</b>	<b>24,723</b>	<b>234,779.3</b>
<b>Grand Total</b>	<b>37,360</b>	<b>531,542.8</b>

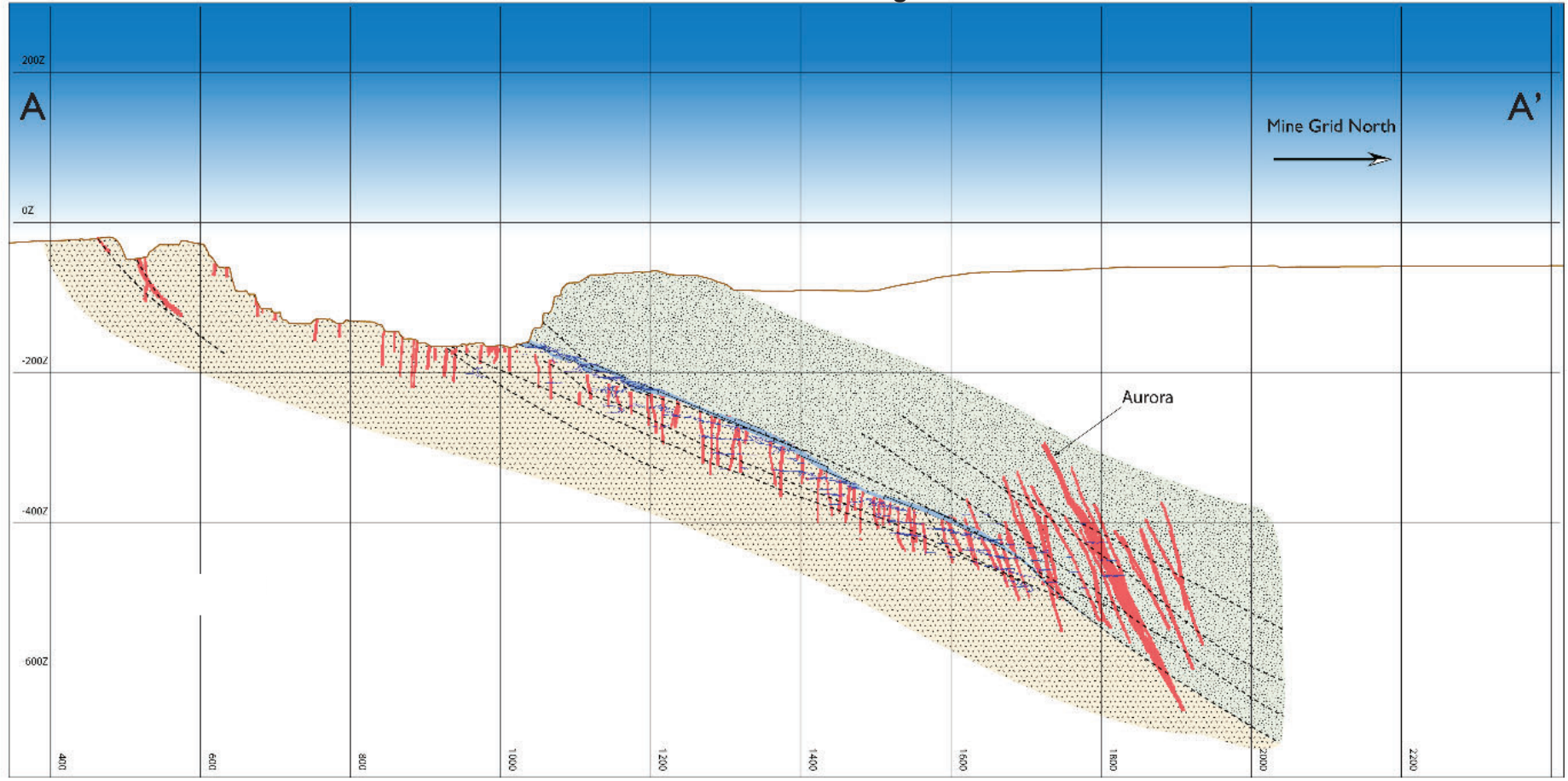
### LITHOLOGY AND MINERALIZATION WIREFRAMES

Wireframe models of the mineralized veins were utilized in geological and grade continuity studies and to constrain the block model interpolation. Wireframe models of the Björkdal veins were constructed by Mandalay and reviewed by RPA. RPA notes that the vein models reflect the grades relating to a targeted vein only and do not include any potentially significant unsampled mineralization that may be present between the veins.

The majority of the past known mineralization at the Mine has been structurally controlled and hosted within a single homogenous host rock (the footwall intermediate volcanic unit), hence construction of a lithological model had historically been judged to be unnecessary other than creation of a surface of the bottom of the marble unit which had been the upper limit of the known veins in the past.

As a result of the additional exploration and development work carried out in 2019, the previous understanding of the relationship of the gold-bearing mineralization with the host rocks and structural features is evolving (Figure 14-4). In contrast, the newly discovered mineralization in the Aurora Zone is seen to be hosted in the hangingwall mafic volcanic unit which is in fault contact with the footwall intermediate volcanic and marble units across the Björkdal, Freya, Odin, and Balder fault zones.

Section 1400 E Looking West



14-10

Figure 14-4

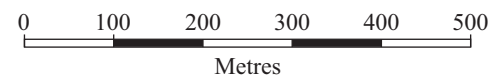
**Mandalay Resources Corporation**

*Björkdal Gold Mine*  
*Västerbotten, Sweden*

**Cross Sectional View of the Björkdal Mineralization**

**Legend:**

Marble	Interbedded Mafic/Intermediate Volcanics	Fault trace
Intermediate Volcanics	Mineralised Veins	Developments



A three-dimensional model of the marble unit was constructed from available drill hole and geological mapping information, using the knowledge and understanding gained during 2018 and 2019. This three-dimensional volume was then used to code the block model, as the relationship that this unit plays as a stratigraphic marker and host for the newly discovered skarn-hosted mineralized zones is becoming better understood. Three-dimensional digital models of the known fault surfaces were prepared by the Mine geological team and were used as guides in preparation of the mineralization wireframes.

RPA recommends that efforts be continued to construct a full three-dimensional digital model of the distribution of the host rocks in the vicinity of the Mine area. Immobile element geochemical signatures (e.g., Ti vs. Zr plots) may be useful in assisting to discriminate between the footwall intermediate volcanic and the hangingwall mafic volcanic units.

Mandalay built individual mineralized wireframes separately for open pit (OP) and underground (UG) domains using both the GEOVIA Surpac and Leapfrog software packages. Instances were observed where the vein interpretations created using the Leapfrog software package did not accurately snap to the sampled assay interval.

RPA recommends that care be taken to ensure that all wireframe interpretations are fully “snapped” to the sampled assay intervals, as doing so will improve the accuracy of the local tonnage and grade estimates.

RPA recommends that the graphical compositing function of the Surpac software package be used as a guide to selection of the optimal wireframe widths and to minimize the amount of dilution introduced into the mineralized wireframes.

For ease of use, the individual vein wireframes were grouped according to their spatial locations. A total of 19 wireframe domains were created for the year end 2019 Mineral Resource estimate. The OP wireframes were based on a nominal 0.3 g/t Au cut-off value over a minimum of two metres. The UG wireframes were based on a nominal two metre minimum width at a cut-off value of 0.5 g/t Au.

New tables were created in the database for each vein group and were coded with the intersection information for the individual mineralized wireframes in the open pit and

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underground mines by exploiting the macro/scripting functionality of the GEOVIA Surpac software package.

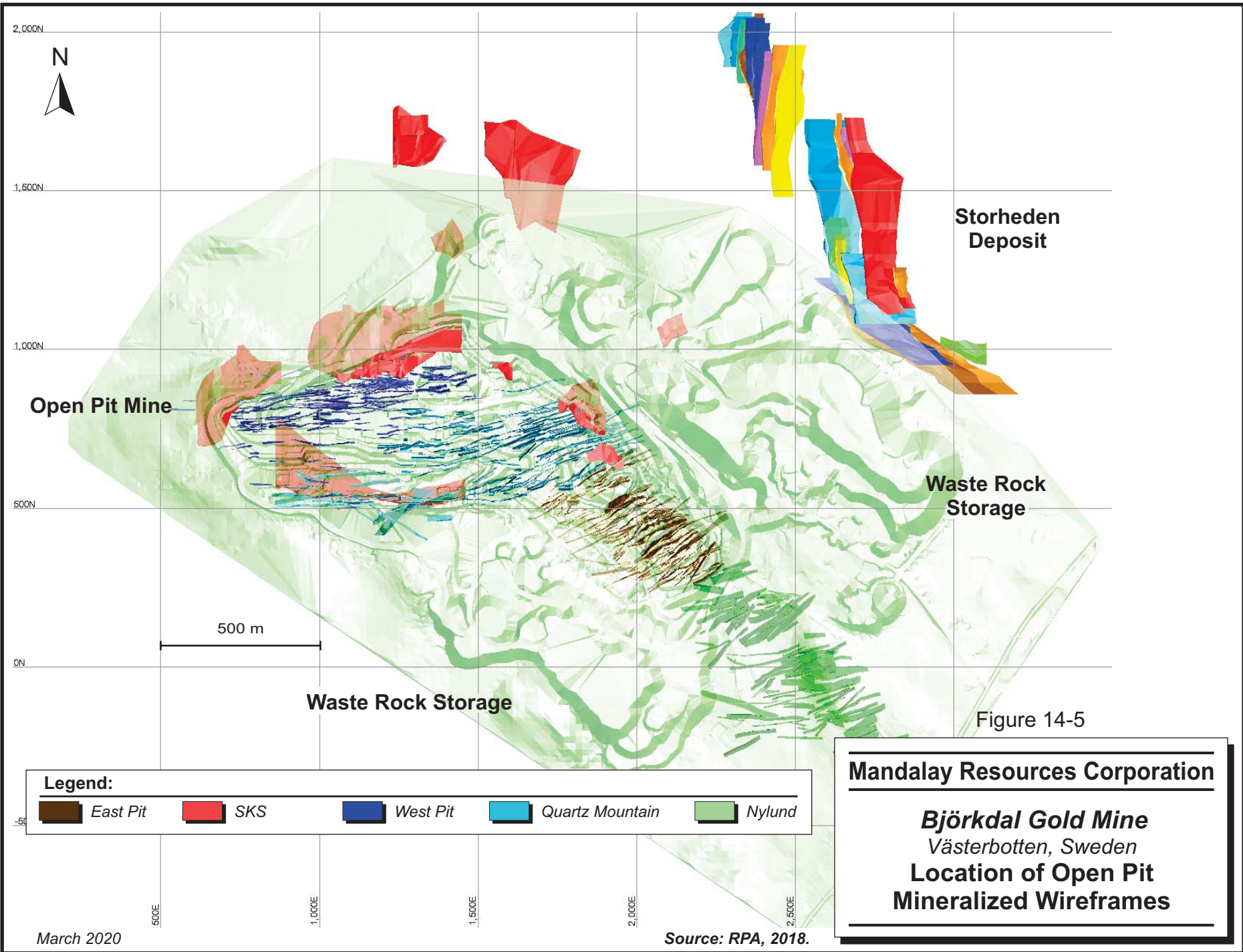
### **OPEN PIT VEIN MODELS**

The OP mineralized wireframe models were grouped into five separate areas as follows: East Pit (EP), West Pit (WP), Quartz Mountain (QM), Shear-Hosted (SKS-Op), and Nylund. In total, 448 individual wireframe models were created for the open pit mine (Figure 14-5).

RPA recommends that the SKS-series wireframes be further divided into shear-hosted units versus skarn-hosted units, and further grouped by open pit or underground mining methods. These further divisions will be of great assistance for future geostatistical studies and block modelling efforts.

The interpretation for the OP mineralized wireframes was guided by mapped quartz veins on various benches in the pit and by knowledge gained from grade control drilling programs. An improved understanding of the distribution and extent of the quartz veining in the open pit resulted in an extensive reinterpretation of the mineralized wireframes for the EP area. The wireframes were created to a minimum width of two metres and were projected to a nominal distance of 30 m away from the last drill hole intercept horizontally, and to a nominal 15 m vertically. The wireframes were driven to mid-distance when barren holes were encountered at the lateral limit of a vein, while occasionally the veins were driven through barren holes to preserve the continuity of the vein.

A total of 22 wireframe models were also created in 2017 for mineralization located at the Storheden deposit but were not used in the current Mineral Resource update.



14-13

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**UNDERGROUND VEIN MODELS**

The construction of the UG vein wireframes was guided by quartz veins mapped in the underground developments, face and wall chip samples, as well as existing underground stopes. Vein shapes from previous years interpretation efforts were retained where no additional information was collected; new interpretations were created for those veins where additional information and knowledge was collected during 2019. The wireframes for the vertically dipping veins were constructed to a minimum width of two metres and were projected up to 30 m away from the last drill hole intercept horizontally, and up to 15 m vertically. The veins were driven through lower grade intercepts or occasionally through barren holes to preserve vein continuity. In many cases, the widths of the mineralized wireframes were drawn larger than the widths of the above cut-off grade assays so as to achieve the minimum width criteria (Figure 14-6). The wireframes were extended to drill hole mid-distance when barren holes were encountered at the lateral limit of a vein. Similar interpretation parameters were applied for the Shear & Skarn hosted (SKS) mineralization.

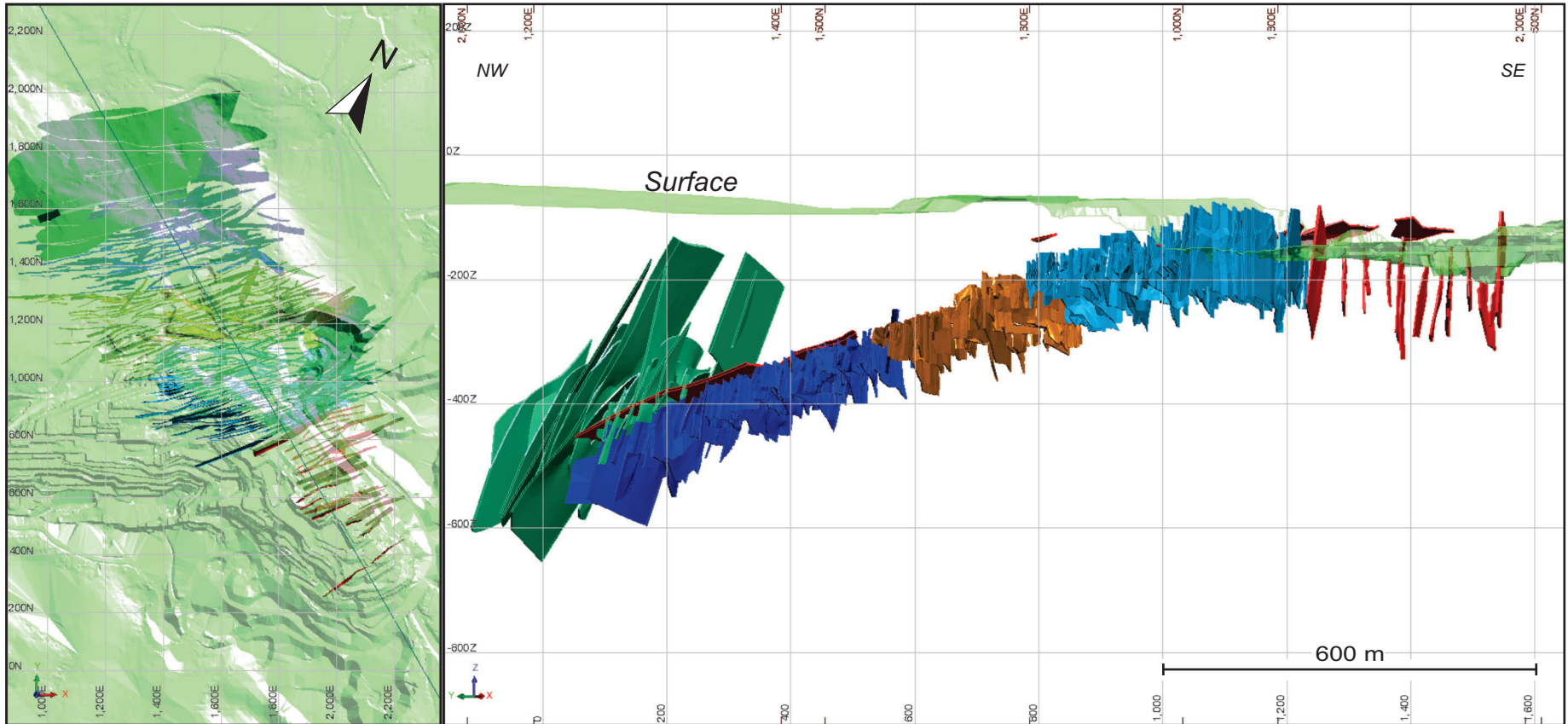
RPA recommends that the two metre minimum width criteria used to create the vein interpretations be examined in light of the reconciliation information being collected for the excavated stopes. Consideration may be given to modifying this minimum width to better reflect the thinnest openings that are being achieved on a day-to-day operational basis.

The UG mineralized wireframe models were grouped into six separate areas as follows: Central Zone (CZ), Lake Zone (LZ), Lake Zone-Aurora (LZA), Main Zone (MZ), Shear & Skarn (SKS-Ug), and South Zone (SZ). A total of 554 individual wireframe models were created for the underground mine (Figure 14-6).

The goal of the UG wireframes was to create continuous models of the mineralized lenses, hence sometimes slight departures from local or general trends might be observed. The general structural fabric of the deposit is characterized by several dominant directions, as shown by the mapped underground veins. These veins show anastomosing, splaying or cross cutting relationships, rendering interpretation and construction of individual wireframes difficult at times, due to occasional multiple interpretation options. The underground chip sampling along any given vein shows marked grade variations, with occasional grouping of higher grades forming ore shoots locally. Information collected from grade control mapping and sampling indicates that some of the veins have formed during progressive periods of strain and brittle movement along fault and shear planes (Figure 14-7). A typical cross section is provided in Figure 14-8.

Plan View

Section View Looking North-East



**Legend:**

- LZA Zone
- Lake Zone
- Central Zone
- Main Zone
- South Zone

Figure 14-6

**Mandalay Resources Corporation**

***Björkdal Gold Mine***  
*Västerbotten, Sweden*  
**Location of the Underground  
 Mineralized Wireframes**

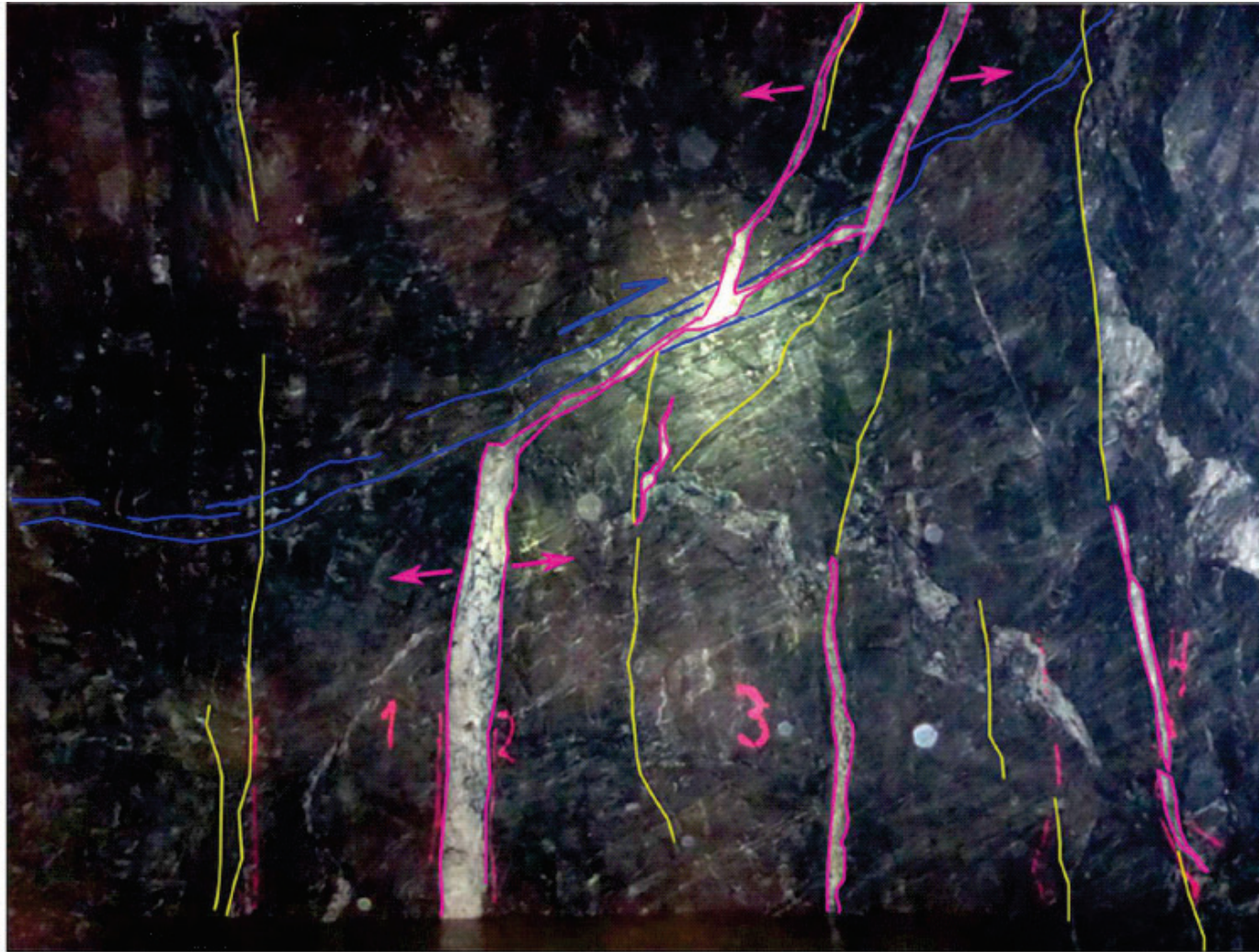


Figure 14-7

**Mandalay Resources Corporation**

***Björkdal Gold Mine***  
*Västerbotten, Sweden*

**Quartz Vein Paragenetic  
Example, Aurora Zone**

### Section View Looking North-East

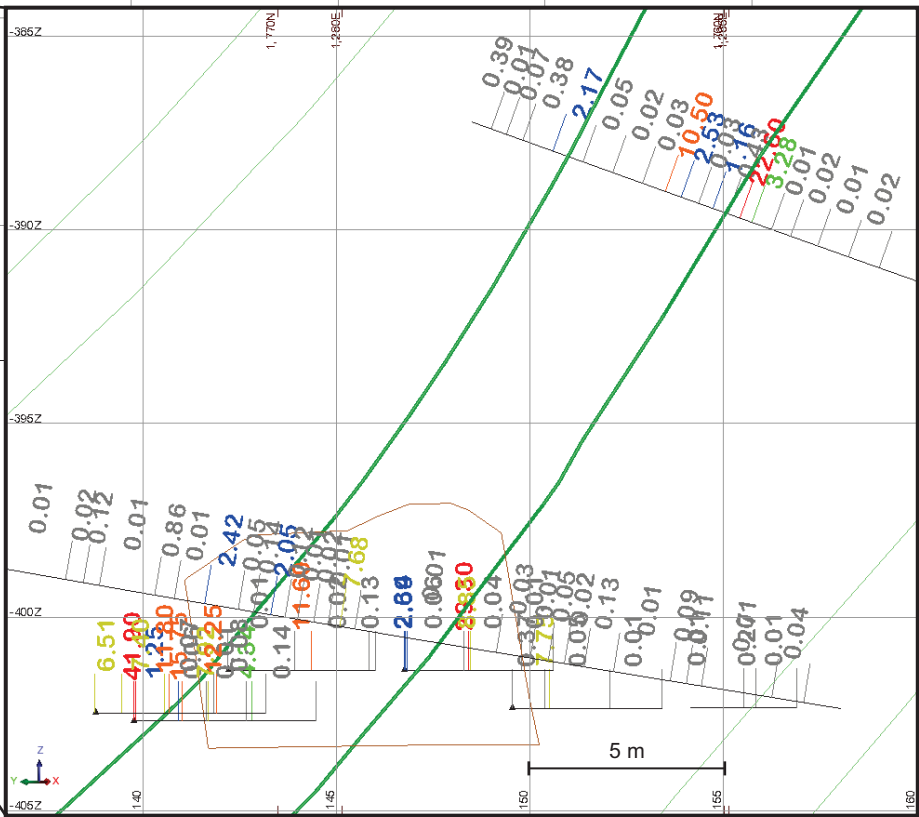
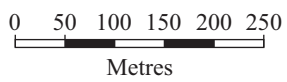
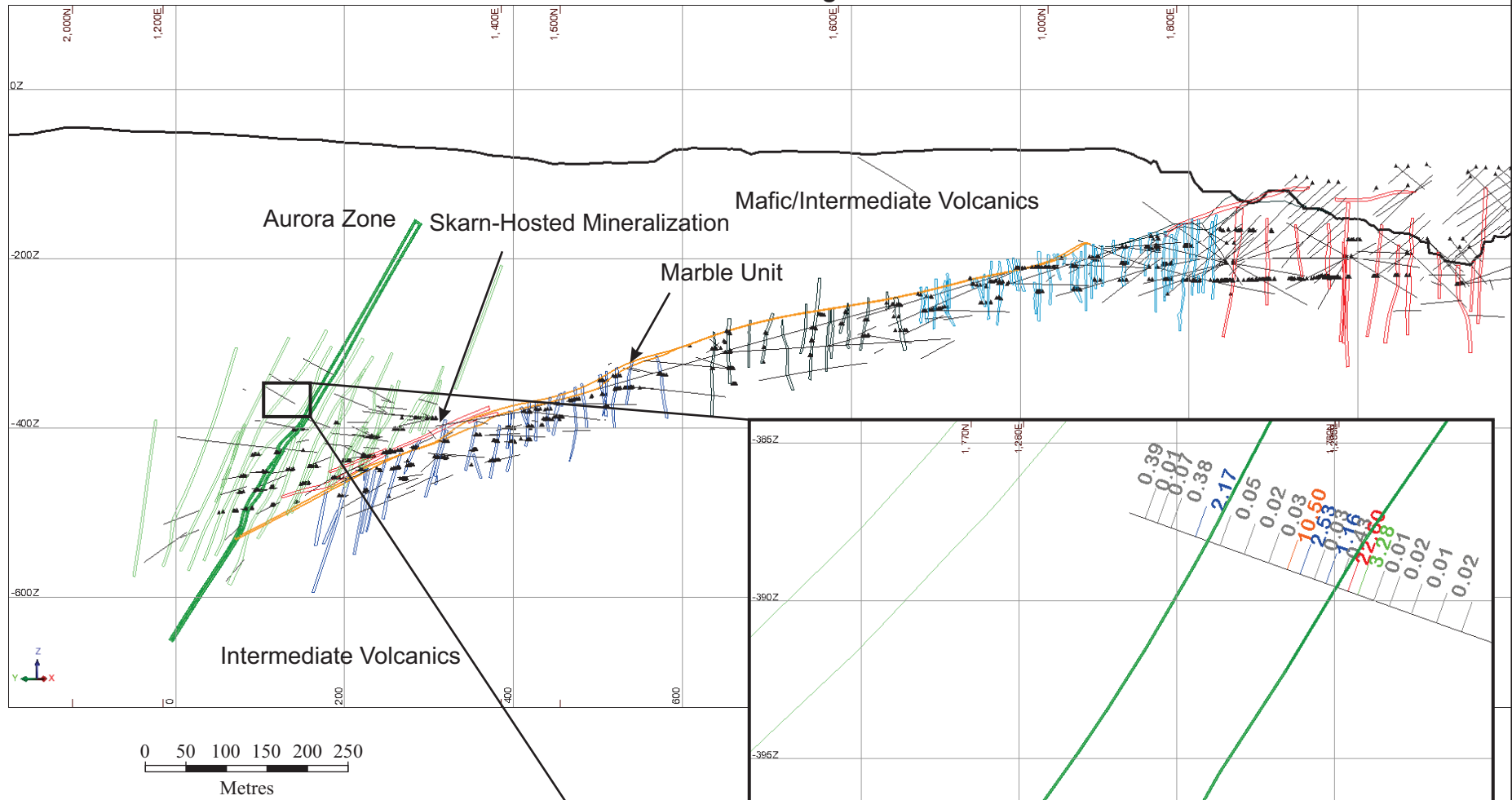


Figure 14-8

**Mandalay Resources Corporation**

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**Björkdal Gold Mine**  
Västerbotten, Sweden

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**Representative Cross Section  
of the Aurora Zone**

March 2020

Source: RPA, 2020.

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## COMPOSITING METHODS AND GRADE CAPPING

### UNDERGROUND MINE

#### Chip Sample Data

The chip sample information for the underground mine has been classified by Mandalay according to the degree of confidence based on the date at which the sample was collected. Those chip samples collected prior to Mandalay's purchase of the Björkdal operations have been assigned a confidence level code of either 10 or 20 in an attempt to recognize the limitations of the sample collection procedures at the time. Those samples collected subsequent to Mandalay's purchase are assigned a confidence level code of 30 or 40 to acknowledge the revised sample collection procedures whereby chip samples are collected across the full width of a given face. Many of the chip samples collected prior to Mandalay's purchase were taken of vein material only, with no sample being collected of either of the walls of the vein.

RPA recommends that the confidence classification for chip/channel samples collected for the LZA group of wireframes be re-examined and reclassified as appropriate.

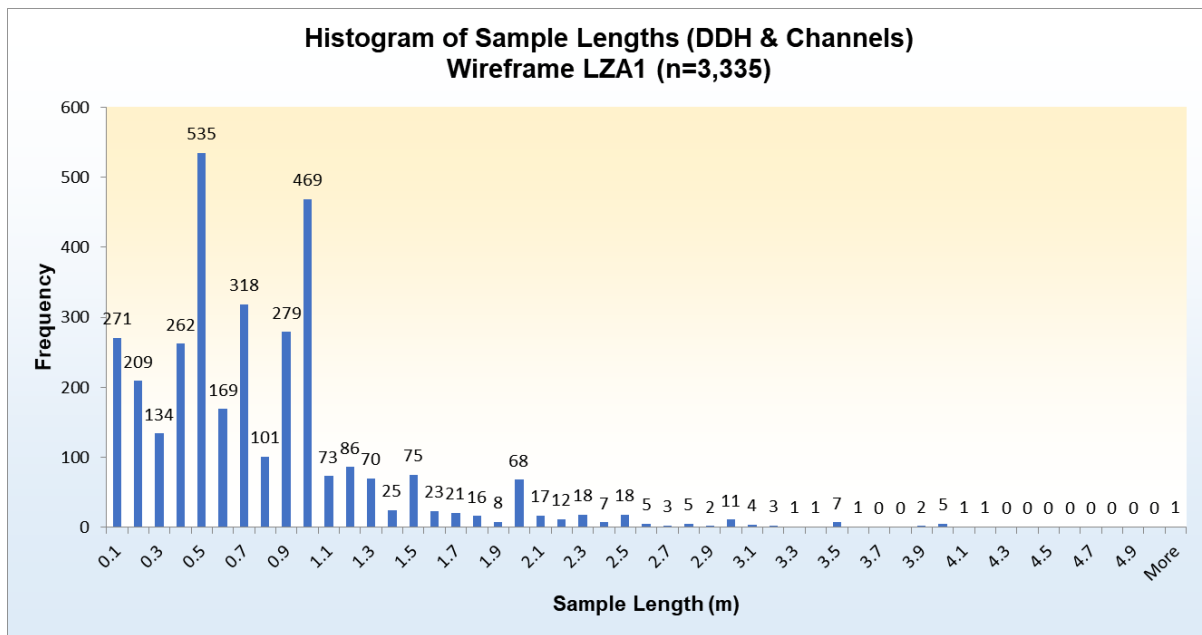
For those chip samples with a confidence level code of either 10 or 20, the grade of the resulting composited, capped sample grade was mathematically diluted to a nominal width of 2.5 m by using the length of the given chip sample as a weighting factor prior to use in estimating the block model grades. The gold grades for chip samples collected by previous operators were capped to 40 g/t Au prior to applying a dilution factor to achieve an equivalent minimum width gold grade. The composited gold grades for chip samples collected by Mandalay are capped to 40 g/t Au.

#### Diamond Drill Holes and RC Drill Holes

Visual examination of the assay tables related to the diamond drill hole data revealed the presence of a large number of un-sampled intervals within and abutting the boundaries of the interpreted mineralization wireframes. Zero values are regularly entered for all such intervals of null values by means of a computer script prior to creation of composited assays. The resulting edited sample information for the diamond drill holes and RC holes was composited into nominal equal lengths of one metre using the best-fit compositing algorithm of the Surpac mine modelling software package. An example of the distribution of the drill hole and channel sample lengths is provided in Figure 14-9. Composited assay values were created on an individual, vein-by-vein basis. Similarly, the assay results in the chip sample databases were

composited into nominal equal lengths of one metre using the best-fit composting function. Both the drill hole and RC samples were assigned a confidence level code of 50 in recognition that these samples are taken on a fully diluted, full-length basis.

**FIGURE 14-9 HISTOGRAM OF SAMPLE LENGTHS, WIREFRAME LZA1 (AURORA ZONE)**



**Capping Values**

The composited assay information for the various versions of chip samples, underground diamond drill holes and the RC drill holes were examined in detail on an individual basis for the year-end 2018 Mineral Resource estimate by means of frequency histograms, decile analyses and probability plots to determine whether capping values are best applied according to the sample type. The results of this analysis showed no material difference in the statistics for the three sample types and that applying the same capping levels to all three sample types was reasonable.

Mandalay elected to maintain the dual capping value approach for estimation of the gold grades contained within the mineralized wireframe models in the underground mine as was used for the previous estimates of the underground Mineral Resources. In this approach, the composited assays for diamond drill holes and RC drill holes are capped to values of 60 g/t Au and 40 g/t Au. Two different areas of influence are then used when estimating the block grades for each mineralized wireframe. The higher grade capped composites are used within a first

pass search ellipse with a 15 m radius while the lower grade capped composites are used for subsequent estimation passes. The summary statistics of the composited, capped assay values for the underground samples that were used to prepare the estimated block model grades are provided in Table 14-3. It is important to note that given the large number of individual vein wireframes that comprise this Mineral Resource estimate, rather than reflecting the specific statistics for each sample type for each vein, these statistics include all composites used to estimate the individual veins within each of these wireframe groups. Consequently, the resulting statistics should be reviewed as being indicative only, rather than being definitive.

**TABLE 14-3 SUMMARY STATISTICS OF THE COMPOSITED, CAPPED SAMPLES BY ZONE, UNDERGROUND MINE  
Mandalay Resources Corporation – Björkdal Gold Mine**

Variable	Central Zone (CZ)		
	Uncapped (g/t Au)	Cap_60 (g/t Au)	Cap_40 (g/t Au)
Weighting Variable	Length	Length	Length
Number of samples	10,623	10,623	10,623
Minimum value	0	0	0
Maximum value	1701.54	60.00	40.00
Mean	3.25	1.61	1.52
Median	0.13	0.10	0.10
Variance	304.30	26.29	19.28
Standard Deviation	17.44	5.13	4.39
Coefficient of variation	5.37	3.19	2.88

Variable	Lake Zone (LZ)		
	Uncapped (g/t Au)	Cap_60 (g/t Au)	Cap_40 (g/t Au)
Weighting Variable	Length	Length	Length
Number of samples	14,523	14,524	14,524
Minimum value	0	0	0
Maximum value	918.58	60.00	40.00
Mean	2.85	1.56	1.48
Median	0.09	0.08	0.08
Variance	301.08	28.13	21.67
Standard Deviation	17.35	5.30	4.66
Coefficient of variation	6.09	3.40	3.14

<b>Lake Zone Aurora (LZA)</b>			
<b>Variable</b>	<b>Uncapped (g/t Au)</b>	<b>Cap_60 (g/t Au)</b>	<b>Cap_40 (g/t Au)</b>
Weighting Variable	Length	Length	Length
Number of samples	10,699	10,699	10,699
Minimum value	0.00	0.00	0.00
Maximum value	1020.00	60.00	40.00
Mean	1.44	1.23	1.21
Median	0.09	0.08	0.08
Variance	35.62	16.06	14.10
Standard Deviation	5.97	4.01	3.76
Coefficient of variation	4.15	3.26	3.11

<b>Main Zone (MZ)</b>			
<b>Variable</b>	<b>Uncapped (g/t Au)</b>	<b>Cap_60 (g/t Au)</b>	<b>Cap_40 (g/t Au)</b>
Weighting Variable	Length	Length	Length
Number of samples	22,910	22,910	22,910
Minimum value	0.00	0.00	0.00
Maximum value	4105.46	60.00	40.00
Mean	4.31	1.88	1.74
Median	0.14	0.10	0.10
Variance	1195.73	38.71	26.74
Standard Deviation	34.58	6.22	5.17
Coefficient of variation	8.02	3.31	2.97

<b>South Zone (SZ)</b>			
<b>Variable</b>	<b>Uncapped (g/t Au)</b>	<b>Cap_60 (g/t Au)</b>	<b>Cap_40 (g/t Au)</b>
Weighting Variable	Length	Length	Length
Number of samples	5,686	5,686	5,686
Minimum value	0.00	0.00	0.00
Maximum value	1230.92	60.00	40.00
Mean	3.49	1.20	1.12
Median	0.07	0.08	0.08
Variance	1655.38	24.94	17.45
Standard Deviation	40.69	4.99	4.18
Coefficient of variation	11.66	4.16	3.74



Variable	Skarn Zones (SKS-UG)		
	Uncapped (g/t Au)	Cap_60 (g/t Au)	Cap_40 (g/t Au)
Weighting Variable	Length	Length	Length
Number of samples	4,538	4,538	4,538
Minimum value	0.00	0.00	0.00
Maximum value	655.23	60.00	40.00
Mean	1.70	1.11	1.06
Median	0.06	0.06	0.06
Variance	205.73	23.42	19.14
Standard Deviation	14.34	4.84	4.37
Coefficient of variation	8.45	4.37	4.12

## **OPEN PIT MINE**

### **Mineralized Wireframe Models**

As for the drill holes intersecting wireframes for the underground mine, zero values were entered for all such intervals of null values in the open pit drill hole database prior to creation of composited assays. The resulting edited sample information for the diamond drill holes and RC holes was composited into nominal equal lengths of one metre using the best-fit compositing algorithm of the Surpac mine modelling software package. Composited assay values were created on an individual, vein-by-vein basis. The open pit sub-set of composite samples included a number of grade control shovel samples that were taken along the width of the observable veins only. These shovel samples were assigned a confidence code of 10 or 20. As with samples from the underground mine, all samples were composited into nominal equal lengths of one metre using the best-fit compositing function.

The composited assay information for the open pit samples were examined in detail on an individual basis by means of frequency histograms, decile analyses, and probability plots to confirm that applying the same capping levels to all three sample types was reasonable.

Mandalay elected to maintain the capping value approach for estimation of the gold grades contained within the mineralized wireframe models in the open pit mine as was used for the previous estimates of the open pit Mineral Resources. In this approach, a capping value of 30 g/t Au has been maintained for the diamond drill hole, RC drill hole, and chip samples contained with the open pit wireframes. The summary statistics of the composited, capped assay values used to prepare the estimated block model grades are provided in Table 14-4.

**TABLE 14-4 SUMMARY STATISTICS OF THE COMPOSITED, CAPPED  
SAMPLES BY ZONE, OPEN PIT MINE  
Mandalay Resources Corporation – Björkdal Gold Mine**

<b>East Pit (EP)</b>		
<b>Variable</b>	<b>Uncapped (g/t Au)</b>	<b>Cap_30 (g/t Au)</b>
Weighting Variable	Length	Length
Number of samples	11,082	11,082
Minimum value	0.00	0.00
Maximum value	390.00	30.00
Mean	1.20	0.69
Median	0.10	0.09
Variance	59.76	5.69
Standard Deviation	7.73	2.38
Coefficient of variation	6.45	3.48

<b>West Pit (WP)</b>		
<b>Variable</b>	<b>Uncapped (g/t Au)</b>	<b>Cap_30 (g/t Au)</b>
Weighting Variable	Length	Length
Number of samples	11,024	11,024
Minimum value	0.00	0.00
Maximum value	901.00	30.00
Mean	1.86	0.83
Median	0.08	0.08
Variance	276.03	8.50
Standard Deviation	16.61	2.92
Coefficient of variation	8.91	3.53

<b>Quartz Mountain (QM)</b>		
<b>Variable</b>	<b>Uncapped (g/t Au)</b>	<b>Cap_30 (g/t Au)</b>
Weighting Variable	Length	Length
Number of samples	15,998	15,998
Minimum value	0.00	0.00
Maximum value	3155.00	30.00
Mean	2.28	0.93
Median	0.08	0.09
Variance	756.12	9.96
Standard Deviation	27.50	3.16
Coefficient of variation	12.08	3.40

<b>Nylund (Nyl)</b>		
<b>Variable</b>	<b>Uncapped (g/t Au)</b>	<b>Cap_30 (g/t Au)</b>
Weighting Variable	Length	Length
Number of samples	2,789	2,789
Minimum value	0.00	0.00
Maximum value	80.77	30.00
Mean	0.60	0.55
Median	0.08	0.08
Variance	8.66	4.75
Standard Deviation	2.94	2.18
Coefficient of variation	4.93	3.93

<b>Skarn Zones (SKS-OP)</b>		
<b>Variable</b>	<b>Uncapped (g/t Au)</b>	<b>Cap_30 (g/t Au)</b>
Weighting Variable	Length	Length
Number of samples	2,059	2,059
Minimum value	0.00	0.00
Maximum value	161.07	30.00
Mean	0.82	0.63
Median	0.06	0.05
Variance	11.89	6.86
Standard Deviation	3.45	2.62
Coefficient of variation	4.21	4.13

### **Dilution Model**

Examination of the distribution of the gold grades for the portion of the Björkdal deposit located within the open pit mine reveals the presence of a significant number of above cut-off grade assay values that are located outside of the limits of the mineralized wireframe models. The current view for these samples is that they represent other occurrences of gold mineralization that are not hosted by a regular series of narrow, steeply dipping quartz veins as represented by the wireframe models. Examples of these types of occurrences could be breccia and/or stockwork styles of quartz veins, vertically dipping quartz veins with limited vertical or lateral extent, or narrow quartz veins that have dips that are not vertical (Figure 14-10). Operational experience from the grade control program supports this view, as a significant amount of additional mineralization is located within the open pit mine each year outside of the modelled zones as a result of sampling at a detailed scale.



Figure 14-10

**Mandalay Resources Corporation**

***Björkdal Gold Mine***

*Västerbotten, Sweden*

**Quartz Vein Breccia and  
Stockwork, Open Pit Mine**

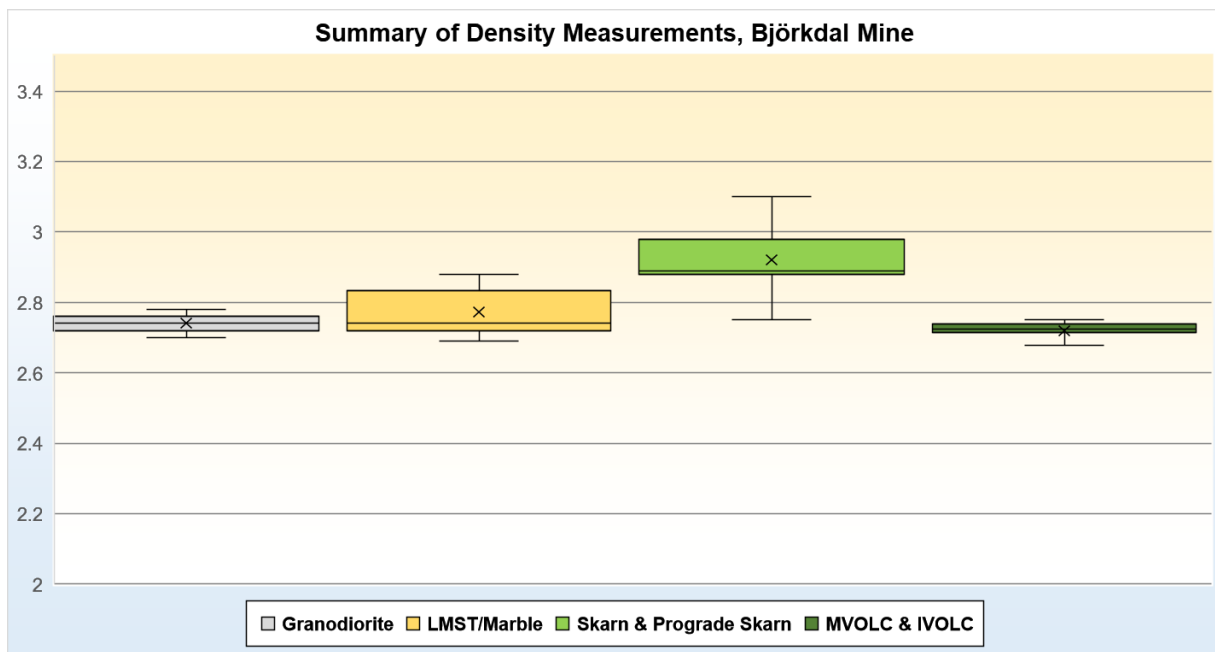
All diamond drill hole and RC drill hole samples that are located outside of the mineralized wireframe models were flagged and composited to nominal equal lengths of one metre using the best-fit compositing algorithm of the Surpac mine modelling software package.

The composited assay information for the open pit diamond drill holes and the RC drill holes located outside of the mineralized wireframe models was examined by means of a frequency histogram to determine an appropriate capping value. A capping value of 30 g/t Au has been selected for the diamond drill hole and RC drill hole samples contained with the dilution model.

**BULK DENSITY**

In 2013, Björkdal collected 176 grab samples selected based on lithology from the open pit and underground for specific gravity analyses. An additional 65 samples were collected from the Aurora and Skarn Zones, as well as the hangingwall and footwall host rocks. The samples were sent to ALS Piteå for OA-GRA08 specific gravity analysis, whereby the specific gravity was determined by a simple water immersion technique on whole rock samples. A summary of all results is shown graphically in Figure 14-11. Table 14-5 presents the summary statistics with the two granodiorite outliers removed.

**FIGURE 14-11 BOX AND WHISKER PLOT OF BJÖRKDAL SPECIFIC GRAVITY MEASUREMENTS**



**TABLE 14-5 SUMMARY STATISTICS FOR BJÖRKDAL SPECIFIC GRAVITY**  
**Mandalay Resources Corporation – Björkdal Gold Mine**

<b>Item/Lithology</b>	<b>Granodiorite</b>	<b>Limestone/ Marble</b>	<b>Skarn &amp; Prograde Skarn</b>	<b>MVOLC &amp; IVOLC</b>
Mean	2.74	2.77	2.92	2.72
Median	2.74	2.74	2.89	2.72
Mode	2.74	2.72	2.88	2.72
Standard Deviation	0.11	0.08	0.09	0.03
Sample Variance	0.01	0.01	0.01	0.00
Minimum	2.24	2.69	2.75	2.62
Maximum	3.32	3.13	3.10	2.75
Count	48	50	13	34

The global bulk density of 2.74 t/m<sup>3</sup> for the footwall mafic and hangingwall intermediate volcanic rocks used for previous Mineral Resource estimates was retained for the current estimate.

RPA recommends that additional samples for density measurements be collected in the Aurora Zone and Skarn Zone mineralization as development activities continue to progress. RPA also recommends that samples be collected from selected exploration drill holes for density measurements.

**TREND ANALYSIS**

**MINERALIZED WIREFRAMES**

Given the large number of mineralized wireframes that comprise the Mineral Resource estimate, the distribution of the gold grades was examined in detail for selected wireframe models only. For this exercise, individual data files were prepared that contained the average gold grade across the entire width for each of the selected mineralized wireframe models. Contours of the average gold grades were then constructed using the contouring function contained within the Surpac software package. The results are presented as longitudinal projections (Figures 14-12, 14-13, and 14-14). Additional longitudinal projections were presented in RPA (2017, 2018, and 2019).

A review of the distribution of the gold grades in the longitudinal projections for the Aurora Zone wireframes (LZA) suggest the following conclusions:

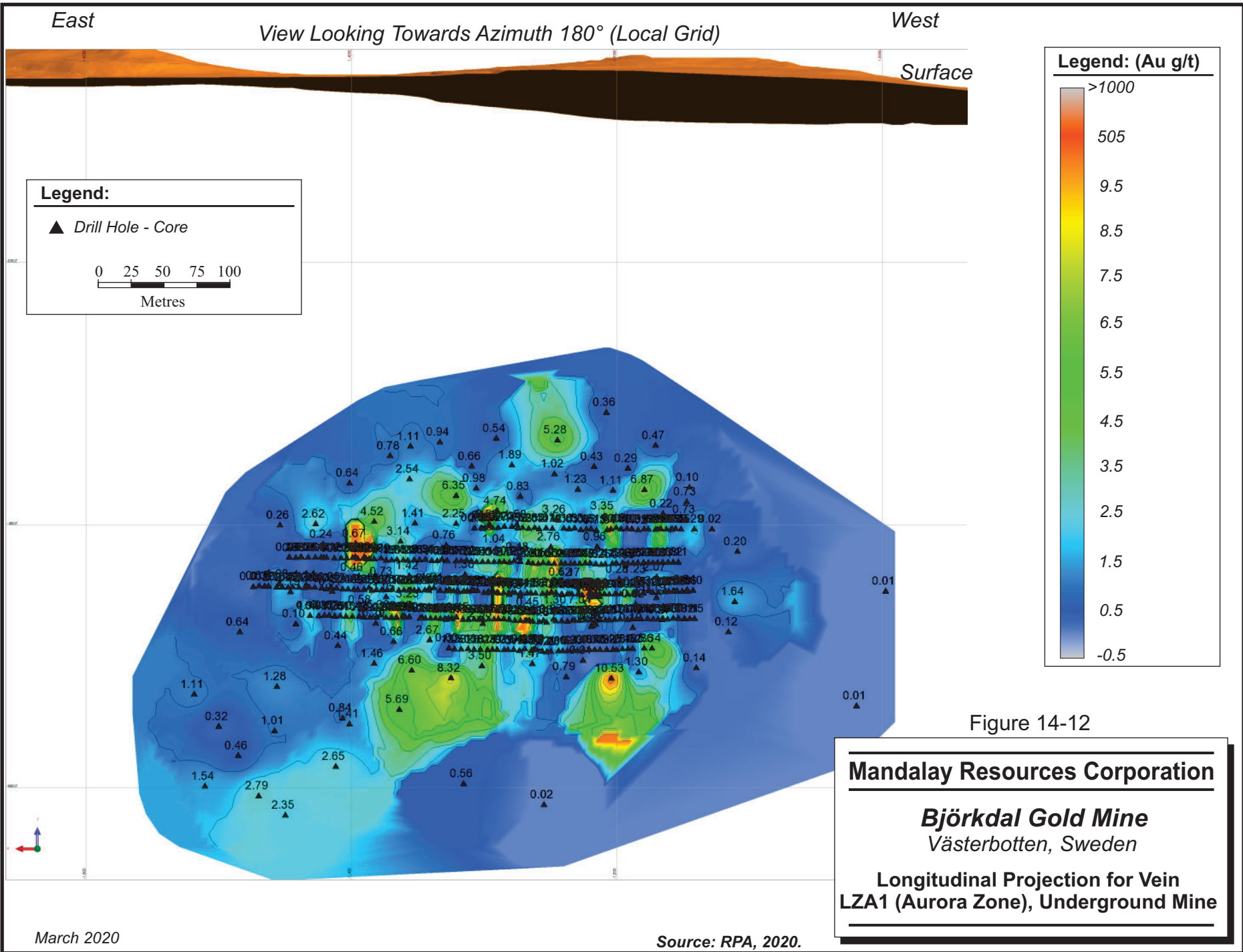
- The gold mineralization in the LZA1 mineralized wireframe seems to occur with two separate characteristics.

- Where the gold grades occur in high grade pockets, detailed chip sampling shows that these occur along short strike lengths (generally less than 10 m to 20 m), but seem to have better vertical continuity. Continuation of the current grade control sampling protocols is clearly necessary for accurate estimates of the gold distribution at the local scale.
- Mineralized intercepts with average grades above approximately 2 g/t Au seem to show better continuities at scales ranging from 10 m to 100 m.
- The up-dip limits of the Aurora Zone have not been defined by the current drilling pattern. The area between the upper limits of the Aurora Zone drilling and the topographic surface should be tested for its potential of hosting economic gold mineralization.
- A southwesterly plunging zone of good gold grades has been outlined by drill holes for the LZA1 wireframe along a length of approximately 150 m. The down-plunge limit of the mineralization of this shoot remains untested by drilling. Additional drilling along the down-plunge projection is clearly warranted.
- Additional sampling should be carried out in the vicinity of the high grade intersections located at the extremities of the LZA101 mineralized wireframe.

On the basis of the knowledge learned from this trend analysis exercise, RPA recommends that efforts continue to examine the distribution of the gold contents within the mineralized wireframes by contouring the gold grades on longitudinal projections on a regular basis. The results will be useful in short term planning and will improve the targeting of exploration and in-fill drilling programs.

For mineralized wireframe interpretations that are wider than the width of the development headings, RPA recommends that Mandalay continue collecting information regarding the distribution of the gold grades in the walls of the development headings by means of the POD-series drill holes. RPA recommends that studies be carried out to examine the impact of the spacing of the POD-series drill holes on the accuracy of the local grade estimate.

RPA recommends that an exercise be carried out that examines whether the use of assay information from the sludge samples collected from development drilling can be used to improve the accuracy of the long-term Mineral Resource block model estimate.



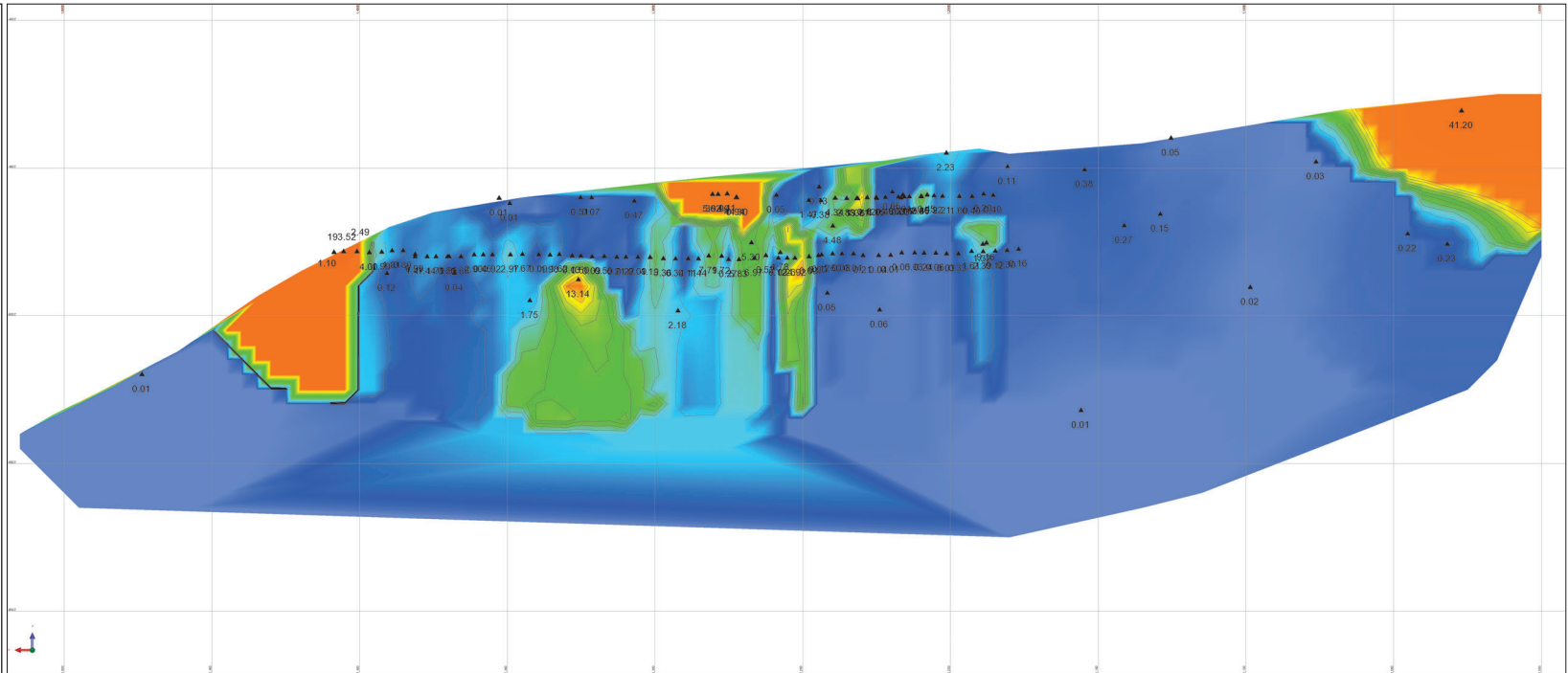
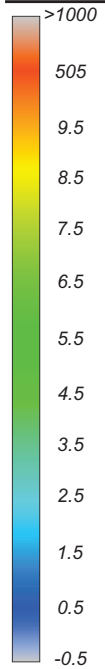


East

View Looking Towards Azimuth 180° (Local Grid)

West

Legend: (Au g/t)



14-30

Figure 14-13

Mandalay Resources Corporation

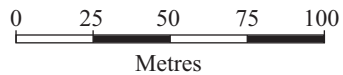
*Björkdal Gold Mine*

*Västerbotten, Sweden*

**Longitudinal Projection for  
 Vein LZ101, Underground Mine**

Legend:

▲ Drill Hole - Core



March 2020

Source: RPA, 2020.

East

View Looking Towards Azimuth 180° (Local Grid)

West

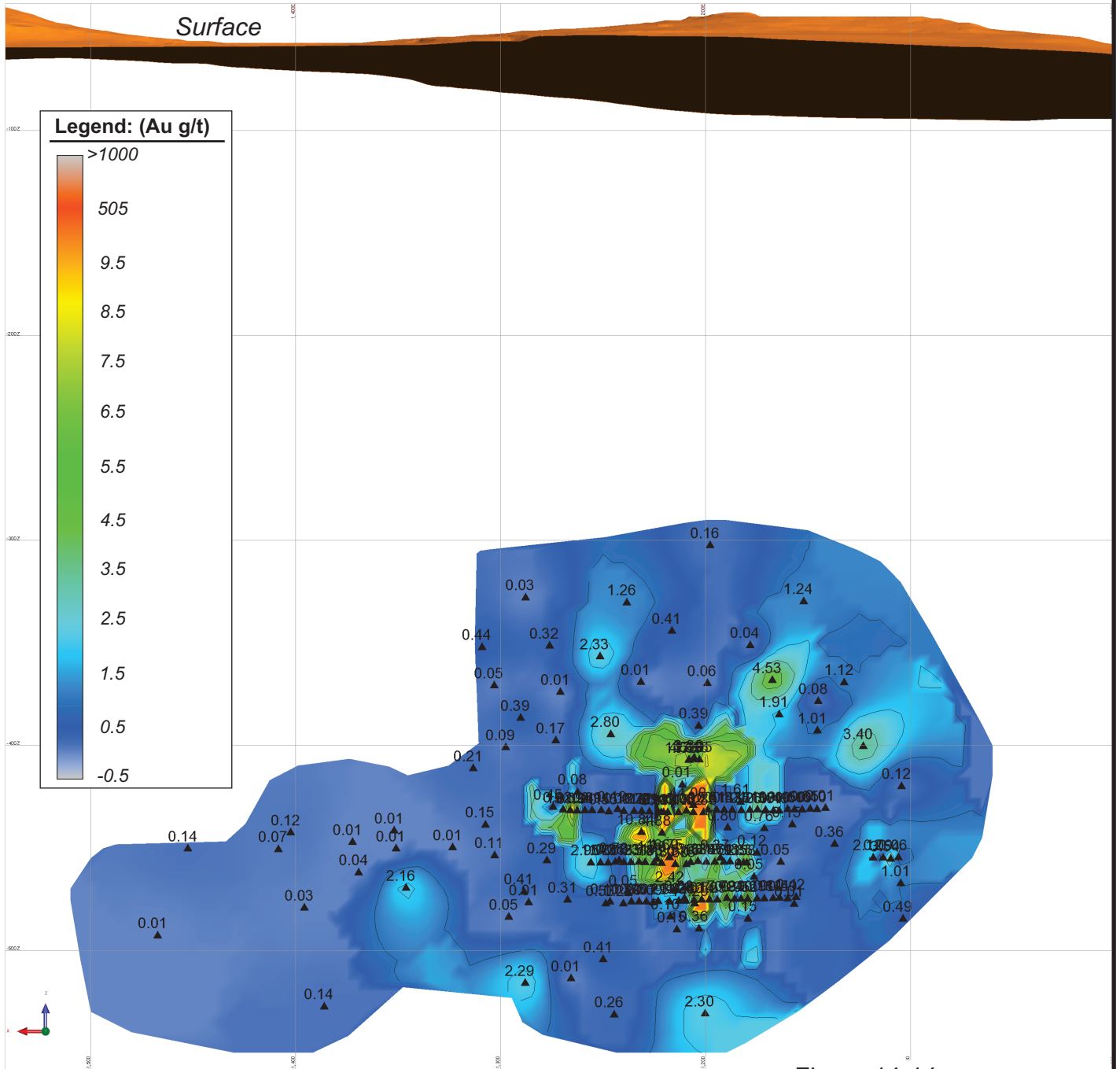


Figure 14-14

**Mandalay Resources Corporation**

**Björkdal Gold Mine**

Västerbotten, Sweden

**Longitudinal Projection for Vein LZA23, Underground Mine**

Figure 14-15

East

View Looking Towards Azimuth 135° (Local Grid)

West

Mandalay Resources Corporation

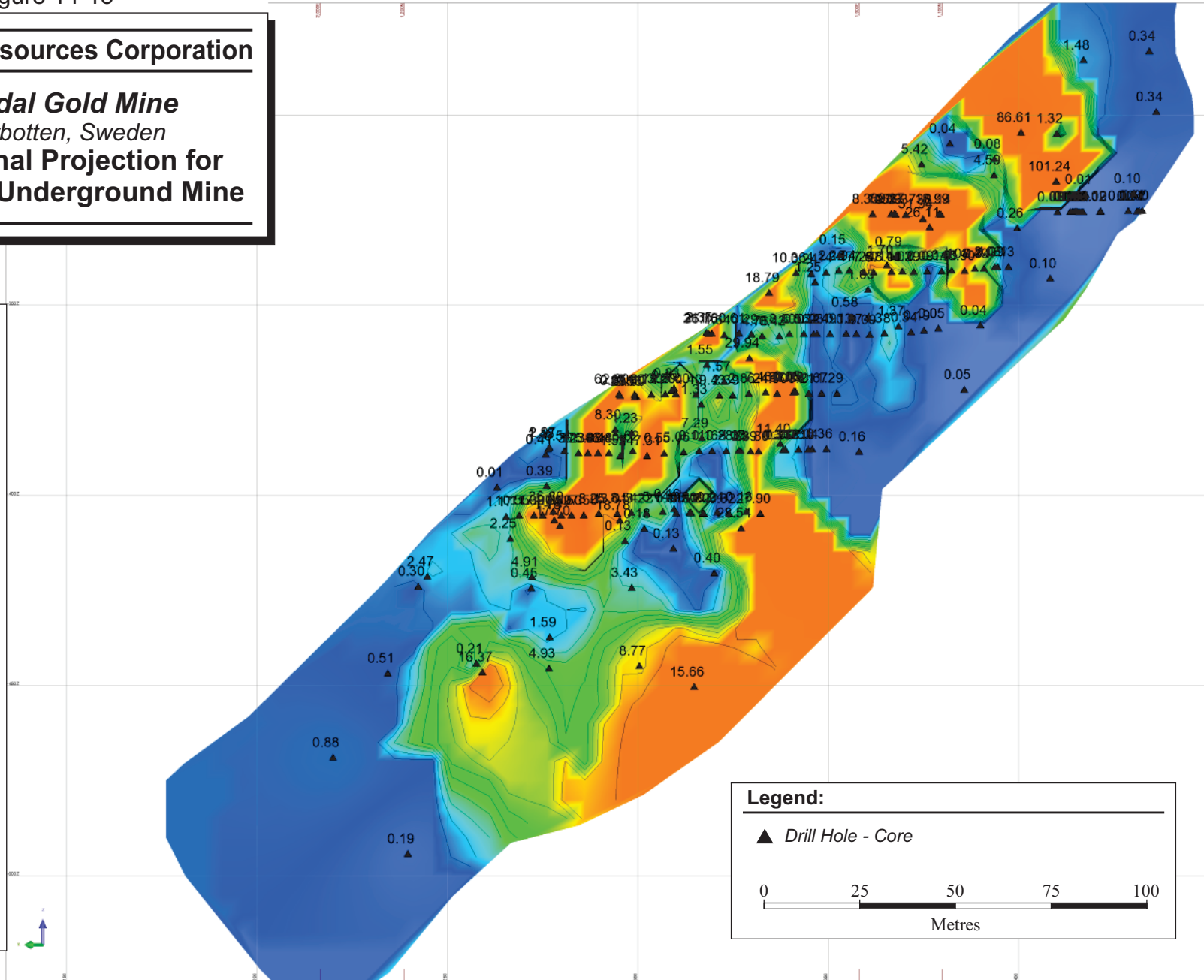
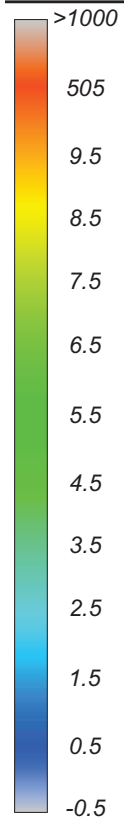
**Björkdal Gold Mine**

Västerbotten, Sweden

**Longitudinal Projection for Vein MZ51, Underground Mine**

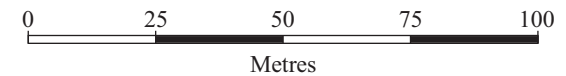
14-32

Legend: (Au g/t)



Legend:

▲ Drill Hole - Core



March 2020

Source: RPA, 2020.

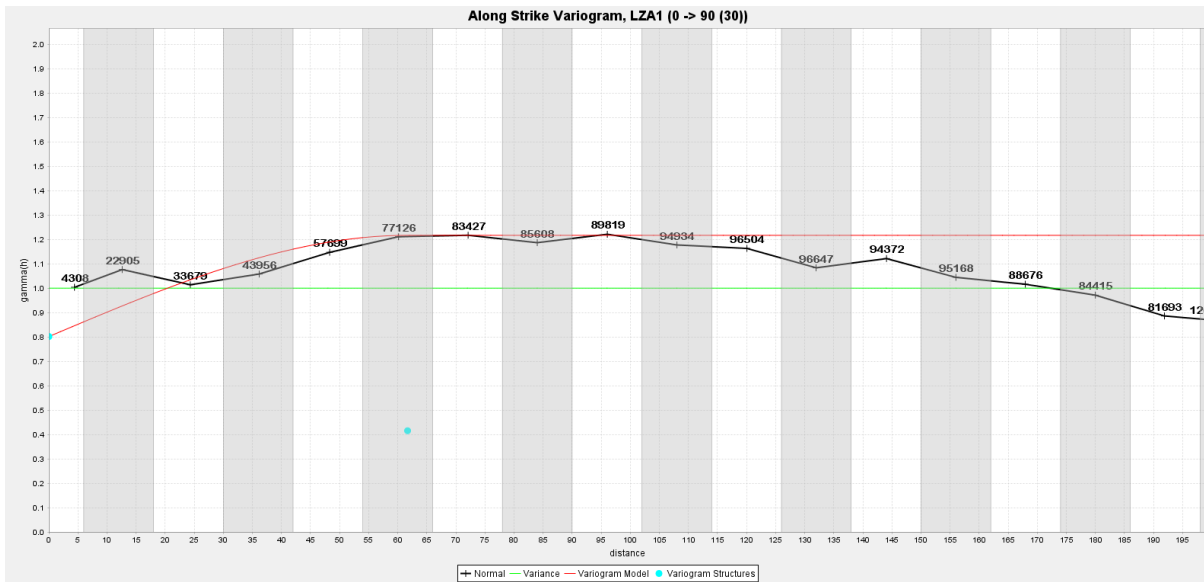
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## VARIOGRAPHY

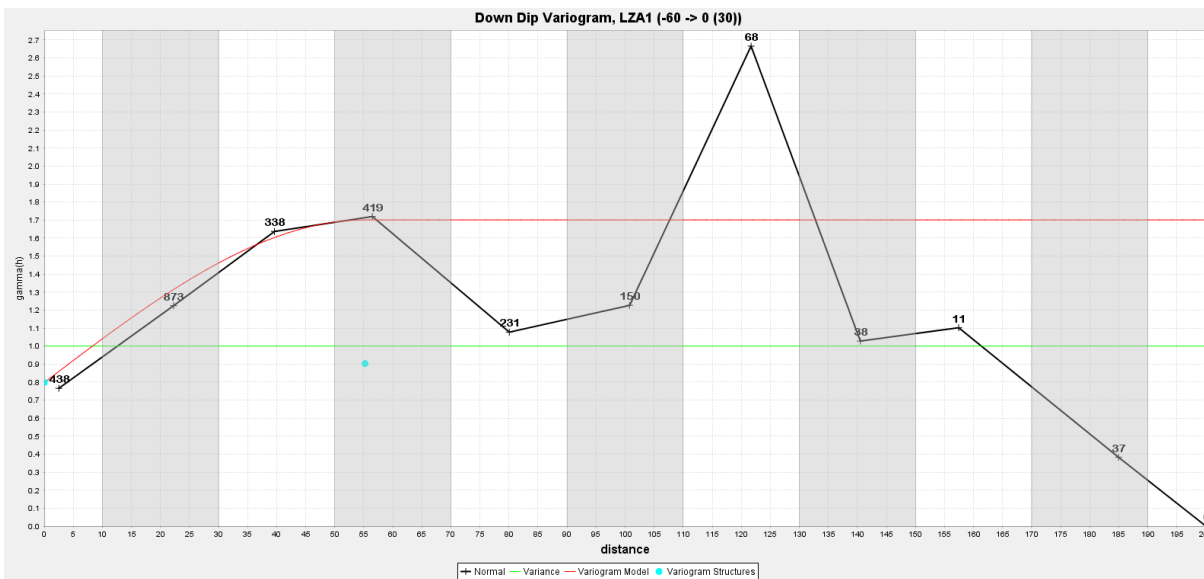
The results of the variography studies presented in RPA (2017) were adopted for use in preparation of the current Mineral Resource estimate. These variography studies were conducted on a small number of selected mineralized wireframes for the open pit and underground mines.

A variography study was also carried out for the mineralization contained within the principal mineralized zone for the Aurora Zone (Wireframe number LZA1). The results indicated that the mineralization contained within this mineralized zone bears similar variographic characteristics to the mineralization contained within the other mineralized wireframes found within the underground mine (Figures 14-16 and 14-17).

**FIGURE 14-16 ALONG STRIKE VARIOGRAM, VEIN LZA1**



**FIGURE 14-17 DOWN DIP VARIOGRAM, VEIN LZA1**



## BLOCK MODEL CONSTRUCTION

An upright, non-rotated block model was constructed to model the mineralization in the underground and open pit mines together.

The block model was constructed using the Surpac version 6.9 software package and comprised an array of 3 m x 3 m x 5 m (Y, X, and Z) sized blocks using one level of sub-blocking to a minimum size of 1.5 m x 1.5 m x 2.5 m. The model was oriented parallel to the local grid coordinate system (i.e., no rotation or tilt). The selection of the block sizes for this model was based upon experience gained by the mine staff. A number of attributes were created to store such information as rock code, material densities, estimated gold grades, mineral resource classification, mined out material and the like. The block model origin, dimensions, and attributes are provided in Tables 14-6 and 14-7.

RPA recommends that the across-strike dimensions (i.e., the northing, or Y-direction) of the blocks be harmonized with the minimum widths selected for preparation of the mineralized wireframes to reduce the amount of dilution being introduced into the block model.

**TABLE 14-6 SUMMARY OF BJÖRKDAL BLOCK MODEL ORIGINS AND BLOCK SIZES**  
**Mandalay Resources Corporation – Björkdal Gold Mine**

Type	Y (Northing)	X (Easting)	Z (Elevation)
Minimum Coordinates	-500	290	-860
Maximum Coordinates	2,101	3,002	50
User Block Size	3	3	5
Min. Block Size	1.5	1.5	2.5
Rotation	0.000	0.000	0.000

**TABLE 14-7 SUMMARY OF BJÖRKDAL BLOCK MODEL ATTRIBUTES**  
**Mandalay Resources Corporation – Björkdal Gold Mine**

Attribute Name	Type	Decimals	Background	Description
au4whit	Real	2	0	Grade values for whittle
au_id3	Float	2	0	Estimated gold grade
avg_dist_true	Float	0	-99	Average distance of informing samples
class_final	Integer	-	0	Final classification
class_org	Integer	-	0	Original classification
density	Real	2	2.74	Density
depleted	Integer	-	0	1=development, 2=stope whole blocks, 3=stope partial percentage
flag_4column	Char.	-	WAST	Flag attribute for column processing for viewing long sections
material	Char.	-	WAST	Material type for Whittle
nearest_true	Float	0	-99	Distance to nearest informing sample
no_samples	Integer	-	-99	Number of informing samples
nr_dh	Integer	-	-99	
op_shell	Integer	-	0	Flag for resource pit shell
pass	Integer	-	0	Estimation pass
pp_depleted	Real	0	0	Partial percentage for depletion coding
vein	Char.	-	0	Vein number
vein_group	Char.	-	0	Vein group
waste_domain	Integer	-	0	Pit waste domain

Gold grades were estimated into the blocks by means of ID<sup>3</sup> interpolation algorithm. A total of three interpolation passes were carried out to estimate the grades in the underground block model. The first pass employed composite samples that had been capped to a maximum of 60 g/t Au and used a search radius of 15 m. The second and third passes used composite samples that were capped to 40 g/t Au and used longer search radii of 35 m and 70 m, respectively.

A two-pass search strategy was applied when estimating the grades for the blocks contained within the mineralized wireframes contained within the open pit mine.

When estimating the grades of the mineralized wireframes, “hard” domain boundaries were used along the contacts of the mineralized wireframe models. Only those composite samples contained within the respective wireframe model were allowed to be used to estimate the grades of the blocks within the wireframe in question, and only those blocks within the wireframe limits were allowed to receive grade estimates. When estimating the grades for the dilution domain, “soft” domain boundaries were applied to minimize any artifacts at the dilution

domain boundaries. A summary of the search strategies employed to estimate the grades into the block model is presented in Table 14-8.

**TABLE 14-8 SUMMARY OF SEARCH STRATEGIES AT BJÖRKDAL  
Mandalay Resources Corporation – Björkdal Gold Mine**

<b>Underground Mine</b>			
<b>Item</b>	<b>Pass 1</b>	<b>Pass 2</b>	<b>Pass 3</b>
Boundary Conditions-Data	Hard	Hard	Hard
Boundary Conditions-Blocks	Write to wireframe only	Write to wireframe only	Write to wireframe only
Major Axis	Isotropic	Isotropic	Isotropic
Major Axis Direction	Isotropic	Isotropic	Isotropic
Semi-Major Axis	Isotropic	Isotropic	Isotropic
Semi-Major Direction	Isotropic	Isotropic	Isotropic
Minor Axis	Isotropic	Isotropic	Isotropic
Minor Direction	Isotropic	Isotropic	Isotropic
Major/Semi-Major Ratio	1.01	1.01	1.01
Major/Minor Ratio	1.02	1.02	1.02
Length of Major Axis (m)	15	35	70
Minimum Number of Drill Holes	2	2	2
Weight by Sample Length	Y	Y	Y
Minimum Number of Samples	4	4	4
Maximum Number of Samples	20	20	20
Max No. of Samples/Hole	20	20	20
Search Ellipse Type	Ellipsoid	Ellipsoid	Ellipsoid
Estimation Algorithm	ID <sup>3</sup>	ID <sup>3</sup>	ID <sup>3</sup>

**Open Pit Mine, Mineralized Wireframes**

<b>Item</b>	<b>Pass 1</b>	<b>Pass 2</b>
Boundary Conditions-Data	Hard	Hard
Boundary Conditions-Blocks	Write to wireframe only	Write to wireframe only
Major Axis	Isotropic	Isotropic
Major Axis Direction	Isotropic	Isotropic
Semi-Major Axis	Isotropic	Isotropic
Semi-Major Direction	Isotropic	Isotropic
Minor Axis	Isotropic	Isotropic
Minor Direction	Isotropic	Isotropic
Major/Semi-Major Ratio	1.01	1.01
Major/Minor Ratio	1.02	1.02
Length of Major Axis (m)	35	70
Minimum Number of Drill Holes	2	2
Weight by Sample Length	Y	Y
Minimum Number of Samples	5	5
Maximum Number of Samples	15	15
Max Number of Samples/Hole	15	15



Item	Pass 1	Pass 2
Search Ellipse Type	Ellipsoid	Ellipsoid
Estimation Algorithm	ID <sup>3</sup>	ID <sup>3</sup>
<b>Open Pit Mine, Dilution Domain</b>		
Item	Waste Domain 1	Waste Domain 2
Boundary Conditions-Data	Soft	Soft
Boundary Conditions-Blocks	Write to Domain 1 only	Write to Domain 2 only
Major Axis	Along Strike (60 m)	Down Dip (80 m)
Major Axis Direction	0°@110°	0°@040°
Semi-Major Axis	Down Dip	Northeast
Semi-Major Direction	-90°@020°	0°@130°
Minor Axis	Across Strike	Southeast
Minor Direction	0°@020	-90°@130
Major/Semi-Major Ratio	1.3	1.01
Major/Minor Ratio	1.7	1.2
Length of Major Axis (m)	60	60
Weight by Sample Length	Y	Y
Minimum Number of Samples	5	5
Maximum Number of Samples	15	15
Max Number of Samples/Hole	15	15
Search Ellipse Type	Ellipsoid	Ellipsoid

## BLOCK MODEL VALIDATION

### COMPARISON OF COMPOSITE SAMPLES TO BLOCK MODEL

Block model validation efforts began with a comparison of the average block grades with the averages of the informing composite samples for a selection of the ten largest veins as measured by the estimated contained gold. The purpose of the comparison is to perform a high-level check as to whether any data-related errors may have occurred during the estimation process and to provide a general basis for the overall accuracy of the estimated block model grades.

The exercise is slightly complicated for the underground block model due to the variable capping strategy that was used to estimate the block grades. The reported block model average grades then are the blended grades that were estimated using two capping values, which makes a direct comparison with composite data difficult. Considering that the large majority of the blocks were estimated using a capping value of 40 g/t Au, RPA elected to use the average composite grades using that capping value as a base for comparison (Table 14-9). A comparison of the wireframe volumes to the block model volumes is presented in Table 14-10.

**TABLE 14-9 COMPARISON OF BLOCK MODEL ESTIMATED GRADES TO COMPOSITE SAMPLES, BJÖRKDAL**  
Mandalay Resources Corporation – Björkdal Gold Mine

Wireframe	LZA1	LZA67	MZ51	LZ101	LZA23
Composite Mean (g/t Au)	1.75	2.59	3.99	2.15	1.18
Block Model Average (g/t Au)	1.06	3.43	3.99	2.03	0.80
Wireframe	SKS2	SKS1	SKS4	MZ140	SZ10
Composite Mean	4.08	0.67	1.13	2.10	2.03
Block Model Average	1.78	0.30	0.60	2.41	1.33

**TABLE 14-10 COMPARISON OF BLOCK MODEL VOLUMES TO WIREFRAMES, BJÖRKDAL**  
Mandalay Resources Corporation – Björkdal Gold Mine

Wireframe Group	Number of Wireframes	Wireframe Volume (m <sup>3</sup> )	Block Volume (m <sup>3</sup> )	Differences (m <sup>3</sup> )	Differences (%)
Central Zone (CZ)	134	2,569,522	2,533,120	-36,402	-1%
Main Zone (MZ)	155	4,392,239	4,258,903	-133,336	-3%
Lake Zone (LZ)	150	3,318,831	3,260,974	-57,857	-2%
Lake Zone-Aurora (LZA)	69	914,299	914,052	-247	0%
South Zone (SZ)	35	2,008,829	1,991,849	-16,980	-1%
East Pit (EP)	57	1,800,698	1,755,951	-44,747	-2%
West Pit (WP)	134	1,716,961	1,707,010	-9,951	-1%
Quartz Mountain (QP)	144	3,274,722	3,254,716	-20,006	-1%
Nylund (NYL)	93	3,222,800	3,222,594	-206	0%
Shear & Skarns	22	2,744,168	2,739,619	-4,549	0%

**VISUAL COMPARISONS**

In order to gauge the accuracy of the local estimate, visual comparisons were carried out that compared the contoured grade distributions prepared during the trend analysis exercise described above with the estimated block grades (Figures 14-18, 14-19, and 14-20). Overall, reasonable spatial correlations were observed, however, estimation artifacts were noted on occasion which RPA suspects is a result of the search strategies employed for estimation of the block grades.

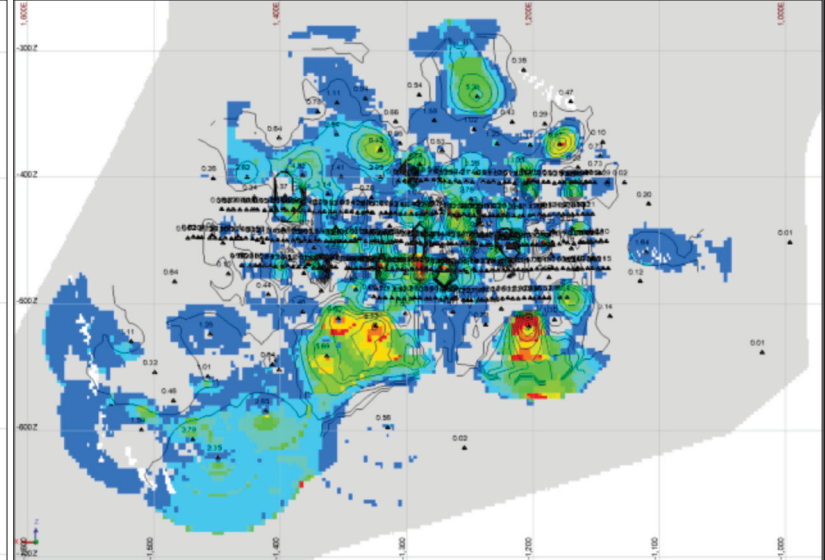
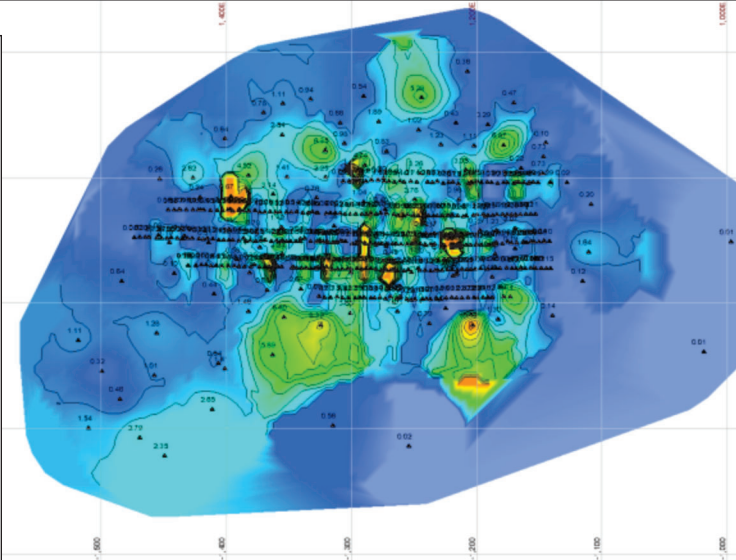
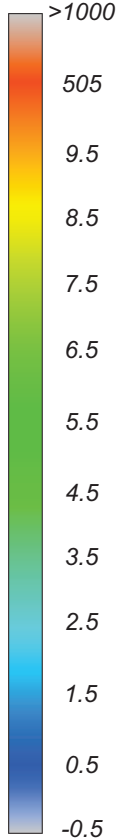
RPA recommends that studies be carried out to review alternate parameters for the search strategies that would help reduce the presence of estimation artifacts and improve the accuracy of the local estimate.

East

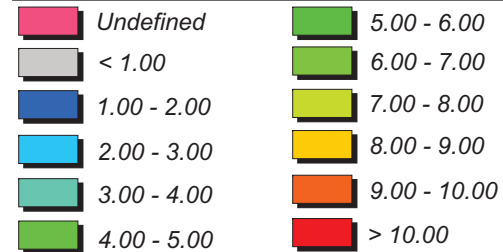
View Looking Towards Azimuth 180° (Local Grid)

West

Legend: (Au g/t)



Legend: (Au g/t)



14-40

Legend:

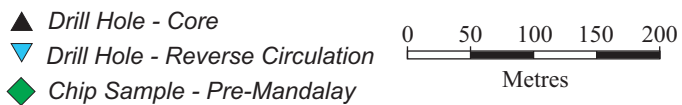


Figure 14-18

Mandalay Resources Corporation

*Björkdal Gold Mine*

Västerbotten, Sweden

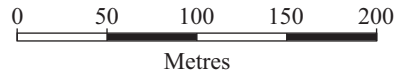
Comparison of Block Model  
 Grades vs. Contoured Grades,  
 Vein LZA1

Figure 14-19

**Mandalay Resources Corporation**  
***Björkdal Gold Mine***  
 Västerbotten, Sweden  
**Comparison of Block Model**  
**Grades vs. Contoured Grades,**  
**Vein LZA23**

**Legend:**

- ▲ Drill Hole - Core
- ▼ Drill Hole - Reverse Circulation
- ◆ Chip Sample - Pre-Mandalay

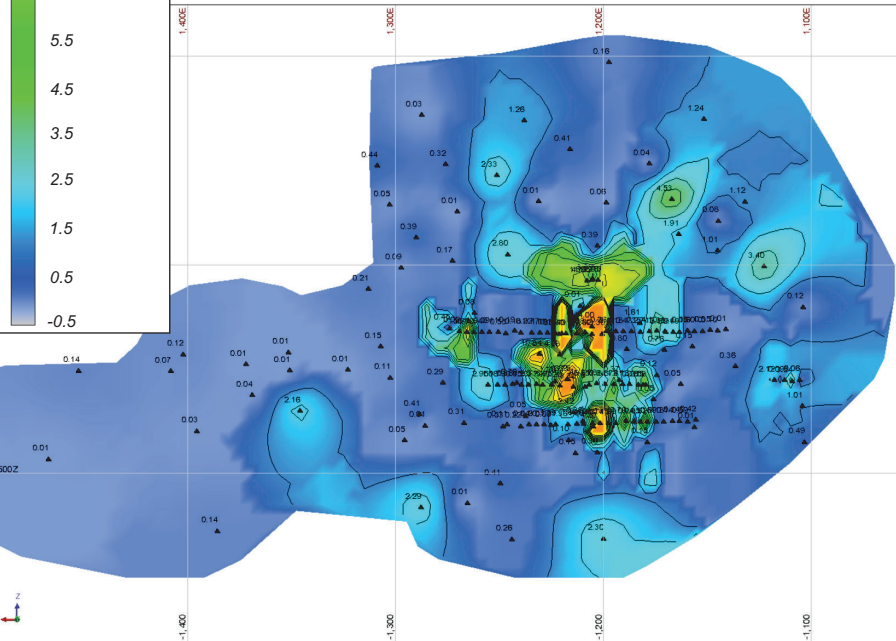
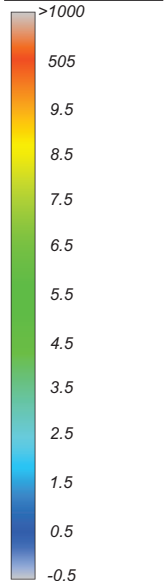


East

View Looking Towards Azimuth 180° (Local Grid)

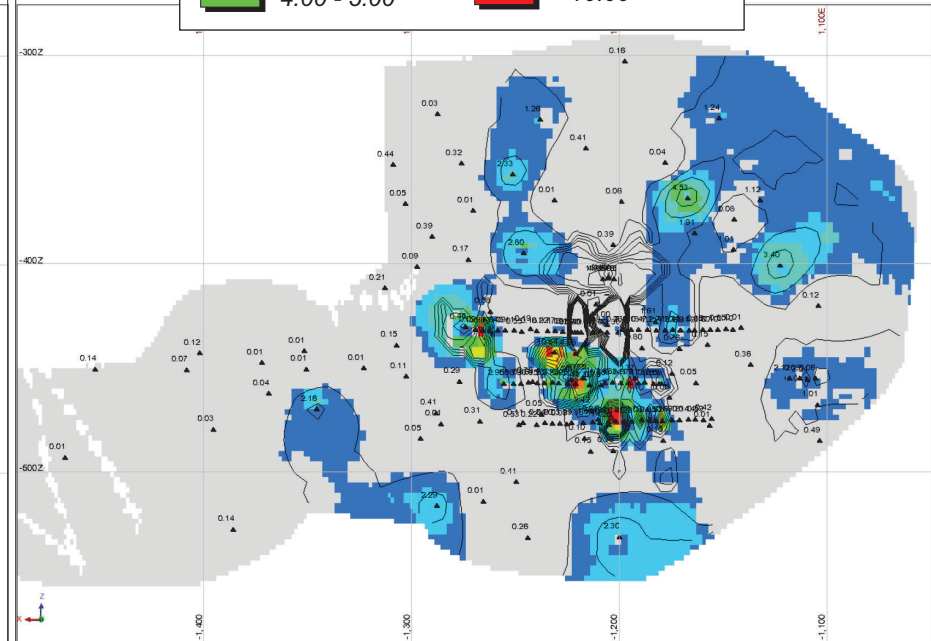
West

**Legend: (Au g/t)**



**Legend: (Au g/t)**

- |               |                |
|---------------|----------------|
| █ Undefined   | █ 5.00 - 6.00  |
| █ < 1.00      | █ 6.00 - 7.00  |
| █ 1.00 - 2.00 | █ 7.00 - 8.00  |
| █ 2.00 - 3.00 | █ 8.00 - 9.00  |
| █ 3.00 - 4.00 | █ 9.00 - 10.00 |
| █ 4.00 - 5.00 | █ > 10.00      |



March 2020

Source: RPA, 2020.

14-41

East

View Looking Towards Azimuth 135° (Local Grid)

West

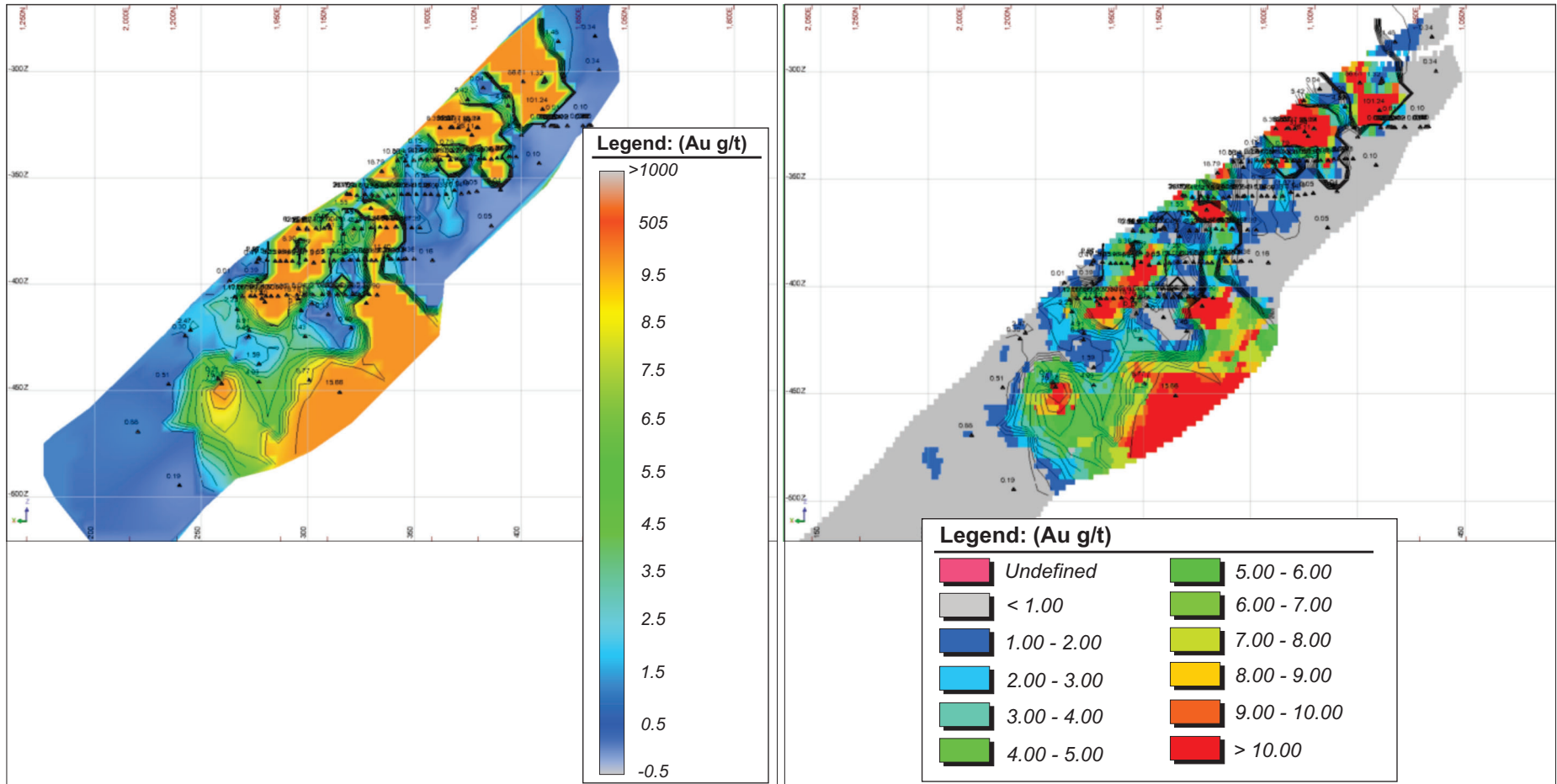


Figure 14-20

**Legend:**

- ▲ Drill Hole - Core
- ▼ Drill Hole - Reverse Circulation
- ◆ Chip Sample - Pre-Mandalay

0 50 100 150 200  
Metres

**Mandalay Resources Corporation**  
**Björkdal Gold Mine**  
 Västerbotten, Sweden  
**Comparison of Block Model  
 Grades vs. Contoured Grades,  
 Vein MZ51**

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**SWATH PLOTS**

Similarly, RPA created swath plots for selected wireframes from the underground mine (Figure 14-21). While some local variations were observed between the composite average grades and the block average grades, no material discrepancies were noted.

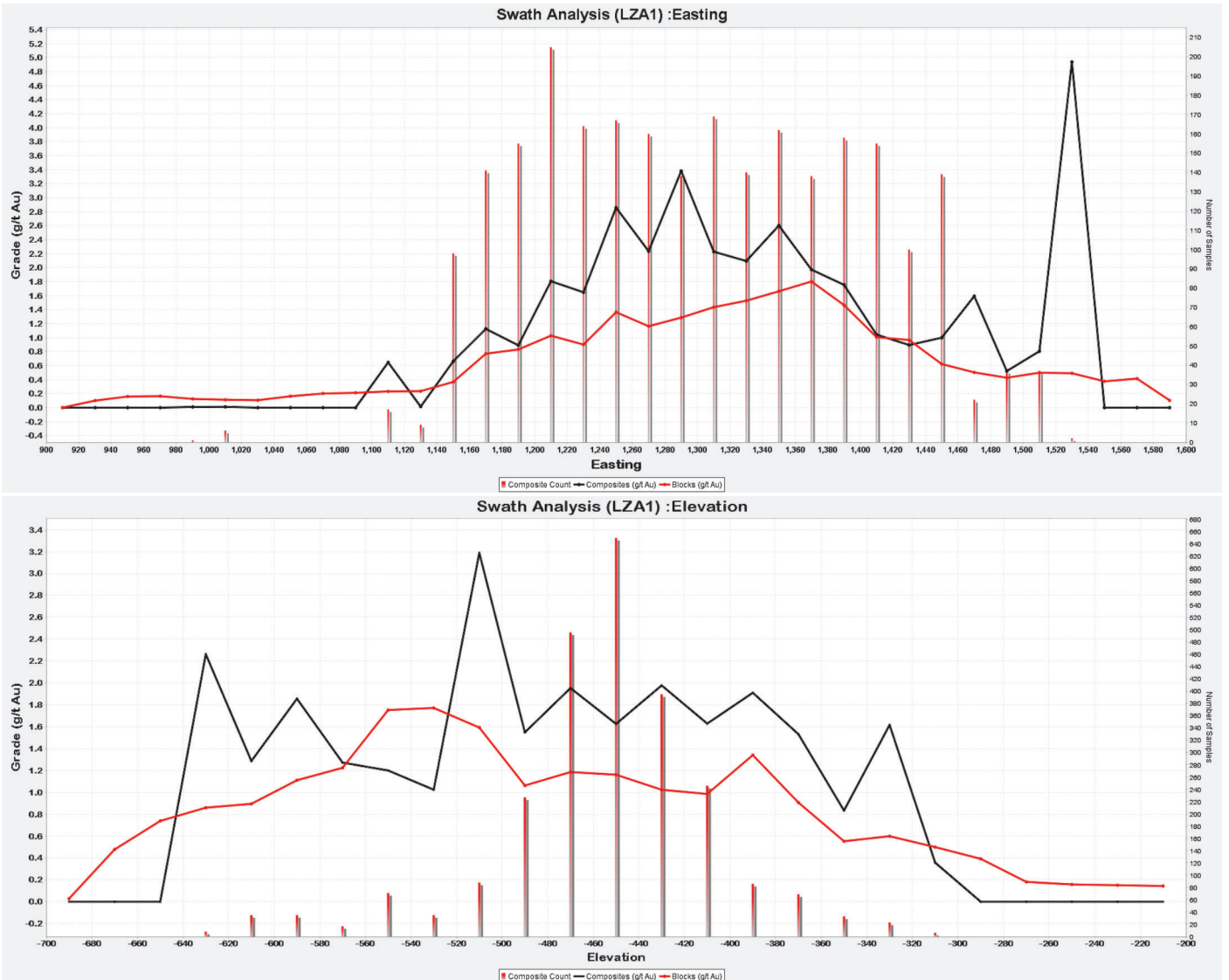


Figure 14-21

**Legend:**

- Number of Samples
- Composites
- Block Grades

**Mandalay Resources Corporation**

***Björkdal Gold Mine***  
*Västerbotten, Sweden*

**Swath Plots (LZA1)**

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## RECONCILIATION TO PRODUCTION STATISTICS

Reconciliation activities were conducted which compared the predicted tonnages, grades, and contained metal from the long term (LT) block model prepared as at year-end 2018 against the short-term (ST) grade control block models updated throughout 2019 and quarterly plant production data for 2019. In addition to a comparison of the LT model predicted values with the ST model actual values, the reconciliation procedures included a measurement of the amount of mineralization that was initially included in the mine schedule but ultimately not excavated, as well as additional mineralized material that was not predicted by the LT model but was discovered as a result of the grade control sampling program as the on-vein development drives were excavated. The identification and quantification of the non-recovered material as well as the additional mineralized material mined is important to achieve a correct reconciliation with the plant production data.

### ***DESCRIPTION OF THE MATERIAL FLOWS***

All of the material extracted from the underground stopes is placed directly onto the designated pile at the plant stockpile area. Material from development drives on the veins is taken to surface and is initially placed in a designated laydown area in the open pit while waiting for assay results. Once the grade of a given advance has been determined, material having grades over 0.40 g/t Au is then transported to one designated pile in the plant stockpile area. The remaining mineralized waste material is placed onto either the North or South long-term stockpile.

After blasting, the ore in the open pit mine is mined in three flitches of 2.5 m in height. Quartz veins are the predominant host material, however, gold can persist for a short distance along vein extensions without a quartz host. The host material provides an excellent visual clue for guiding of detailed sampling and for excavation. Detailed sampling is carried out on the top of each blast using a hand shovel to collect a sample at approximately a five metre interval along the strike of the vein. Results are used to prepare dig plans.

Material from the open pit mine having grades greater than 1 g/t Au is classified as “A-ore” and is placed directly onto a designated pile at the plant stockpile area. Material in the open pit that has been determined to have gold grades between 0.40 g/t Au and 1 g/t Au is classified as “B-ore”. Depending upon the plant capacity, the B-ore material from the open pit is either placed onto a designated pile at the plant stockpile area or is co-mingled on the long-term stockpiles with the B-ore material from the underground mine. The tonnages of the ore



excavated from the open pit mine are determined from truck counts. The grade of the ore in the open pit mine is determined on an in-situ basis from the detailed channel samples taken on each flitch.

Material from the North and South long-term stockpiles is fed to the plant when sufficient capacity is available. The stockpile volumes are determined on a monthly basis using drone-based laser topology equipment and an average density of 1.8 t/m<sup>3</sup>. The plant maintains a monthly record of the amount of feed received from the stockpiles on a combined basis. A short-term stockpile of crushed ore (nominal -8 mm in size) is maintained in close proximity to the plant fine ore bin to maintain the plant throughput in the event of unforeseen shortages in feed. This fine ore stockpile has also been used to feed the plant on a batch basis.

A daily sampling procedure is followed to calculate the provisional gold content in connection with the sale of concentrates and also for determining the daily average feed grade. Samples are taken from the high grade gravity concentrate containing approximately 60% Au, the middlings concentrate containing approximately 1,500 g/t Au, the Knelson concentrate containing approximately 300 g/t Au, and the flotation concentrate containing approximately 100 g/t Au. The tailings stream containing approximately 0.16 g/t Au is sampled every 20 minutes and the results are compiled and reported on a shift composite basis. The tailings densities are determined using Marcy scales and the tailings flow rate is measured with a flow meter. Daily feed grades are calculated using the gold content in the four concentrates, the tailings stream, and the total daily tonnage throughput. The daily tonnage is determined using three calibrated weightometers located ahead of the primary grinding circuit.

The material flows at the Björkdal Mine are summarized in Figure 14-22.

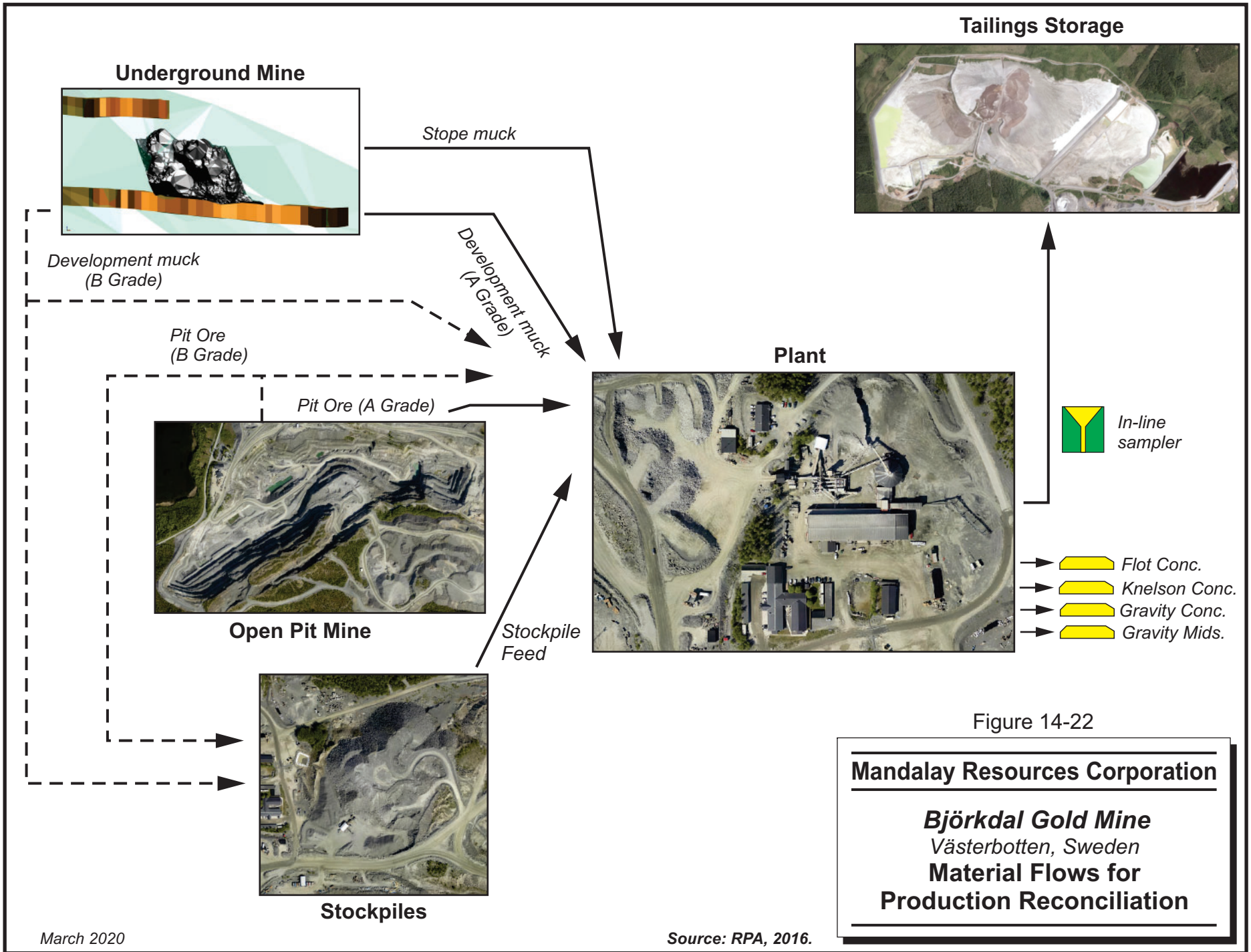


Figure 14-22  
**Mandalay Resources Corporation**  
**Björkdal Gold Mine**  
 Västerbotten, Sweden  
**Material Flows for**  
**Production Reconciliation**

### MODEL-TO-MILL RECONCILIATIONS, OPEN PIT MINE

A comparison of the predicted tonnage, grade, and gold content between the year-end 2018 long-term model and the 2019 grade control model (constructed using the same parameters as the long-term model and updated more frequently as additional sample information became available) to plant production statistics was carried out for January to July 2019 when production from the open pit was halted (Table 14-11). For this comparison, the tonnages and grades were reported from the model at a block cut-off grade of 1.0 g/t Au for all material, on a blast by blast basis, representing the A-ore. As the A-ore was directly fed to the mill, it can therefore be directly compared to predicted tonnes, grade, and contained gold.

It is important to understand that the reports from the long-term and grade control models consider the undiluted, in-situ tonnes and grade only while the plant production data is reporting the mill feed tonnes and grade which are inclusive of mining dilution (internal, planned, and unplanned) and mining losses, and so these factors must be considered when analyzing the information.

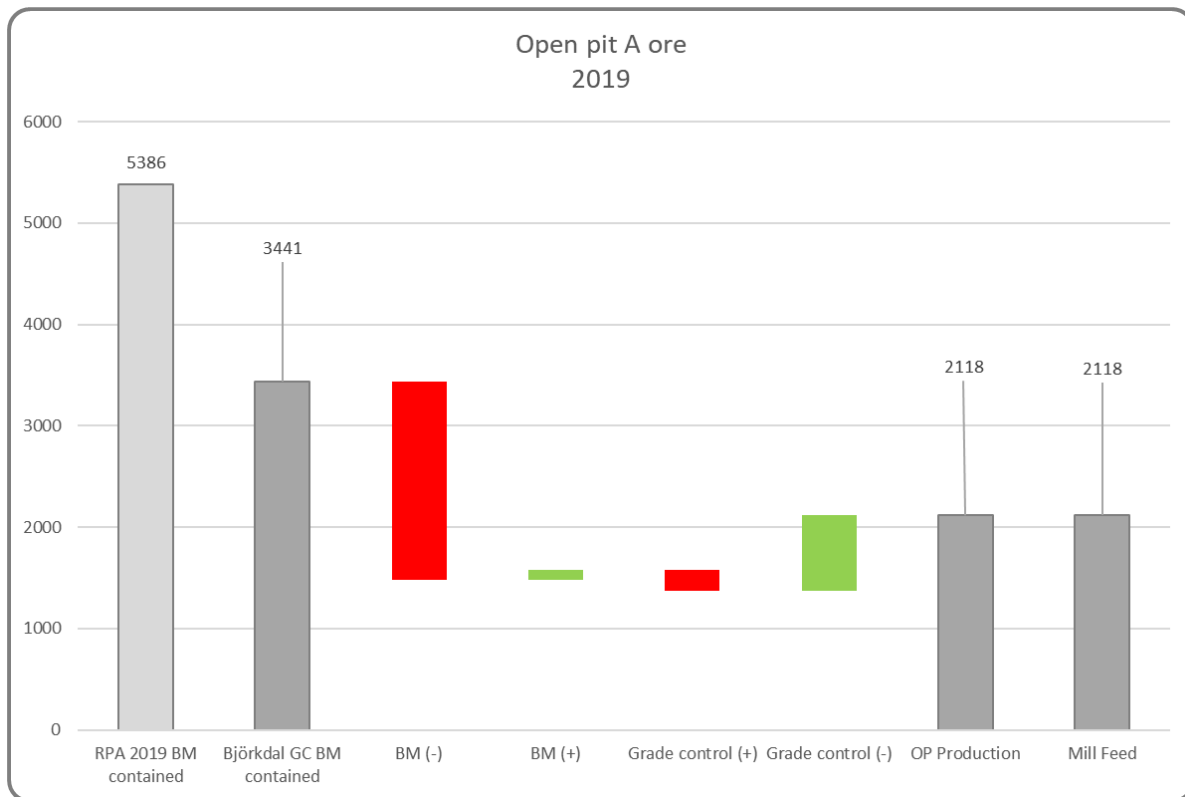
Similarly, the predicted tonnages and grades from the 2019 planned dig packets were compiled for comparison with the grade control model and the plant production data. It is important to understand that these tonnes and grade represent the planned diluted and recovered material on an in-situ basis, while the plant production data represents the actual tonnes and grade recovered after the material is extracted from the open pit mine. The impact of these material flows is illustrated in Figure 14-23.

**TABLE 14-11 2019 RECONCILIATION DATA, OPEN PIT MINE**  
**Mandalay Resources Corporation – Björkdal Gold Mine**

**Open Pit: A Ore (> 1 g/t Au)**

Quarter	Long-Term Model (as at December 31, 2018, In-situ)			Grade Control Model (2019, In-situ)			Planned Dig Packets (Diluted, Recovered)			Milled (Plant Feed)		
	Tonnes	Grade (g/t Au)	Oz Au	Tonnes	Grade (g/t Au)	Oz Au	Tonnes	Grade (g/t Au)	Oz Au	Tonnes	Grade (g/t Au)	Oz Au
Q1	22,201	2.37	1,691	19,057	2.30	1,410	19,840	0.99	634	25,041	1.22	979
Q2	24,962	2.40	1,928	11,367	2.84	32,297	17,446	0.78	438	20,717	1.03	683
Q3	22,766	2.41	1,767	13,143	2.35	992	17,556	0.89	504	15,706	0.90	457
Q4	0	0	0	0	0	0	0	0	0	0	0	0
<b>2019 Total</b>	<b>69,929</b>	<b>2.40</b>	<b>5,386</b>	<b>43,568</b>	<b>2.46</b>	<b>3,441</b>	<b>54,843</b>	<b>0.89</b>	<b>1,577</b>	<b>61,465</b>	<b>1.07</b>	<b>2,118</b>

**FIGURE 14-23 WATERFALL CHART FOR THE OPEN PIT A-ORE, 2019**



It can be seen that, while the average grade predicted by the LT block model for the entire period is in good agreement with the ST block model, the tonnages and contained metal are significantly higher. Review of workflows by the mine staff revealed that the majority of this discrepancy in the tonnages (and contained metal) could be attributed to optimistic interpretations for the mineralized wireframes for the EP area. All mineralized wireframes for this area were reinterpreted for use in the year-end 2019 Mineral Resource estimate. The current year-end 2019 LT model was prepared using the same estimation parameters as were used in the previous year.

**MODEL-TO-MILL RECONCILIATION, UNDERGROUND MINE**

A comparison of the predicted tonnage, grade, and contained gold between the year-end 2018 long-term model and the 2019 grade control model (constructed using the same parameters as the long-term model and updated more frequently as additional sample information became available) to plant production statistics was carried out for January to December 2019 for both stopes and for development material (Tables 14-12 and 14-13).

For the stope material, valid CMS scans were not always available due to equipment failure and the implementation of new protocols around the scanning of stope voids. For stopes where valid scans were not available, the designed excavation was used, along with an expansion factor applied to account for likely overbreak.

For development material, the surveyed monthly drive solids were used to report the predicted tonnes, grade, and contained gold for these areas. It is important to note that not all development material is milled. Material that the grade control program identifies as waste or very low grade (generally less than 0.35 g/t Au) is rejected and sent to the appropriate waste or low grade stockpiles. No cut-off grade was applied to the model for the underground reconciliation reports, as digital models of the excavated voids were used to report all tonnes within the excavation volume. The impact of the various material types on the reconciliation results are shown in Figures 14-24 and 14-25.

**TABLE 14-12 2019 STOPE RECONCILIATION DATA, UNDERGROUND MINE  
Mandalay Resources Corporation – Björkdal Gold Mine**

**Underground: Stopes**

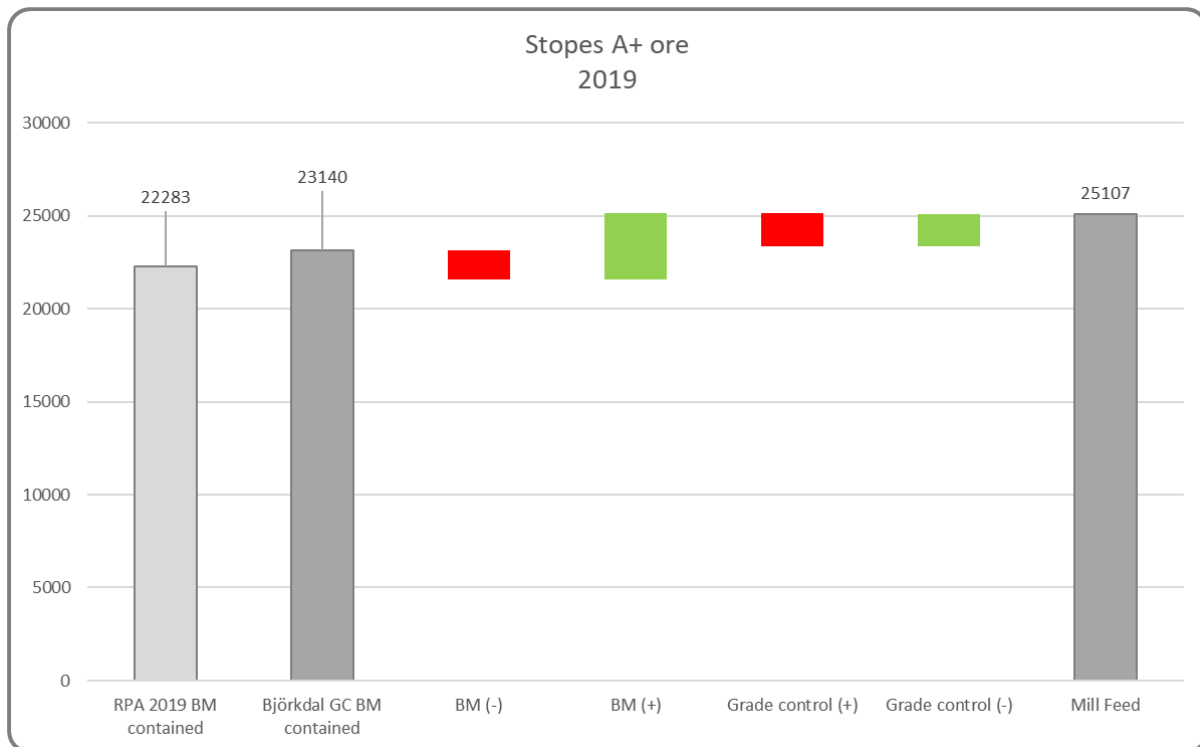
Quarter	Long-Term Model (December 31, 2018)			Grade Control Model			Trucked Material			Milled		
	Tonnes	Grade (g/t Au)	Oz Au	Tonnes	Grade (g/t Au)	Oz Au	Tonnes	Grade (g/t Au)	Oz Au	Tonnes	Grade (g/t Au)	Oz Au
Q1	88,019	1.98	5,593	94,689	1.64	4,999	103,912	2.13	7,100	91,301	2.11	6,199
Q2	117,629	1.56	5,914	112,605	1.73	6,253	111,404	1.56	5,592	120,349	1.62	6,274
Q3	120,945	1.69	6,576	117,448	1.71	6,449	129,248	1.53	6,340	132,524	1.63	6,952
Q4	104,191	1.25	4,200	104,742	1.62	5,440	111,358	1.71	6,117	109,597	1.61	5,683
<b>2019 Total</b>	<b>430,784</b>	<b>1.61</b>	<b>22,283</b>	<b>429,484</b>	<b>1.68</b>	<b>23,140</b>	<b>455,972</b>	<b>1.72</b>	<b>25,148</b>	<b>453,771</b>	<b>1.72</b>	<b>25,107</b>

**TABLE 14-13 2019 DEVELOPMENT RECONCILIATION DATA, UNDERGROUND MINE**  
**Mandalay Resources Corporation – Björkdal Gold Mine**

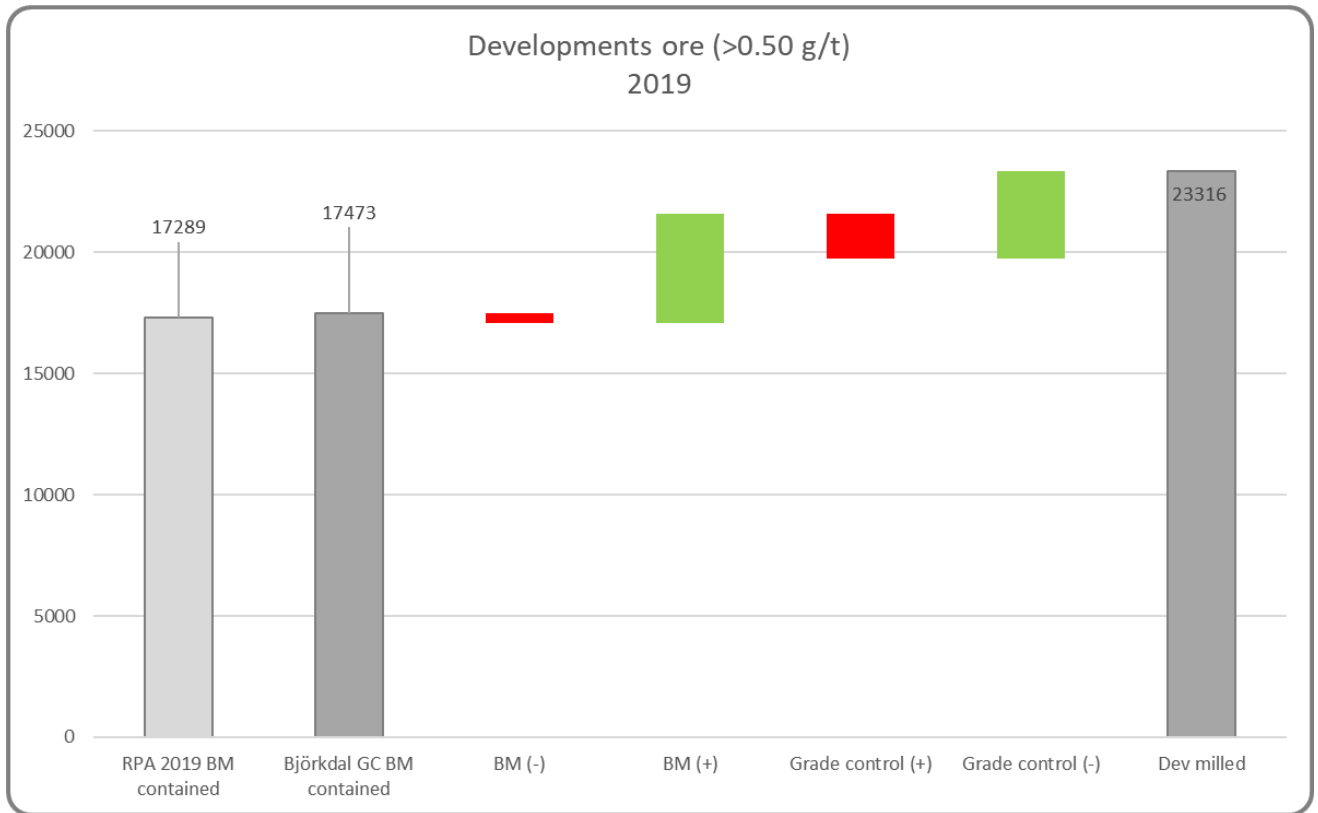
**Underground: Development**

Quarter	Long-Term Model (December 31, 2018)			Grade Control Model			Trucked Material			Milled		
	Tonnes	Grade (g/t Au)	Oz Au	Tonnes	Grade (g/t Au)	Oz Au	Tonnes	Grade (g/t Au)	Oz Au	Tonnes	Grade (g/t Au)	Oz Au
Q1	149,349	1.16	5,567	148,191	1.26	6,014	137,742	1.71	7,581	98,964	2.12	6,734
Q2	158,075	0.71	3,587	157,990	0.70	3,531	124,670	1.23	4,903	101,548	2.36	7,694
Q3	139,828	0.64	2,899	140,879	0.83	3,775	125,177	1.02	4,119	86,117	1.53	4,248
Q4	144,542	1.13	5,237	146,622	0.88	4,154	143,658	1.08	4,972	94,921	1.52	4,640
<b>2019 Total</b>	<b>591,794</b>	<b>0.91</b>	<b>17,289</b>	<b>593,682</b>	<b>0.92</b>	<b>17,473</b>	<b>531,248</b>	<b>1.26</b>	<b>21,585</b>	<b>381,549</b>	<b>1.90</b>	<b>23,316</b>

**FIGURE 14-24 WATERFALL CHART FOR THE UNDERGROUND STOPES, 2019**



**FIGURE 14-25 WATERFALL CHART FOR THE UNDERGROUND DEVELOPMENT, 2019**



It can be seen that the tonnages, grades, and contained metal are all in good agreement between the year-end 2018 LT block model and the 2019 grade control model for both the stope muck and development muck from the underground mine.

The current year-end 2019 LT model was prepared using the same work flows and estimation parameters as were used to prepare the year-end 2018 LT model.

RPA recommends that Mandalay continue to collect high quality scans of all stope voids on a regular and timely basis. This information should then be integrated into the material tracking and metal accounting systems to permit comparisons to be made for the block model versus the mine actual production and then the mill output. The information will also be useful in evaluating the accuracy of the excavation voids against the designed excavations.

RPA also recommends that consideration be given to expanding the time period for the reconciliation studies. The current reconciliation studies evaluate the predictive accuracy of the year-end 2018 LT block model over the most recent 12-month production period. Use of

the year-end 2017 block model for comparison with the production data for 2018 and 2019 will enable the quantification of the accuracy of the estimation procedures and parameters over a 24-month period.

## **MINERAL RESOURCES CLASSIFICATION CRITERIA**

The definitions for resource categories used in this report are consistent with CIM (2014) definitions and adopted by NI 43-101.

In respect of the block model for the veins in the underground mine, all blocks that were located within a mineralization wireframe whose grades were estimated in either the first or second estimation passes were assigned a preliminary classification of Indicated Mineral Resources. Those blocks whose grades were estimated in the third estimation pass were assigned a preliminary classification of Inferred Mineral Resources. No Measured Mineral Resources were assigned.

The preliminary classifications were subsequently refined to reflect the location of the marble contact. Only those blocks within the mineralized wireframes that were located below the marble contact retained their classifications as either Indicated or Inferred Mineral Resources. Any blocks within the mineralized wireframes in the MZ, LZ, CZ, or SZ vein groups that were located above the footwall contact of the marble unit were removed from the Mineral Resource classification and their block grades reduced to zero.

Similarly, in respect of the block model for the open pit mine, all blocks that were located within a mineralization wireframe whose grades were estimated in the first estimation pass were assigned a preliminary classification of Indicated Mineral Resources. Those blocks whose grades were estimated in the second estimation pass were assigned a preliminary classification of Inferred Mineral Resources. No Measured Mineral Resources were assigned.

Finally, all blocks that received an estimated grade within the waste domain were assigned a preliminary classification of Inferred Mineral Resources.

As with the block model for the underground mine, the preliminary classifications were subsequently refined to reflect the location of the footwall contact of the marble unit. Only those blocks that were located below this surface retained their classifications as either Indicated or Inferred Mineral Resources. Any blocks that were located above the surface for



the EP, WP, QM, or NYL vein groups were removed from the Mineral Resource classification and the block grades reduced to zero.

A series of manual clean-up passes were also carried out on a number of veins in the underground and open pit mines to address areas of the veins that were estimated from a single drill hole.

## **RESPONSIBILITY FOR THE ESTIMATE**

The estimate of the Mineral Resources for the Björkdal Mine presented in this report was prepared by Mr. Reno Pressacco, M.Sc.(A), P.Geo., who is a Qualified Person as defined in NI 43-101, and is independent of Mandalay.

## **CUT-OFF GRADE AND RESOURCE REPORTING CRITERIA**

Separate cut-off grades were developed for reporting of the underground and open pit Mineral Resources. Each cut-off grade was developed using the January to September 2019 actual cost information along with a gold price of US\$1,500 per ounce and an exchange rate of 9.0 SEK/US\$. The cut-off grade for reporting of Mineral Resources was determined to be 0.80 g/t Au within the underground mine and 0.34 g/t Au for the open pit mine.

Metal prices used for reserves are based on consensus, long term forecasts from banks, financial institutions, and other sources. For resources, metal prices used are slightly higher than those for reserves.

To fulfill the NI 43-101 requirement of “reasonable prospects for eventual economic extraction”, Mandalay prepared a preliminary open pit resource shell using the Whittle parameters reported in Section 15 and based on a US\$1,500/oz gold price.

The criteria used to report the Mineral Resources within the open pit mine included:

- All blocks located above the resource pit surface
- Not depleted for mining;
- Not including loose or backfill material;
- Within either a mineralized wireframe model, the mineralized waste domain model, or the failure zone;
- Having estimated block grades greater than 0.34 g/t Au, and
- Having a Mineral Resource category of either Indicated or Inferred.

The criteria used to report the Mineral Resources within the underground mine included:

- All blocks within a mineralized wireframe;
- Located below the open pit reporting shell;
- Not depleted for mining or the subsidence area;
- Having estimated block grades greater than 0.80 g/t Au; and
- Having a Mineral Resource category of either Indicated or Inferred.

RPA recommends that the Mineral Resource reporting criteria for the underground mine be amended to include the use of constraining volumes for defining the potentially economic portions of the mineralized wireframes as use of such constraining volumes will improve the accuracy of the Mineral Resource statements.

### **BJÖRKDAL MINE MINERAL RESOURCE ESTIMATE**

The Mineral Resources are inclusive of Mineral Reserves. The Mineral Resources are reported using excavation volumes and surfaces current as of December 31, 2019 (Table 14-14).

**TABLE 14-14 SUMMARY OF BJÖRKDAL MINERAL RESOURCES AS OF  
DECEMBER 31, 2019  
Mandalay Resources Corporation – Björkdal Gold Mine**

<b>Category</b>	<b>Area</b>	<b>Tonnage (kt)</b>	<b>Grade (g/t Au)</b>	<b>Contained Au (koz)</b>
Indicated	Open Pit	3,114	2.08	208
	Underground	9,656	2.58	799
	<i>Sub-total</i>	<i>12,770</i>	<i>2.45</i>	<i>1,007</i>
	Stockpile	2,644	0.64	54
<b>Total Indicated</b>		<b>15,414</b>	<b>2.14</b>	<b>1,061</b>
Inferred	Open Pit	3,338	1.30	139
	Underground	2,143	2.36	163
<b>Total Inferred</b>		<b>5,480</b>	<b>1.71</b>	<b>302</b>

Notes:

1. Björkdal Mineral Resources are estimated using drill hole and sample data as of September 30, 2019 and account for production to December 31, 2019.
2. CIM (2014) definitions were followed for Mineral Resources.
3. Mineral Resources are inclusive of Mineral Reserves.
4. Mineral Resources are estimated using an average gold price of US\$1,500/oz and an exchange rate of 9.0 SEK/US\$.
5. High gold assays were capped to 30 g/t Au for the open pit mine.
6. High gold assays for the underground mine were capped at 60 g/t Au for the first search pass and 40 g/t Au for subsequent passes.

7. Interpolation was by inverse distance cubed utilizing diamond drill, reverse circulation and chip channel samples.
8. Open pit Mineral Resources are estimated at a cut-off grade of 0.34 g/t Au and constrained by the resource pit design.
9. Underground Mineral Resources are estimated at a block cut-off grade of 0.80 g/t Au.
10. A nominal two metres minimum mining width was used to interpret veins using diamond drill, reverse circulation, and underground chip sampling.
11. Stockpile Mineral Resources are estimated at a cut-off grade of 0.40 g/t Au and are based upon surveyed volumes supplemented by production data.
12. Mineral Resources that are not Mineral Reserves do not have demonstrated economic viability.
13. Numbers may not add due to rounding.

RPA is not aware of any environmental, permitting, legal, title, taxation, socio-economic, marketing, political, or other relevant factors that could materially affect the Mineral Resource estimate.

## **NORRBERGET**

The following description for Norrberget was taken from the 2018 Technical Report (RPA, 2018). No changes have been made to the Mineral Resource estimate since the underlying assumptions have not changed materially.

### **TOPOGRAPHY MODEL**

A DTM generated from Surpac software was provided to clip the block model. The drill hole collars within the resource database were checked against the DTM elevation and all were within 0.03 m difference except drill hole 2009610, which was less than 0.30 m.

### **DESCRIPTION OF THE DATABASE**

RPA received the Norrberget dataset in July 2017 as an Access database that contained all drilling up until the completion of the 2016 exploration program. Additional drilling was completed in 2017 and appended to the drill hole database later this year. The cut-off grade of the database is September 30, 2017, and no drilling has been carried out since that date.

The database was imported into Micromine v 2016.1 (SP 2) geological modelling software for data validation and modelling. The database contained 167 drill holes, however, 107 of these drill holes were flagged as occurring significantly outside the licence area of Norrberget 300. The remaining 72 drill holes were used for the resource database and block model interpolation.

A summary of the resource database is provided in Table 14-15.

**TABLE 14-15 SUMMARY OF NORRBERGET MINERAL RESOURCE DATABASE**  
**Mandalay Resources Corporation – Norrberget Deposit**

Item	Record Count/Details
Drill Holes	72
Total Length (m)	6,972.10
Downhole Survey	1,607
Lithology	480
Assay Values	5,526
Assay Length (m)	5,385.10

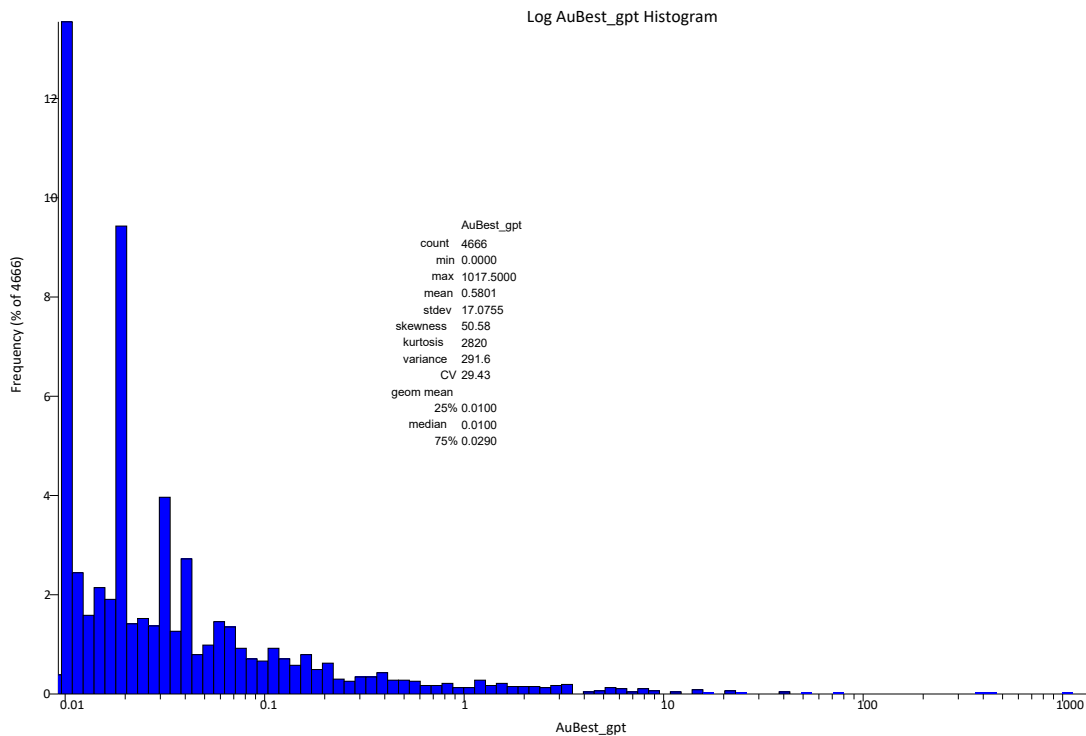
The imported data was validated to check for issues such as duplicate drill holes, survey issues, typos, samples beyond end of hole, etc. One assay sample was identified as being invalid as a result of the From and To depths being the same value. This sample was well below cut-off grade and the depths were corrected to match the neighbouring intercepts. Nine drill holes did not have a collar survey, however, the first downhole survey measurement was taken at a three metre depth.

The resource database is considered by RPA to be sufficiently reliable for grade modelling and Mineral Resource estimation.

**LITHOLOGY AND MINERALIZATION WIREFRAMES**

The Norrberget mineralization occurs within bands of veinlets and alteration containing amphibole in a package of interbedded mafic tuffs and volcanoclastics. RPA reviewed the geological logging and was not able to differentiate suitably the grade from waste rock using the lithology and alteration logging. RPA reviewed the assay data statistically and spatially and observed a second gold grade population at approximately 0.4 g/t Au. RPA’s wireframes were built based on an approximately 0.4 g/t Au wireframe cut-off grade. The raw gold assay histogram is shown in Figure 14-26.

**FIGURE 14-26 RAW AU DATA HISTOGRAM**



Fourteen cross sections were created on a 20° azimuth across the strike of the deposit to match the main direction of drilling. As the drill hole spacing and direction was not a constant, these sections were created between 6 m and 40 m apart, although most were between 20 m and 25 m apart. Due to the variable cross section spacing, each cross-sections window of view extended half the distance to the next cross section to cover the entire deposit.

Polylines were generated around the mineralization and as the mineralization has been observed to be fairly continuous these shapes were extrapolated. A two metre minimum mining width was applied which had the result of bringing in some waste material into the model in small intercepts. Some mineralization below the 0.4 g/t Au cut-off grade was included within the model to allow for geological continuity.

The sectional polylines were joined together in three dimensions to form valid and closed wireframes that contained the mineralization along the length of the deposit. In total three mineralization wireframes were created, one main wireframe that ran the length of the deposit, and two small footwall wireframes that occur at either end. Other above cut-off intercepts

occurred in both the hanging and footwall, however these could not be traced to adjacent sections without significant waste material being incorporated and were therefore rejected.

A bedrock surface was generated from contouring the depth of the first bedrock intercept downhole and creating a DTM of the contours. The bedrock surface was used to clip the top of the mineralization wireframes. The final volumes of the mineralization wireframes are:

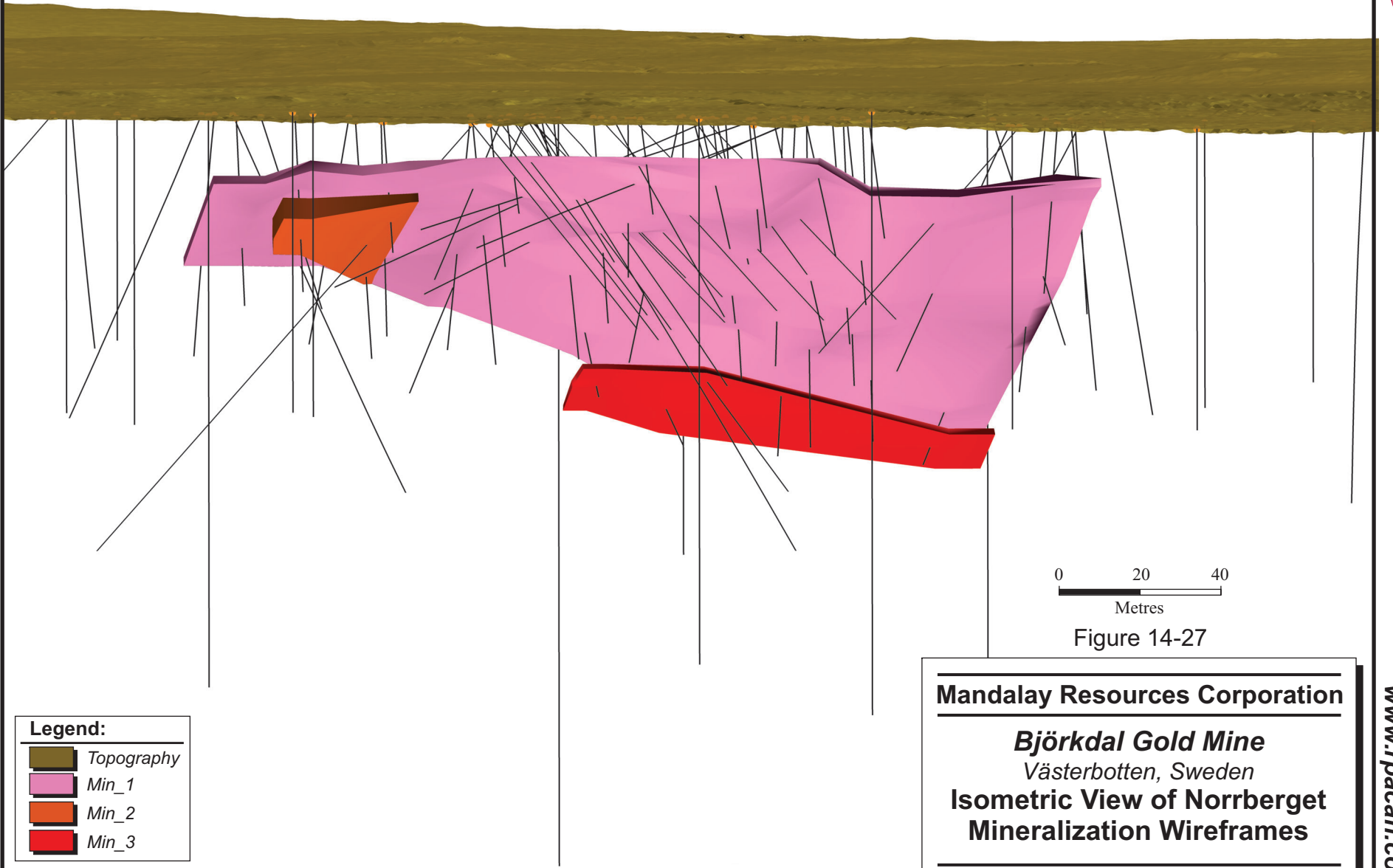
- Min\_1 = 187,642 m<sup>3</sup>
- Min\_2 = 11,909 m<sup>3</sup>
- Min\_3 = 14,733 m<sup>3</sup>

Figure 14-27 illustrates an orthogonal view of the mineralization wireframes (Pink = Min\_1, Orange = Min\_2, Red = Min\_3) below the topographic surface (brown) supplied by Mandalay.

Additional surfaces were generated through contouring the boundary intercept between the volcanics and mafics and the volcanics and limestone for the purposes of flagging density values to the block model.





Looking North

14-60



0 20 40  
Metres

Figure 14-27

Legend:	
	Topography
	Min_1
	Min_2
	Min_3

**Mandalay Resources Corporation**  
*Björkdal Gold Mine*  
*Västerbotten, Sweden*  
**Isometric View of Norrberget  
Mineralization Wireframes**

March 2020

Source: RPA, 2018.

## COMPOSITING METHODS AND GRADE CAPPING

Samples within the domain wireframes were flagged with the domain name. Statistics for samples in the entire dataset and within the domain only are presented in Table 14-16.

**TABLE 14-16 SUMMARY OF NORRBERGET SAMPLE STATISTICS**  
Mandalay Resources Corporation – Norrberget Deposit

Data	No. of Samples	Min (g/t Au)	Max (g/t Au)	Mean (g/t Au)	Var. (g/t Au)	StDev. (g/t Au)	CV (g/t Au)
All	8,519	0.00	1,017.50	0.36	167.21	12.93	35.79
Within Domains	327	0.00	1,017.50	7.75	4,115.79	64.15	8.28

### GRADE CAPPING

Gold projects are often susceptible to nugget effect where anomalous high grades can be encountered during assay analysis. Erratic high grade values can be over-represented during block model interpolation, resulting in significant over-estimation of the local gold grade. Gold values were observed as high as 1,017.5 g/t Au within the Norrberget resource dataset. To remove the influence of these high grade samples, a top-cut (capping) level is applied where the grade is observed to become erratic. Histograms, probability plots, and decile analysis were reviewed for all gold samples contained within the combined mineralization wireframes. The domains were not analyzed separately due to the small sample numbers in domains Min\_2 and Min\_3. The gold capping analysis is illustrated in Figure 14-28.

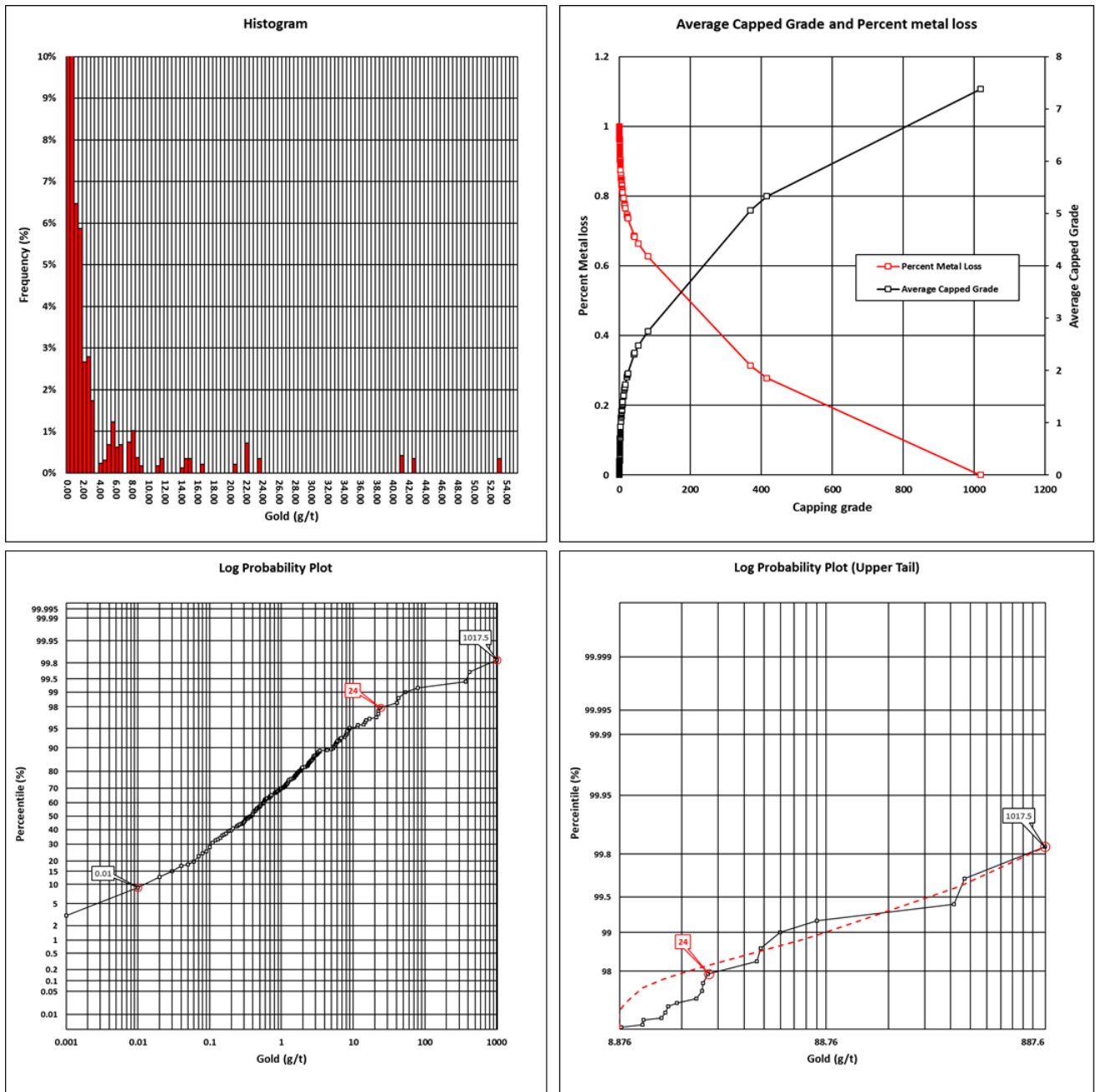
Table 14-17 outlines the capping values and statistics for the combined mineralized domain.

**TABLE 14-17 SUMMARY OF NORRBERGET GOLD CAPPING**  
Mandalay Resources Corporation – Norrberget Deposit

Metal	Unit	Dataset	Cap	No of Samples	Min	Max	Mean	StDev	CV	No of Caps	Metal Loss
Au	g/t	Uncapped	24	311	0.00	1,017.50	7.38	65.55	8.88	7	74%
		Capped			0.00	24.00	1.95	4.66	2.39		



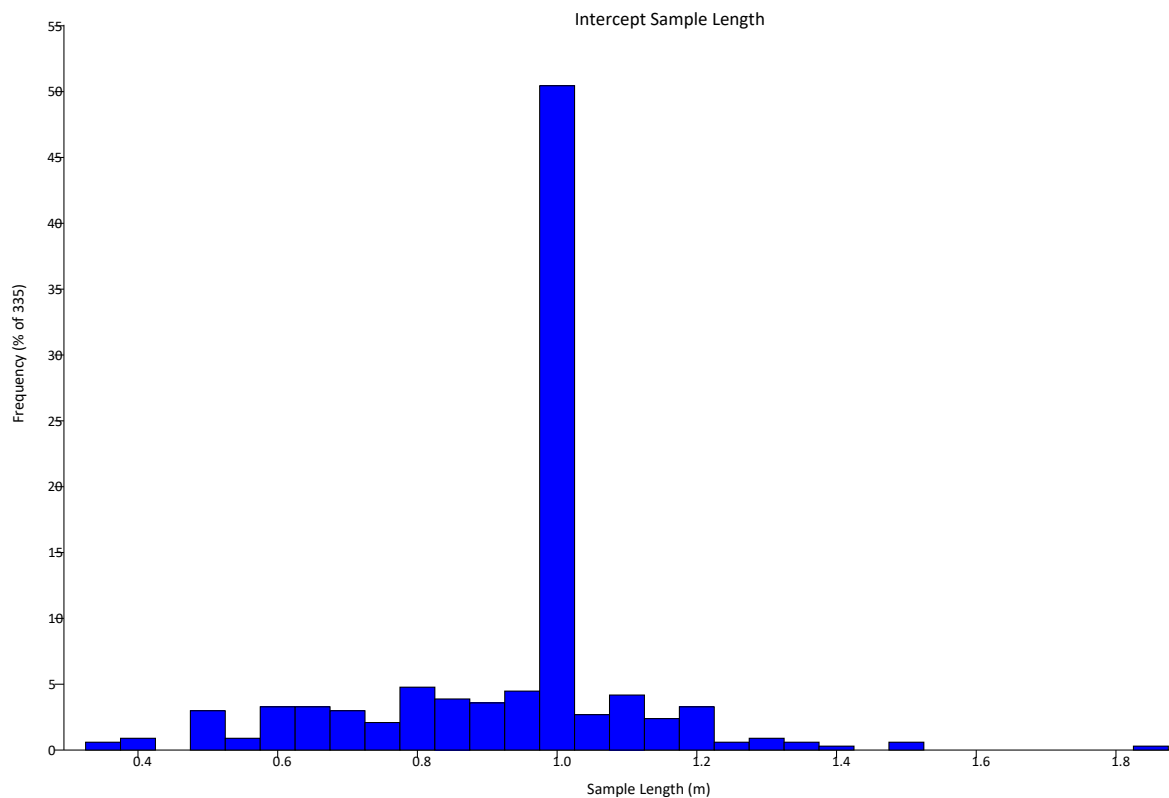
**FIGURE 14-28 CAPPING ANALYSIS OF GOLD WITHIN VEIN DOMAINS, NORRBERGET**



**COMPOSITING**

Sample lengths within the mineralized domains ranged between 0.35 m and 1.86 m, with over 50% occurring at 1.00 m ± 0.05 m (Figure 14-29). The samples within the mineralized domain wireframes were composited on a one metre interval. Intercepts that were less than 0.50 m after compositing were removed from the estimation database to ensure that they did not overly influence the resource estimation.

**FIGURE 14-29 HISTOGRAM OF SAMPLE LENGTHS WITHIN VEIN DOMAINS, NORRBERGET**



**BULK DENSITY**

Density measurements were taken during a previous exploration program that collected 358 samples from four diamond drill holes. Sample densities were calculated using Archimedean principles of measuring a sample in air and immersed in water. An average bulk density for each lithology is presented in Table 14-18.

**TABLE 14-18 NORRBERGET MEAN BULK DENSITY BY LITHOLOGY**  
**Mandalay Resources Corporation – Norrberget Deposit**

<b>Lithology</b>	<b>Density (g/cm<sup>3</sup>)</b>
Overburden	1.80
Mafic Tuff	2.78
Mineralization	2.78
Mafic Volcaniclastic	2.72
Limestone	2.76

**VARIOGRAPHY**

The capped and composited intercepts were loaded into Snowden Supervisor v8.6 for continuity analysis and semi-variogram modelling. Due to the low sample numbers present within the wireframed domains it was not possible to model meaningful semi-variograms.

To review the continuity analysis, the data was loaded into Leapfrog Geo and the gold grade values contoured, which defined a trend for the high grade zone that matched a trend observed in Snowden Supervisor. These trends were used to inform the interpolation parameters.

**BLOCK MODEL CONSTRUCTION**

An empty block model was created of sufficient size to encompass the three mineralized domains and allow suitable waste for a pit shape that would be required to constrain the Mineral Resource. A parent block size of 6 m by 4 m by 4 m in the X, Y, and Z directions was used, providing 85 blocks in the X direction, 80 blocks in the Y direction, and 34 blocks in the Z direction. The blocks were rotated by 105° from north to match the strike of the mineralization. The block model has been clipped below the DTM surface supplied by Mandalay. In total, the block model contains 240,291 blocks.

Sub-blocking was applied along the boundaries of the mineralized domains to a minimum of 2.0 m in all directions. The blocks were flagged with each mineralized domain separately so that a hard boundary could be applied. A summary of the block model dimensions is provided in Table 14-19.

**TABLE 14-19 NORRBERGET BLOCK MODEL DIMENSIONS**  
Mandalay Resources Corporation – Norrberget Deposit

Origin			Block Model Length (m)			Parent Block Dimension (m)			Minimum Sub Block Size (m)	Block Model Rotation
X	Y	Z	X	Y	Z	X	Y	Z	X, Y or Z	
768,900	7,211,600	0	470	350	130	6.0	4.0	4.0	2.0	105°

The block model attributes are outlined in Table 14-20.

**TABLE 14-20 NORRBERGET BLOCK MODEL ATTRIBUTES**  
Mandalay Resources Corporation – Norrberget Deposit

Variables	Default	Type	Description
EAST	0	Real	X Position
NORTH	0	Real	Y Position
RL	0	Real	Z Position
_EAST	0	Float	X Block Size
_NORTH	0	Float	Y Block Size
_RL	0	Float	Z Block Size
SG	0	Real	Specific Gravity
Run	0	Character	Search Pass Number
Class	0	Character	Block Classification
Domain	0	Character	Mineralisation Domain Name
RPA_Cap_Au	0	Real	Capped Au Grade
AuBest_gpt	0	Real	Uncapped Au grade
POINTS	0	Short	Number of Samples Used
STD_DEV	0	Real	Standard Deviation
Hole Count	0	Short	Number of Drill Holes Used
AVERAGE DISTANCE	0	Float	Average Distance of Samples
CLOSEST DISTANCE	0	Float	Closest Sample Distance
NN_RPA_Cap_Au	0	Real	Nearest Neighbour Au Grade

The block model was flagged using ID<sup>3</sup> for the blocks as no meaningful variograms could be modelled. A simultaneous Nearest Neighbour (NN) interpolation was undertaken using the same parameters to provide a check against the ID<sup>3</sup> model.

The orientation and radius of the search ellipse were calculated using the parameters observed during the continuity analysis. The continuity analysis highlighted a perceived strong 15° plunge to the deposit.

Three passes of a search ellipsoid were undertaken during interpolation, each run having an increasing search radius and a decreasing minimum number of interpolants to ensure that all blocks were interpolated with an estimated grade. All domains were estimated using a hard boundary. The parameters used for the ID<sup>3</sup> interpolation are outlined in Table 14-21.

**TABLE 14-21 NORRBERGET BLOCK MODEL INTERPOLATION PARAMETERS  
Mandalay Resources Corporation – Norrberget Deposit**

Run	Axis 1 Radius (m)	Axis 2 Radius (m)	Axis 3 Radius (m)	Max Samples	Max Samples Per Hole	Min Points (Total)	Min Holes	Search Ellipse		
								Azi (°)	Plunge (°)	Dip (°)
1	33.3	16.6	16.6	12	2	3	3	5	15	5
2	50	25	25	8	2	3	2	5	15	5
3	100	25	25	8	2	1	1	5	15	5

### BLOCK MODEL VALIDATION

RPA reviewed the interpolated block model to ensure that it is representative of the input data.

This validation used the following methodologies:

- Volumetric comparison between domain wireframes and flagged block model.
- Visual comparison of composite grade to interpolated block grades in plan and long/cross section.
- Statistical comparison between raw, composite and interpolated block grades.
- Swath plots comparing the interpolated block grades (ID<sup>3</sup> and NN) against composite sample grades.

### COMPARISON OF COMPOSITE SAMPLES TO BLOCK MODEL

A comparison between the wireframe volume and the resultant flagged block model volume is presented in Table 14-22.

**TABLE 14-22 NORRBERGET WIREFRAME VOLUMES VS. BLOCK MODEL  
VOLUMES  
Mandalay Resources Corporation – Norrberget Deposit**

Domain	Wireframe Volume (m <sup>3</sup> )	Block Model Volume (m <sup>3</sup> )	Difference	
			(m <sup>3</sup> )	(%)
Min_1	187,643	186,272	-1,371	-0.73%
Min_2	11,909	12,128	219	1.84%
Min_3	14,734	16,088	1,354	9.19%
<b>Total</b>	<b>214,286</b>	<b>214,488</b>	<b>202</b>	<b>0.09%</b>

The results show that although there are some significant differences between the wireframe volumes in Min\_2 and Min-3, most likely a result of the limited volume of these domains resulting in a higher chance that the centroid of the block will occur near the edges of the wireframe. The main mineralized domain (Min\_1) however, has a much smaller volume difference (-0.73%). When compared overall, the difference between the wireframe volumes and the block model volumes are negligible. This indicates that the trade-off between the block size and minimum practical block size for Mineral Resource estimation purposes is at an acceptable level.

Table 14-23 summarizes the statistical properties of the ID<sup>3</sup> Norrberget block model.

**TABLE 14-23 NORRBERGET BLOCK MODEL STATISTICS**  
Mandalay Resources Corporation – Norrberget Deposit

Domain	Count	Min (g/t Au)	Max (g/t Au)	Mean (g/t Au)	Variance	StDev	CV
Min_1	7,740	0.00	18.01	1.50	3.63	1.91	1.27
Min_2	358	0.00	4.23	0.80	1.33	1.15	1.44
Min_3	910	0.03	3.32	0.96	0.78	0.88	0.92

Table 14-24 outlines the minimum, maximum, and mean grade for the capped assays, composited intervals and the block model.

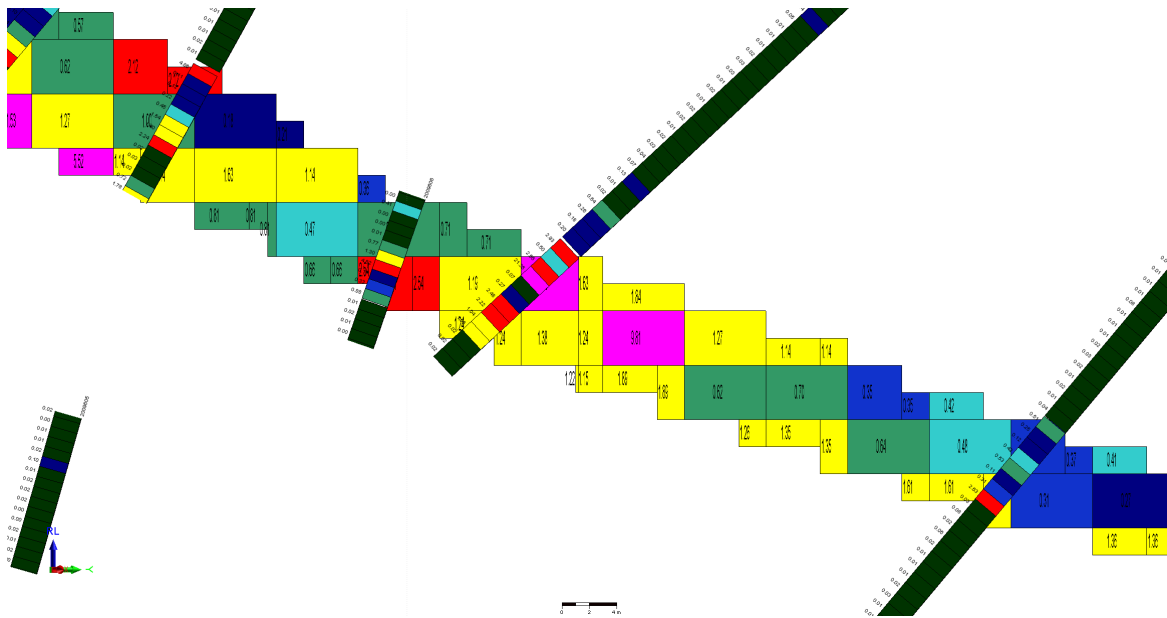
**TABLE 14-24 COMPARISON OF NORRBERGET AU STATISTICS**  
Mandalay Resources Corporation – Norrberget Deposit

Domain	Capped Assay (g/t Au)			Composites (g/t Au)			Block Model (g/t Au)		
	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
Min_1	0.00	24.00	2.09	0.00	24.00	2.03	0.00	18.01	1.50
Min_2	0.00	5.62	0.64	0.00	5.62	0.67	0.00	4.23	0.80
Min_3	0.02	5.05	1.34	0.02	5.05	1.34	0.03	3.32	0.96

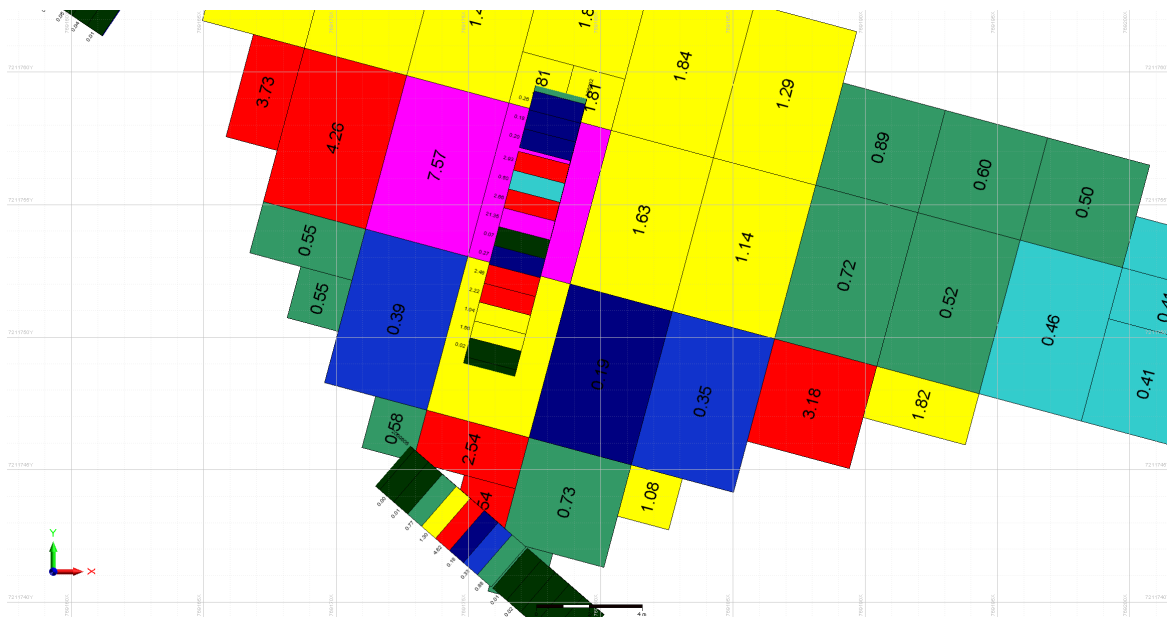
**VISUAL COMPARISONS**

Figures 14-30 and 14-31 illustrate a visual comparison of the block grade versus the composite grade in section and plan, respectively. These images show that the block grade is appropriate to the local scale composite grade and that it does not appear that the block model is over smoothed. The intersection appears significantly smaller than the blocks in Figure 14-30 as a result of the steep drill hole angle and relatively shallow domain relative to the plan view.

**FIGURE 14-30 NORRBERGET CROSS SECTION OF BLOCK GRADE VERSUS COMPOSITE GRADE**



**FIGURE 14-31 NORRBERGET PLAN OF BLOCK GRADE VERSUS COMPOSITE GRADE**

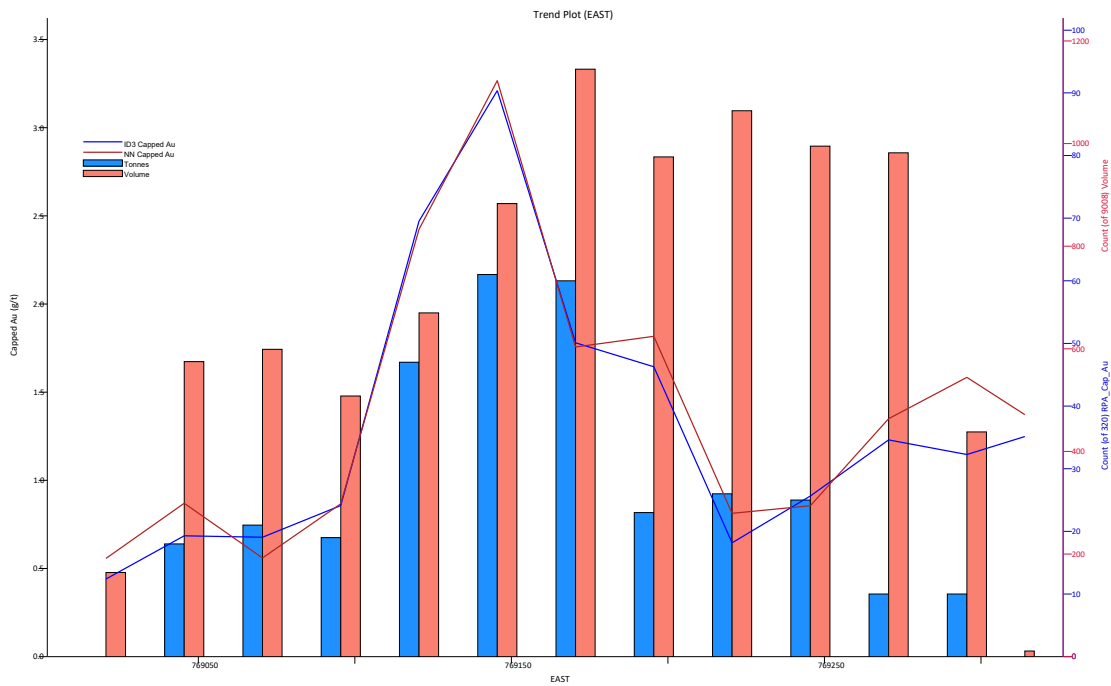


**SWATH PLOTS**

The trend (swath) plots presented in Figures 14-32 to 14-34 compare the capped composite grades against the ID<sup>3</sup> and NN interpolations along a particular orientation. These plots indicate that the ID<sup>3</sup> block model is supported by the underlying data and that the grade is not overly smoothed.

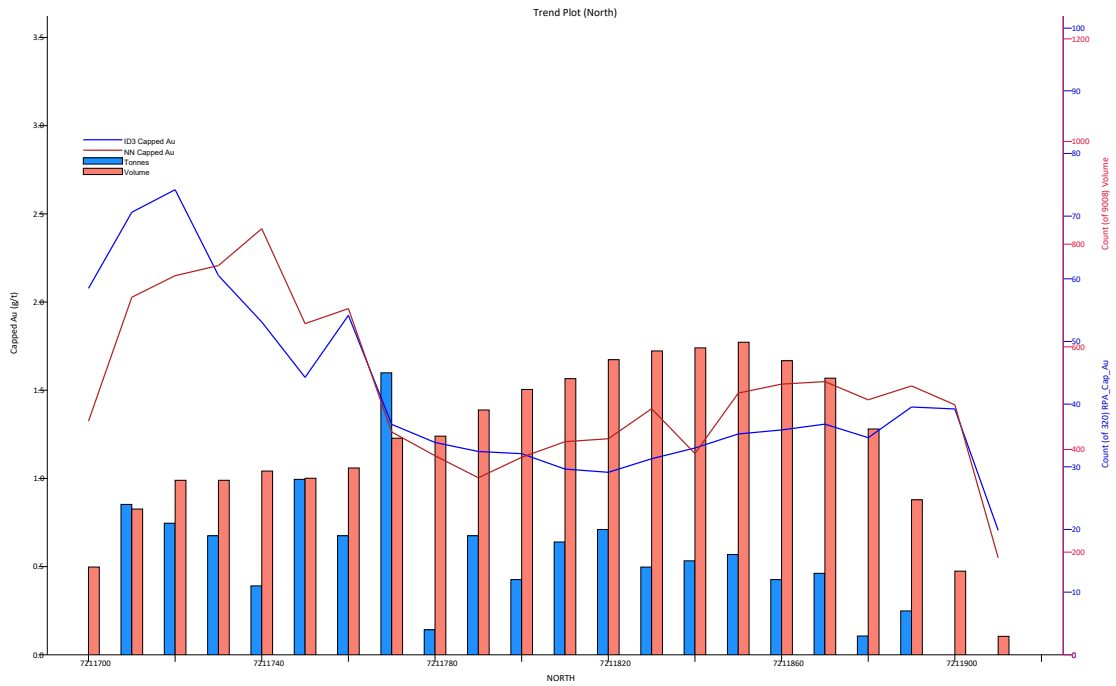
These results indicate that the block model grade is reflective of the input capped and composited sample grades.

**FIGURE 14-32 TREND PLOT (EAST) ANALYSIS OF ID<sup>3</sup> AND NN ANALYSIS VERSUS COMPOSITE SAMPLES, NORRBERGET**

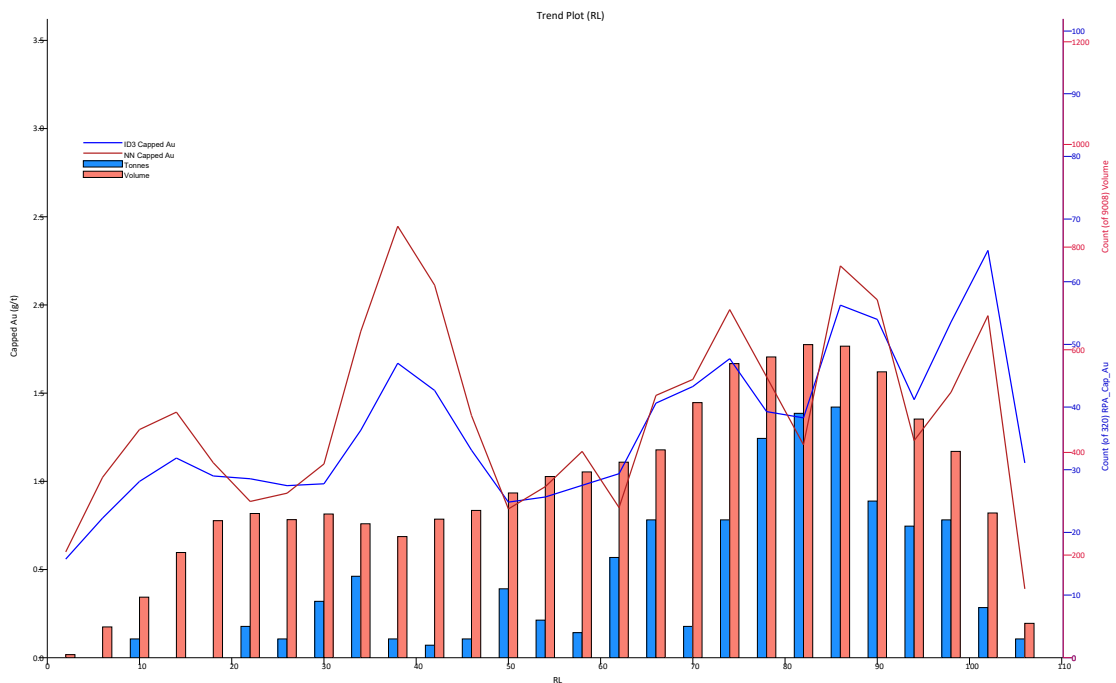




**FIGURE 14-33 TREND PLOT (NORTH) ANALYSIS OF ID<sup>3</sup> AND NN ANALYSIS VERSUS COMPOSITE SAMPLES, NORRBERGET**



**FIGURE 14-34 TREND PLOT (ELEVATION) ANALYSIS OF ID<sup>3</sup> AND NN ANALYSIS VERSUS COMPOSITE SAMPLES, NORRBERGET**



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## **MINERAL RESOURCES CLASSIFICATION CRITERIA**

Definitions for resource categories used in this report are consistent with CIM (2014) definitions and adopted by NI 43-101.

It has previously been reported by Geovista in March 2017 that no drill holes prior to 2004 have QA/QC data available for them. This was taken into account when classifying the Mineral Resource. Wireframes were created to surround areas of potential similar classification to ensure that the classification was contiguous and no spotted dog classification was applied. Some blocks were included within the classification wireframes that may not meet the criteria for the purposes of continuity.

Indicated blocks were those which was interpolated by drill holes that had an average spacing of less than 40 m for drill holes completed since 2004, interpolated primarily within pass one or two and are within domain Min\_1.

Inferred blocks were blocks that did not meet the classification parameters for Indicated and all blocks within the two smaller domains (Min\_2 and Min\_3) due to their limited number of interpolants. Inferred material included blocks that were primarily interpolated using pre-2004 drill holes.

## **RESPONSIBILITY FOR THE ESTIMATE**

The estimate of the Mineral Resources for Norrberget presented in this report was prepared by Mr. Jack Lunnon, CGeol, who is a Qualified Person as defined in NI 43-101, and is independent of Mandalay.

## **CUT-OFF GRADE AND RESOURCE REPORTING CRITERIA**

The cut-off grade for the Norrberget deposit was developed using the January to September 2017 actual cost information along with a gold price of US\$1,400 per ounce and an exchange rate of 9.0 SEK/US\$. The cut-off grade for reporting of Mineral Resources was determined to be 0.35 g/t Au.

To fulfill the NI 43-101 requirement of “reasonable prospects for eventual economic extraction”, Mandalay prepared a preliminary open pit resource shell using the Whittle parameters used in Section 15 and based on a gold price of US\$1,400 per ounce.

The criteria used to report the Mineral Resources at Norrberget included:

- All blocks located above the resource pit surface.
- All blocks with a grade above 0.35 g/t Au.
- A Mineral Resource category of either Indicated or Inferred.

## NORRBERGET DEPOSIT MINERAL RESOURCE ESTIMATE

Table 14-25 presents the Norrberget Mineral Resource estimate as of September 30, 2017.

**TABLE 14-25 SUMMARY OF NORRBERGET MINERAL RESOURCES AS OF SEPTEMBER 30, 2017**  
Mandalay Resources Corporation – Norrberget Deposit

Category	Tonnage (kt)	Grade (g/t Au)	Contained Au (koz)
Measured	-	-	-
Indicated	144	3.29	15
<b>Total Measured + Indicated</b>	<b>144</b>	<b>3.29</b>	<b>15</b>
Inferred	3	4.03	0.5

Notes:

1. Norrberget Mineral Resources are estimated using drill hole and sample data as of September 30, 2017.
2. CIM (2014) definitions were followed for Mineral Resources.
3. Mineral Resources are inclusive of Mineral Reserves.
4. For Norrberget, a nominal two metres minimum mining width was used to interpret veins using diamond drill and reverse circulation drill samples.
5. Bulk density is 2.74 t/m<sup>3</sup>.
6. High gold assays at Norrberget were capped at 24 g/t Au.
7. Interpolation was by inverse distance cubed.
8. Open pit Mineral Resources are estimated at a cut-off grade of 0.35 g/t Au and constrained by a resource pit shell.
9. Mineral Resources are estimated using an average gold price of US\$1,400/oz and an exchange rate of 9.0 SEK/US\$.
10. Mineral Resources that are not Mineral Reserves do not have demonstrated economic viability.
11. Numbers may not add due to rounding.

RPA is not aware of any environmental, permitting, legal, title, taxation, socio-economic, marketing, political, or other relevant factors that could materially affect the Mineral Resource estimate.

# 15 MINERAL RESERVE ESTIMATE

## SUMMARY

The Mineral Reserves estimated by Mandalay, with an effective date of December 31, 2019, are listed in Table 15-1. The total Mineral Reserve estimate for the Björkdal Mine and Norrberget deposit is 11.09 million tonnes at a grade of 1.54 g/t Au, for a total of 548,000 ounces of contained gold. The Mineral Reserve estimate for Norrberget is 162,000 tonnes at a grade of 2.80 g/t Au, for a total of 15,000 ounces of contained gold.

**TABLE 15-1 SUMMARY OF MINERAL RESERVES AT THE BJÖRKDAL MINE AND NORRBERGET DEPOSIT AS OF DECEMBER 31, 2019**  
Mandalay Resources Corporation – Björkdal Gold Mine

Location	Area	Tonnage (kt)	Grade (g/t Au)	Contained Au (koz)
<b>Probable Mineral Reserves</b>				
Björkdal	Open Pit	2,875	1.23	114
	Underground	5,410	2.10	365
Norrberget	Open Pit	162	2.80	15
Stockpiles	Stockpiles	2,644	0.64	54
<b>Total Probable Mineral Reserve</b>		<b>11,090</b>	<b>1.54</b>	<b>548</b>

Notes:

1. Mineral Reserves are estimated using drill hole and sample data as of September 30, 2019 and depleted for production through December 31, 2019.
2. Norrberget Mineral Reserves are estimated using data as of September 30, 2017.
3. CIM (2014) definitions were followed for Mineral Reserves.
4. Open Pit Mineral Reserves are based on mine designs carried out on an updated resource model, applying a block dilution of 100% at 0.0 g/t Au for blocks above 1.0 g/t Au and 100% at in-situ grade for blocks between 0.4 g/t Au and 1.0 g/t Au. The application of these block dilution factors is based on historical reconciliation data. A cut-off grade of 0.4 g/t Au was applied. Open Pit Mineral Reserves for Norrberget are based on 15% dilution at zero grade and 100% extraction.
5. Underground Mineral Reserves are based on mine designs carried out on an updated resource model. Minimum mining widths of 3.85 m for stopes (after dilution) and 4.35 m for development (after dilution) were used. Stope dilution was applied by adding 0.5 m on each side of stopes as well as an additional 10% over break dilution. Further dilution, ranging from 10% to 100%, was added on a stope by stope basis depending on their proximity with other stopes. An overall dilution factor of 14.5% was added to development designs. Mining extraction was assessed at 95% for contained ounces within stopes and 100% for development. A cut-off grade of 0.92 g/t Au was applied. An incremental cut-off grade of 0.4 g/t Au was used for development material.
6. Stockpile Mineral Resources are estimated at a cut-off grade of 0.40 g/t Au and are based upon surveyed volumes supplemented by production data.
7. Mineral Reserves are estimated using an average long-term gold price of US\$1,300/oz, and an exchange rate of 9.0 SEK/US\$.
8. Tonnes and contained gold are rounded to the nearest thousand.
9. Totals may appear different from the sum of their components due to rounding.

RPA is not aware of any mining, metallurgical, infrastructure, permitting, or other relevant factors that could materially affect the Mineral Reserve estimate.

## **BJÖRKDAL**

### **OPEN PIT OPTIMIZATION**

Potential pits were evaluated using the Whittle software package, which employs the Lerchs-Grossmann pit optimization algorithm. The parameters used to derive the selected pit optimization are presented in Table 15-2. The optimization was completed in 2019 and a check was performed in 2020, which found the 2019 values and mine design to still be valid. As the open pit mining was stopped in 2019 and deferred to 2023, the economic parameters will need to be updated again at a later stage.

Overall pit slopes of 45° and 50° were determined using actual pit slope angles achieved in the main pit. The overall pit slopes for Nylunds were approximately 42° after accounting for ramps which had a larger impact on overall slope angles since the Nylund pits are much smaller than the main pit. Operating costs and mill recovery are based on actual operating data from 2019.

Dilution and extraction factors are based on a reconciliation data exercise and are discussed in detail in Section 14 of this report.

A selective mining unit (SMU) of 5 m x 3 m x 3 m was used in the block model but was reblocked in Whittle to 10 m x 6 m x 6 m to improve processing time.

**TABLE 15-2 BJÖRKDAL WHITTLE RESERVE PIT PARAMETERS**  
**Mandalay Resources Corporation – Björkdal Gold Mine**

Parameter	Unit	Input
Pit Slopes (Main Pit)	degrees	45 to 50
Pit Slopes (Nylunds)	degrees	42
Pit Slopes (Overburden)	degrees	18
Mining Cost (Rock)	SEK/t	21
	US\$/t	2.33
Process and General & Administrative Cost	SEK/t	130
	US\$/t	14.44
Process Recovery	%	89.7
Mining Extraction	%	100
Mining Dilution	%	100
Base Gold Price	US\$/oz Au	1,300
Exchange Rate	SEK/\$US	9.0
Block Size	m	5x3x3
Block Size (reblocked)	m	10x6x6

Several Whittle shells were run and the results show that the majority of ore tonnage in the pit optimization is located in the crown pillar along the east wall of the pit. This pillar contains the two main portal accesses to the underground operation and associated infrastructure and mine services.

## DILUTION AND EXTRACTION

### **OPEN PIT**

Historically, the mining parameters and loading equipment allowed for reasonably good selectivity, however, dilution levels are much higher than typical open pit parameters given the thin veined nature of the Björkdal deposit.

The open pit contains “A-ore”, which is ore with a grade greater than 1.0 g/t Au, while “B-ore” has a grade of 0.4 g/t Au to 1.0 g/t Au. Historically, the bulk of the lower grade ore was stockpiled, which led to the creation of a large stockpile, which is now being processed.

Over a year (2018-2019) of reconciled open-pit A-ore production was compared against the modelled tonnes and grade on a blast by blast basis. While the contained ounces of the A-ore reconciles well with the model, the tonnage is significantly understated. This is because the tonnes were reported using a block cut-off grade rather than a mining shape. The compiled data supports the use of a block dilution of 100% at 0.1 g/t Au for blocks above 1.0 g/t Au.

Based on the historical reconciliation data, a tonnage dilution factor of 100% at the estimated grade was applied to all blocks between 0.4 g/t Au and 1.0 g/t Au. As a result, a significant tonnage of low grade dilution as well as additional tonnes of low-grade material that was not in the reserve estimate was mined.

RPA recommends an improved reconciliation process be implemented that compares the block model, grade control model, and declared ore mined (mill data). Following this process, the minimum mining widths and the anticipated planned and unplanned dilution applied should be updated, together with, (if possible) an estimate of the additional low-grade material that will likely be mined.

### **UNDERGROUND**

A detailed underground reconciliation exercise was completed in 2018 and 2019, which compared the design and actual production from 51 stopes, with estimates for dilution and underbreak. The long term estimate underestimated the tonnes by 5% and the gold content by 13%. These values average a wide range of underbreak and dilution across the stopes. In general, the planned and unplanned dilution is just over 50%. This is in line with the factors used in the mine design. The underbreak, or mining losses, at approximately 14%, is not well accounted for in the mine design, however, the dilution appears to contain enough grade to offset these losses.

For the long term design, dilution was applied in the Deswik software package and was assigned to the stope shapes as 0.5 m in the footwall and 0.5 m in the hangingwall. The minimum mining width is 2.5 m, which results in a final minimum width of 3.5 m after dilution is applied. A further general dilution of 10% was added to all the stopes.

A mining recovery rate of 95% was applied to the in-stope ounces, rather than to the ore tonnes. No losses were applied to the development in ore.

RPA recommends that mining losses be included in the long term plan in the form of tonnages. The Aurora Zone with its wider and larger stopes should be evaluated for its own local factors.

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## **CUT-OFF GRADE**

### ***OPEN PIT***

Based on the reconciliation exercise between the 2018 block model and the 2018 mill data explained in Section 14, an additional block dilution factor of 100% was applied in the Whittle optimization stage which accounts for both planned and unplanned dilution. The inclusion of dilution in the Whittle optimization process increases the effective cut-off grade and results in a smaller pit shell since ore blocks will have to carry a higher grade to offset the additional dilution material that would be processed.

In the December 31, 2017 Mineral Reserve estimate, a final pit design (2018 Pit Design) was carried out based on the 2018 Whittle shell (2018 Whittle Shell). For the December 31, 2019 Mineral Reserve estimate, the 2018 Pit Design was left unchanged since the Whittle output was very similar between 2018 and 2019. RPA has reviewed the 2019 Whittle Shell with the 2018 Pit Design and agrees that a detailed pit redesign was not required for purposes of Mineral Reserve reporting.

Mining solids were created from the final pit design shells and the resource block model was used to report tonnes and grade for all blocks above the in-situ 0.4 g/t Au cut-off grade. The in-situ cut-off grade is calculated as a pit discard cut-off using only the processing and general and administrative (G&A) costs as operating costs, since it is assumed that once the material is mined, it will either be sent to the mill or the waste dump. The blocks above the cut-off grade were then reported as Mineral Reserves and form the basis of the LOM plan.

### ***UNDERGROUND***

The cut-off grade for underground mining was calculated based on several criteria. Consideration was given to the type of mining activity on which the cut-off parameter would be applied. The cut-off grades apply to the run-of-mine (ROM) head grade and are not in-situ grades as they include dilution and losses. For stopes, a cut-off grade of 0.92 g/t Au was calculated, while, for development, a lower cut-off grade of 0.39 g/t Au was calculated. The lower cut-off grade is similar to the 2019 value of 0.4 g/t Au so this value was retained. Both of these grades are marginal cut-off grades.

The stoping cut-off grade is based on the direct stoping cost average from 2018 and 2019, and excludes all development, making it a marginal cut-off grade. Based on the inclusion of the full cost of mining in 2019, a full cost cut-off grade is approximately 1.28 g/t Au. As under 15%



of the stope tonnes are between the full cost and marginal cost cut-off grades, there is enough high value material to support the development that is assumed to exist for the remaining marginal material.

The 0.4 g/t Au cut-off grade is the grade at which processing the development material becomes economically viable. As this material will be mined anyway to access the stopes, the only costs to consider when determining whether it should be processed or discarded are the processing costs.

The 0.4 g/t Au cut-off grade for development material is consistent with the pit discard calculation for open pit mining. The cut-off grade calculation is shown in Table 15-3.

**TABLE 15-3 BJÖRKDAL UNDERGROUND CUT-OFF GRADE CALCULATION**  
**Mandalay Resources Corporation – Björkdal Gold Mine**

Parameter	Unit	Value
Metal Price	US\$/oz	1,300
Exchange Rate	SEK/US\$	9.0
Process Recovery	%	89.7
Net Payable	%	98.3
Stoping Cost	US\$/t	16.22
Process Cost	US\$/t	7.78
G&A Cost	US\$/t	8.89
Transport and Refining Cost	US\$/t	1.20
Cut-Off Grade Cost	US\$/t	34.08
Cut-Off Grade	g/t Au	0.92
Incremental Cut-Off Grade	g/t Au	0.39

Costs were based on Björkdal’s actual stoping and other costs for 2018 and 2019. As production is expected to increase from the underground, in RPA’s opinion, these costs are likely to be conservative due to the expected increased mined tonnage.

Metal prices used for Mineral Reserves are based on consensus, long term forecasts from banks, financial institutions, and other sources. For Mineral Resources, metal prices used are slightly higher than those for Mineral Reserves.

## NORRBERGET

### OPEN PIT OPTIMIZATION

The following description for Norrberget was taken from the 2018 Technical Report (RPA, 2018). No changes have been made to the Mineral Reserve estimate since the underlying assumptions have not materially changed with the exception of the exchange rate

**TABLE 15-4 NORRBERGET WHITTLE RESERVE PIT PARAMETERS**  
**Mandalay Resources Corporation – Björkdal Gold Mine**

Parameter	Unit	Input
Pit Slopes (South West Wall)	degrees	36
Pit Slopes (North West and North East Walls)	degrees	52
Pit Slopes (Overburden)	degrees	25
Mining Cost (Overburden)	US\$/t	1.55
Mining Cost (Solid Waste)	US\$/t	2.50
Mining Cost (Ore)	US\$/t	2.97
Process Cost	US\$/t	7.63
General and Administrative Cost	US\$/t	6.65
Process Recovery	%	75
Mining Extraction	%	100
Mining Dilution	%	15
Base Gold Price	US\$/oz Au	1,200
Block Size	m	6x4x4

Pit slopes were determined based on a geotechnical assessment carried out by SRK Consulting (SRK) in October 2017 (Di Giovinazzo, 2017). The northwest and northeastern wall sectors have slope angles of 52° while the southwest (footwall) sector has a slope angle of 36°.

A dilution factor of 15% and extraction factor of 100% was added based on reconciled production data from mining shallow dipping structures at Björkdal.

The Whittle optimization was carried out at the parent block size of 6 m x 4 m x 4 m.

Mining costs were based on actual 2017 mining costs at Björkdal, the higher cost of mining ore (increase of approximately 19%) is due to the longer trucking distance to the Björkdal Mill. An overall gold recovery of 75% is based on recent metallurgical work as discussed in Section 13 of this report.

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## **DILUTION AND EXTRACTION**

### ***OPEN PIT***

Because no production has taken place at Norrberget, a reconciled dilution and extraction factor cannot be obtained. A dilution factor of 15% and extraction factor of 100% has been drawn out of reconciled production data from mining shallow dipping structures at the Björkdal open pit, and therefore it is reasonable to assume that the similar conditions at Norrberget will yield similar results.

## **CUT-OFF GRADE**

### ***OPEN PIT***

After the Whittle pit optimization was completed, a final pit design was carried out based on the Whittle shell. Mining solids were created from the final pit design shells and the resource block model was used to report tonnes and grade for all blocks above the in-situ 0.4 g/t Au cut-off grade for Björkdal. The in-situ cut-off grade is calculated as a pit discard cut-off using only the processing and G&A costs as operating costs, since it is assumed that once the material is mined, it will either be sent to the mill or the waste dump. The blocks above the cut-off grade were then reported as Mineral Reserves and form the basis of the LOM plan.

## 16 MINING METHODS

The current environmental permit limits the total Björkdal production capacity to 1.70 Mtpa. In 2019, 1.29 Mt of ore was processed and 1.3 Mtpa is planned for 2020. Prior to 2020, production was split between the underground mine and the open pit. In 2019, mining of the open pit was stopped for economic reasons and this production was replaced with ore from the low grade stockpile and an increase in underground production. The remaining open pit material remains economically viable, however, the low grade stockpile realizes more value, so open pit mining has been deferred for several years until the stockpile is run-down and open pit production is needed to offset reducing underground production.

During 2019, 914,000 tonnes of ore was mined from underground, of which 895,000 tonnes was processed and the remainder stockpiled. The open pit produced 184,000 tonnes in 2019, with additional tonnage coming from the stockpile, for a total of 236,000 tonnes of ore processed from the stockpile and open pit ore.

The current production strategy is to maximize the underground extraction with the remaining ore coming from stockpiles. Underground production for 2020 is planned to be 796,000 tonnes. No production from the open pit is planned in 2020 and instead, 504,000 tonnes of ore will be drawn from the stockpile to make up the balance of the mill feed. When the underground can no longer supply enough ore, the open pit production will be restarted.

The current LOM plan envisages production from the open pit restarting in 2023.

### **BJÖRKDAL**

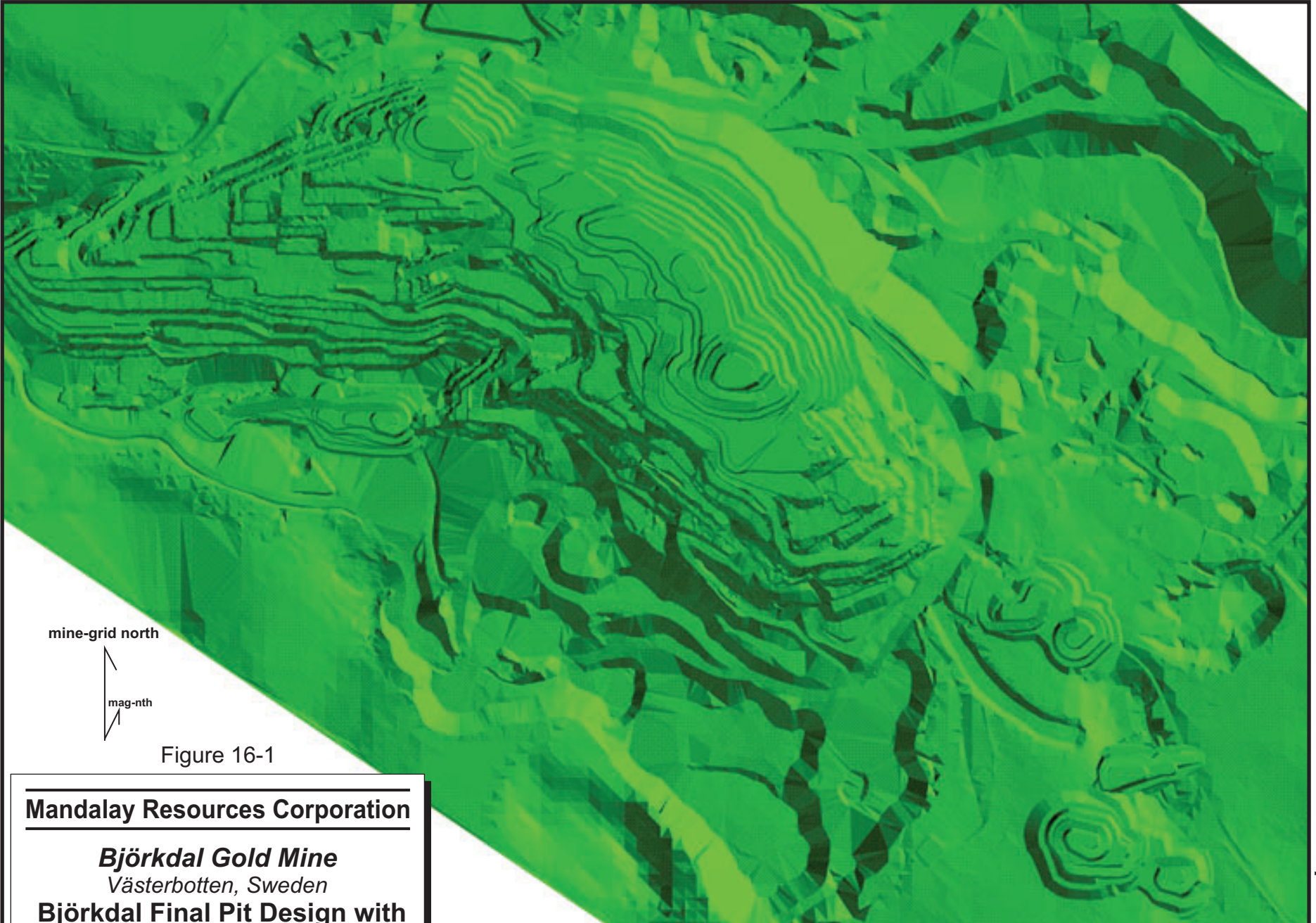
#### **MINE DESIGN**

##### ***OPEN PIT***

As production from the open pit has been stopped, the open pit design created in December 2018 has not been updated. The December 2018 design still aligns with an updated 2019 Whittle shell that was generated using up to date revenue and cost factors.

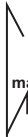
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The 2018 pit design was generated from the Whittle output shell produced from the use of Deswik mine planning software. The final pit outline, along with the mid-2019 topography, when open pit mining was halted, is presented in Figure 16-1.



16-3

mine-grid north



mag-nth

Figure 16-1

**Mandalay Resources Corporation**

***Björkdal Gold Mine***

*Västerbotten, Sweden*

**Björkdal Final Pit Design with  
August 2019 Topography**

0 100 200 300 400 500

Metres

March 2020

Source: Mandalay Resources Corporation, 2020.

The final pit bottom is at the -240 level. Single ramps, with widths of 15 m, are used in the first series of benches to access ore in the pit bottom. These single ramps converge into a double ramp at the -160 level pit and finish at the northeast side of the pit rim. The pit is designed slightly wider than the Whittle shell in order to achieve a reasonable mining width to operate the equipment. While there is currently no fleet in operation, RPA considers the 30 m to 40 m mining width to be reasonable for future mining equipment, which will be similar to the previous equipment that was used.

Benches are 5 m high, and are taken in groups of two to four with an 8 m to 10 m wide berm every 10 m to 20 m. A 72° to 85° bench face angle (BFA) is used to give an overall wall slope of 42° to 52°.

The pit design parameters used are shown in Table 16-1.

**TABLE 16-1 BJÖRKDAL PIT DESIGN PARAMETERS**  
**Mandalay Resources Corporation – Björkdal Gold Mine**

Parameter	Unit	Input
Overall Slope Angle	degrees	42-52
Bench Face Angle	degrees	70-85
Berm Width	m	8-10
Bench Height	m	5
Benches per Berm	#	2-4
Double Ramp Width	m	24
Single Ramp Width	m	15
Ramp Slope	%	10

**UNDERGROUND**

Indicated Mineral Resource blocks greater than 0.8 g/t Au were used as a basis for initial stope designs generated by Auto Stope Designer, an automated layout function that is part of Deswik software. Stope design parameters are presented in Table 16-2.

**TABLE 16-2 BJÖRKDAL UNDERGROUND STOPE DESIGN PARAMETERS**  
**Mandalay Resources Corporation – Björkdal Gold Mine**

<b>Parameter</b>	<b>Unit</b>	<b>Input</b>
On-Vein Development Size	m	3.8 m wide x 4.9 m high
Maximum Stope Height	m	25
Undiluted Minimum Mining Width	m	2.5
Allowance for Overbreak	m	0.5 x 2
Diluted Minimum Mining Width	m	3.5
Maximum Mining Width	m	12
Minimum Inter-Vein Pillar Width	m	5
Stope Mining Extraction	%	95
On-Vein Mining Extraction	%	100
Block Size	m	5x3x5
Design Cut-off Grade Based on US\$1,300/oz Au	g/t Au	0.92

The resulting stopes were evaluated manually and adjustments were made where necessary. Stopes were evaluated based on size, grade, and relative distance to existing development. Stopes that were not economically viable were removed from reserves. Most stopes that were within five metres of each other were combined into larger stopes and dilution was applied based on the additional internal waste captured in the new stope. The five metre pillar requirement is based on actual mining conditions experienced at Björkdal. The current stope designs do not incorporate localized geotechnical and geological considerations including detailed knowledge of hangingwall and footwall contacts, fault zones, and structural features such as folding.

## **MINING METHOD**

### ***OPEN PIT***

The open pit has currently been halted and is planned to be restarted in 2023. The planned method is standard truck and shovel mining, as done historically. Details will be redefined closer to the restart date.

### ***UNDERGROUND***

The known Björkdal underground deposit lies within a footprint of approximately 1,200 m x 400 m and has a vertical extent of approximately 400 m. Descriptions of the geology and styles of mineralization have been provided in Sections 7 and 14.



The underground mine production rate is planned to be between 800,000 tpa and 900,000 tpa. The OVD will be carried out over approximately four years and stope production will be carried out over approximately seven years. A decrease in production is planned after the sixth year, when underground output reduces to a 243,000 tpa, with the balance being made up with open pit and stockpile tonnes.

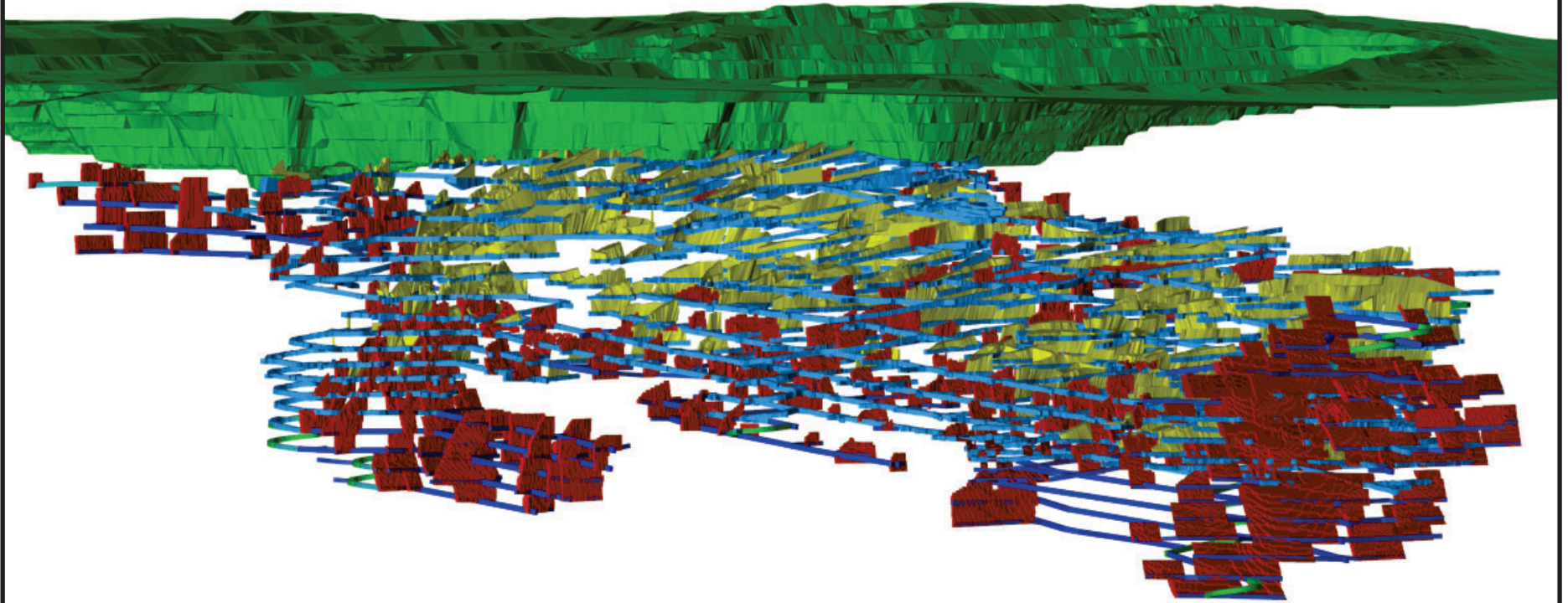
Primary access to the underground operation is via ramp systems originating from two portals located in the wall of the existing open pit. Open pit mining and removal of the crown pillar in the east wall will disrupt this access as well as the supply of other services such as emergency egress, electrical, ventilation, and mine drainage systems. An additional portal will be developed before open pit mining makes the old portals inaccessible, to ensure continuity of the supply of all necessary services.

The underground mining method used at the Björkdal Mine is longhole stoping with a sub-level spacing of 15 m to 20 m, depending on the zone. Cross-cuts are established perpendicular to the vein system. Veins are then developed by drifting on each sub-level from the cross-cut. All pre-production vein, cross-cut, and ramp development is drilled and blasted using conventional trackless mining equipment.

The underground mine design is presented in Figure 16-2.

Stoping blocks are currently drilled with approximately 15 m long 64 mm diameter up-holes connecting to the bottom of the overlying stope using Atlas Copco Simba drill rigs. When production drilling is completed, initial slot raises are developed and drill lines blasted in groups of three to five rings using a burden of 1.5 m and retreating towards the hangingwall. The material is removed between blasts, which also creates void space for the following blast. Remotely operated scoops are used to muck the stopes to nearby re-handle areas or directly into trucks.

Looking South West



Existing Development/Capital - light blue  
 Planned Capital - dark blue  
 Planned Development - bright green  
 Existing Stopes - yellow  
 Planned Stopes - red  
 Pit Reserve - mint green

Not to Scale

Figure 16-2

**Mandalay Resources Corporation**

**Björkdal Gold Mine**  
 Västerbotten, Sweden  
**Björkdal Underground  
 Mine Layout**

16-7

The majority of material mined underground is hauled to the surface as there is currently minimal underground waste disposal. As the mine continues to increase production from the Aurora Zone, some waste will be used as unconsolidated backfill. Otherwise, waste is only used where required to regain access over a mined out stope. If insufficient underground waste is available, open pit waste will be backhauled into the underground mine.

All underground material is loaded by Volvo L180 front end loaders (FELs) or Sandvik 514 load-haul-dumpers (LHDs), and hauled to surface by a contractor using 26t Scania R520 XT highway tipper trucks. The objective of the current materials handling strategy is as follows:

- Development material from cross-cuts and ramps above a grade of 0.4 g/t Au is hauled to a B-ore stockpile at the mill.
- OVD material is either hauled to the OVD production ROM stockpile where it is classified as waste or ore and sent to the appropriate location, or, where it is evidently high grade, is sent directly to the production stockpile.
- All stope production, regardless of grade, is hauled to the stope production stockpile.
- Waste material is hauled to surface waste dumps or to backfill areas underground if required.

In consideration of the variable vein geometry and existing equipment configuration, 3.5 m has been measured as the average minimum mining width. This includes provision for a 0.5 m overbreak on both the hangingwall and footwall sides of the stope.

Most of the mined out stopes are left open without any backfill, however the relatively new Aurora Zone will have stopes that will be both wider, longer and taller than in other areas. In these areas, the stopes are planned to be mined and backfilled with unconsolidated fill. This will allow pillars to be reduced and will increase the extraction ratio. A prefeasibility study to determine the mining method of this area was completed by Itasca Consultants AB (Itasca) in late 2019, which recommended a mining method, stope and pillar dimensions, as well as future support. Rill (or Avoca) mining with unconsolidated fill was determined to be the most cost effective option. Given that mining is already taking place in the Aurora Zone, these results are considered by RPA to be appropriate. This will require some new sequencing and the new practice of waste filling. Neither of these new procedures is considered to be risky or onerous.

The current top-down footwall to hangingwall retreat system results in the placement of ramp development outside the marble contact, while cross-cut pillars are within the ore zone.

A portion of remnant above cut-off grade material adjacent to previously mined out stopes is excluded from the underground Mineral Reserves, however, the extraction of these remnants warrants further evaluation. Some recovery of ore contained in pillar areas is planned at the end of the mine life, however, this is also excluded from the current Mineral Reserve estimate.

Stope grades are evaluated using an internal grade control model and the sludge grades from OVD are used to cross reference the grade control model. Stope tonnages are estimated from the stope design volume and are tracked by equipment bucket and truck count. A CMS is used to compare actual stope volumes.

The nature of the mining method is such that OVD comprises not more than 36% of the total underground tonnage production. Currently, the separation in OVD between what is considered ore and waste is 0.4 g/t Au, which is consistent with the open pit cut-off grade. All OVD is mined, hauled to a surface ROM stockpile, and sent to processing if sample data confirms a grade of over 0.4 g/t Au. While efforts are made to identify areas of waste development, a portion of cross-cut and ramp material is combined and hauled to a low-grade surface stockpile and processed as B-ore.

#### **LOW GRADE STOCKPILES**

Selective open pit mining at Björkdal commenced in 2009 with ore greater than 1.0 g/t Au being separated and milled as A-ore and material between 0.3 g/t Au and 1.0 g/t Au being stockpiled as B-ore.

Batch milling experience from these stockpiles has indicated that mill feed averages 0.65 g/t Au. Approximately 2.6 million tonnes of B-ore has been classified as an Indicated Mineral Resource at a grade of approximately 0.65 g/t Au.

This material forms the supply of ore for two phases of mine production. The mine is currently processing this ore and will do so until 2022. Stockpiled ore will not be processed when the open pit is restarted, except for periods of shortfalls in production. Once the open pit is depleted, the processing of the stockpile will recommence, up to the end of the life of mine.

Rehandling will be carried out with a small equipment fleet. Assuming a rehandling cost for stockpiled material results in a cut-off grade between 0.3 g/t Au and 0.4 g/t Au.

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## GEOTECHNICAL AND SLOPE STABILITY

### **OPEN PIT**

A structural and kinematic inter-ramp slope stability analysis for the Björkdal Mine was carried out by SRK in October 2012 (Saiang, 2012). The proposed inter-ramp slope angle of 70° and an inter-ramp height of 40 m were validated and showed a minimum factor of safety of 1.48. Water or pore pressure was not accounted for and required monitoring to see if it might become a concern.

Structural analysis showed that the dominant joint sets have similar orientations to the gold-bearing quartz veins and dip steeply either parallel or sub-parallel to quartz veins. As a result, the hangingwall side is less prone to any major instability because the intersections of joints do not daylight at the slope face. This is clearly evident at Björkdal where the hangingwall side of the pit is very stable even though slope angles are near vertical. On the footwall side, however, potential instabilities are observed. Structural and kinematic analyses show that there is no major threat for the footwall slopes or pit walls.

The rock mass at Björkdal is of very high quality. Test work carried out at Björkdal has shown that Geological Strength Index (GSI) is estimated to be between 70 and 80, and intact strength exceeds 200 MPa. This data is supported by the fact that approximately 50% of the entire underground development excavations are unsupported, neither with shotcrete nor rockbolts. A visual observation of the open pit slopes indicates near-vertical to vertical benches and narrow stable berms.

In 2016, SRK carried out an additional slope design review (Di Giovinazzo, 2016). The outcome of the review highlighted the opportunity for the potential of 25 m high benches (5 m benches in sets of five) with the potential to maintain the BFAs at 75°, and reduce the berm width to eight to ten metres. The 2017 pit design incorporated these changes. The review also highlighted the differing geotechnical character of various geographical and geological sectors of the mine. These geotechnical sectors have been used to assign varying BFAs (from 70° to 85°), bench heights (from 10 m to 20 m), and localized face azimuths to avoid planar failure in specific areas.

### **UNDERGROUND**

Rock mechanic consultants have made several visits to the Björkdal underground mine since start of its operation in 2009 and, in general, consider the rock quality and ground conditions

to be extremely good. The most recent work was carried out by Itasca in August 2019. Approximately 50% of the underground development requires ground control and simple standard procedures have been established. Mechanical scaling of all development is carried out immediately following blasting. Shotcrete and resin rebar are used in the pre-production OVD on an as-required basis and shotcrete followed by systematic resin bolting is used for permanent development such as ramps and cross-cuts. Longer bolts are installed in wider intersections with unfavourable structure orientations. Permanent development is also re-scaled every 12 months.

In some areas of the mine, the spacing between the parallel vein systems is small and the resulting pillar between the mined stopes has collapsed. Itasca has made a general recommendation that a minimum 10.0 m pillar is required around permanent development.

Ground control equipment at Björkdal includes an Atlas Copco Scaletec, 3 Jama 8000 scaler, a Sandvik DS411 bolting machine, a Normet 7110 Shotcrete and a Normet 8100 units supported by the delivery of concrete directly to the face by a local supplier.

Development has started in the Aurora Zone, which has veins that are larger and more extensive than elsewhere. These areas were the focus of the 2019 Itasca report, which analyzed potential stopes, pillars, and the related stress regimes in some detail, with the following conclusions:

- Unconsolidated backfill is required to limit the stope back length to 60 m.
- Sill pillars between 15 m and 10 m are required.
- Some stope backs should be shotcreted.
- Permanent accesses should be 25 m in the hangingwall, and will need protection pillars of 10 m where they pass through the orebody.
- Cable bolts are recommended but can be reconsidered depending on the acceptable level of risk.

RPA considers it essential that Björkdal continue to monitor local ground conditions as mining progresses. Global rock mechanic issues should be incorporated during future mine design studies as underground stresses are redistributed.

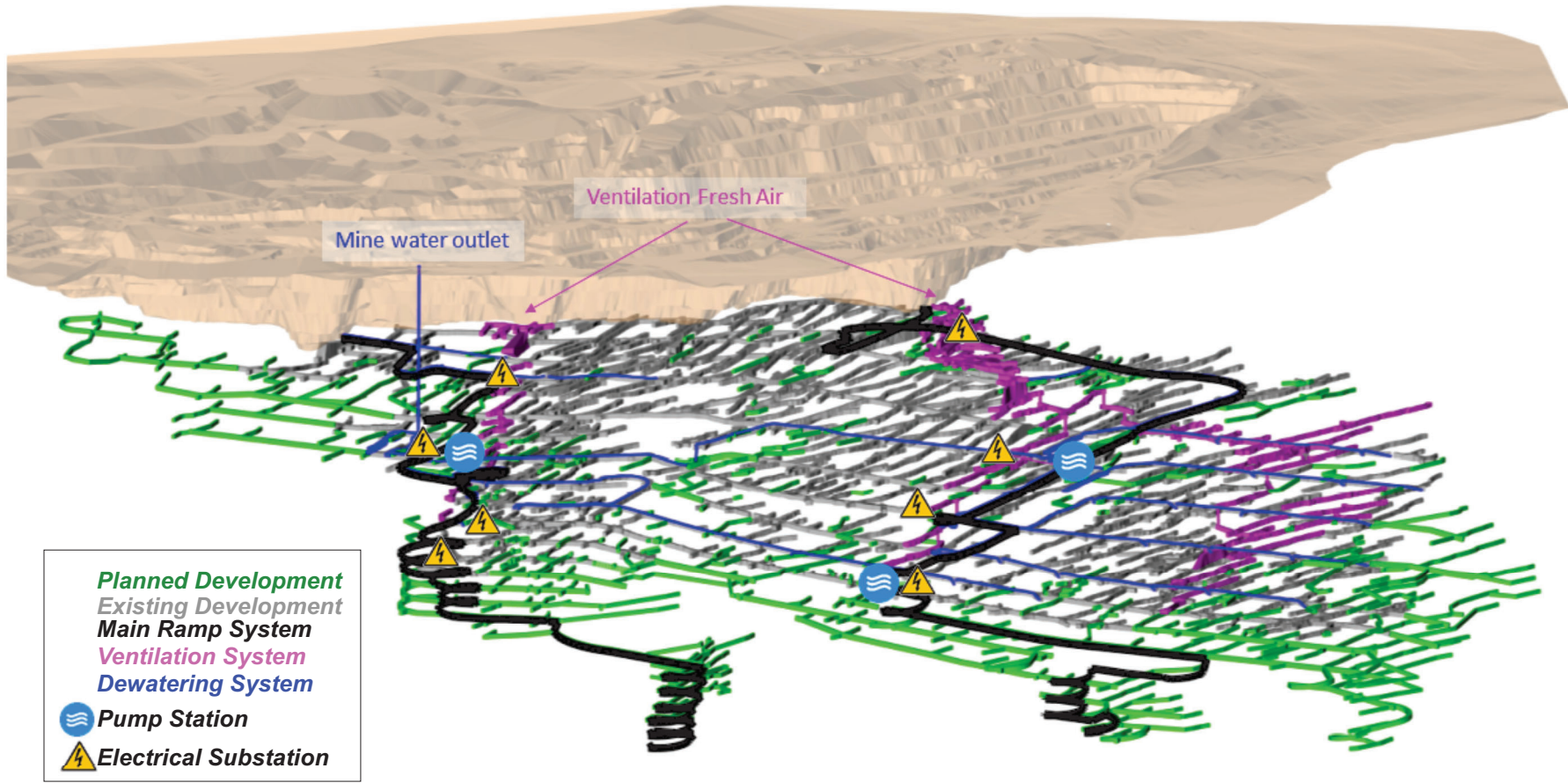
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## **INFRASTRUCTURE**

The underground mine workings are accessed by two ramps located in the wall of the existing open pit. The ramps cut through the orebody and connect to cross-cuts that run perpendicular to the vein structure. All material mined underground is hauled to the surface via these two ramps by a contractor using rigid trucks.

A layout of the 2019 underground infrastructure is presented in Figure 16-3.

Looking South West



- Planned Development*
- Existing Development*
- Main Ramp System**
- Ventilation System*
- Dewatering System*
-  **Pump Station**
-  **Electrical Substation**

Not to Scale

Figure 16-3

**Mandalay Resources Corporation**

***Björkdal Gold Mine***  
*Västerbotten, Sweden*

**Björkdal 2019 Underground  
 Infrastructure Layout**



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**DEWATERING**

Heavy storm events can result in a substantial influx of water into the underground mine via high permeability fault systems connecting with the open pit. The site is currently in the process of upgrading the pumping system.

The 340/ramp 2 pump station handles all the water that comes from production and groundwater inflows from the Lake Zone and Central Zone. The water is pumped from the working faces with submersible pumps in lifts to the 340/ramp 2 pump station. The 340/ramp 2 pump station pumps the water using two large submersible pumps (2 x 90 kW) in one horizontal 800 m section in two 150 mm diameter pipes to the Main Zone pump station. The water flow from this area varies between 10 m<sup>3</sup>/h and 70 m<sup>3</sup>/h, depending on the level of production activities and the season.

The Main Zone pump station, located on the 265 level, sends all underground pump water to surface using three centrifugal pumps (3 x 75 kW), with a capacity of 180 m<sup>3</sup>/hr in total. The water is transported in one vertical lift of 200 m to surface in a 250 mm diameter steel pipe. The mine water then flows in a ditch to a clear water basin where the water is treated to remove suspended solids and nitrates.

The pump water that comes to the Main Zone pump station is mainly from the Lake Zone 340 ramp pump station, but also from the working faces in the deeper levels of the Main Zone, which is pumped with submersible pumps similar to Lake Zone.

Total annual pumped water from underground to surface is approximately 750,000 m<sup>3</sup>.

**VENTILATION**

The underground ventilation system is simple and effective. Fresh air is introduced into the mine via two primary intake air shafts located adjacent to the open pit and is distributed to the working areas by means of 10 secondary fans installed throughout the mine. Fresh air is drawn through old stopes to avoid the need for heating during the winter months. The return air is exhausted via two main ramp systems into the open pit.

**ELECTRICAL**

Björkdal has combined 400 V/1,000 V electrical sub-stations as well as single 400 V and 1,000 V sub-stations. Separate cables for both 1,000 V and 400 V are used.

All underground mining equipment requiring electrical power operate on 1,000 V while pumps and fans operate on 400 V. Electrical sub-stations are placed in strategic locations, close to fresh air ventilation shafts and near production faces.

Underground communication uses a digital leaky feeder system that covers the entire mine. Communication between personnel is carried out using Motorola two-way radios.

**MINE EQUIPMENT**

**OPEN PIT**

The open pit is not currently being mined. Some equipment is being used to rehandle the low grade stockpile into the primary crusher.

**UNDERGROUND**

With the exception of materials handling, haulage to the surface, and road maintenance, underground mining activities are carried out by Björkdal personnel. The underground mining equipment used at Björkdal is presented in Table 16-3.

**TABLE 16-3 BJÖRKDAL UNDERGROUND MINING EQUIPMENT**  
**Mandalay Resources Corporation – Björkdal Gold Mine**

<b>Make</b>	<b>Model</b>	<b>Type</b>	<b>Owner</b>	<b>Units</b>
Atlas Copco	Simba	Longhole Drilling	Björkdal	3
Atlas Copco	Boomer M2C	Drifting	Björkdal	2
Atlas Copco	Boomer E2C	Drifting	Contractor	1
Atlas Copco	Scaletec MC	Scaler	Björkdal	2
JAMA	8000	Scaler	Björkdal	3
Gia	UV211	Charging unit	Björkdal	1
Normet	8100	Shotcreting	Björkdal	1
Normet	7110	Shotcreting	Björkdal	1
Sandvik	DS411	Bolter	Björkdal	1
Sandvik	LH 410 1	RC loader	Björkdal	1
Sandvik	514	RC loader	Björkdal	2
Volvo	5350	Water dumper "A25"	Björkdal	1
Volvo	L 90F	Production	Björkdal	2
Volvo	L 90F	Mine construction	Viddes gräv	1
Volvo	L 180H	Loader	Björkdal	3
Volvo	L 120H	Loader	Björkdal	1
Volvo	L110H	Charging unit	EPC	1
Scania	R520 XT	Hauling	Renfors	7
Volvo	L90	Road Maintenance	Renfors	1

## NORRBERGET

Norrberget is planned to supply approximately 280,000 tonnes of ore over 2027 and 2028. The planned monthly tonnage is a relatively small proportion of the total mine production, and will be mined to supplement the open pit feed to the plant.

### MINE DESIGN

#### OPEN PIT

A pit design for Norrberget was created based on the Whittle output shell using Deswik mine planning software. The pit design parameters used are shown in Table 16-4 and are based on the current operating practices at Björkdal.

**TABLE 16-4 NORRBERGET PIT DESIGN PARAMETERS**  
**Mandalay Resources Corporation – Björkdal Gold Mine**

Parameter	Unit	Input
Overall Slope Angle	degrees	36-52
Bench Face Angle	degrees	70-75
Berm Width	m	5
Bench Height	m	5-10
Benches per Berm	#	1
Single Ramp Width	m	15
Ramp Slope	%	10

The final pit bottom is at the 70 level, approximately 50 m below the original topography. A single 15 m wide ramp is used to access the orebody.

The final pit outline, along with topography and crown pillar for reference, is presented in Figure 16-1.

### MINING METHOD

At Norrberget, open pit mining will be carried out by a contractor, using trucks and excavators. This production will be part of an integrated mining contract for both Björkdal and Norrberget.

The mining schedule at Norrberget is integrated into the Björkdal open pit schedule to minimize potential production shortfalls and to provide added flexibility to the deliverable mill feed.

Waste mined during the life of the open pit will be placed on the north side of the open pit and will contribute to sound attenuation from the operation of the pit.

## **GEOTECHNICAL AND SLOPE STABILITY**

In July 2017, SRK was engaged to carry out a geotechnical assessment of the Norrberget deposit. The assessment included the following:

- analysis of drill core from existing logs and photographs,
- intact rock strength,
- jointing and structure,
- kinematic analysis,
- SBlock analysis, and
- recommendations for slope designs to be used in for pit optimization and pit design.

The review recommended that the pit design be split into two distinct sectors: the southwest (footwall to the ore) and the northeastern sector (hangingwall). The southwest sector has been designed with an overall slope angle of 36° and a BFA of 70°. The northeastern sector has been designed with an overall slope angle of 52° and a BFA of 75°. The shallower design of the southwest sector does not significantly raise the strip ratio of the Norrberget mine as the recommended overall slope angle closely mirrors the dip of the orebody.

## **HYDROLOGICAL STUDIES**

In 2016, Golder Associates AB (Golder) was commissioned to carry out a hydrological study of the Norrberget area. Water handling at Norrberget will be integrated into the water management plan for Björkdal. Water quality of discharge from the mine and existing surface waterways will be monitored by Björkdal staff to comply with local regulations and the operating conditions of the environmental permit.

Golder concluded that the groundwater level at Norrberget is 115 MASL and the existing topography at the site averages 120 MASL. At an expected pit depth of 57 MASL (60 m below surface) the expected groundwater infiltration rate is 800 m<sup>3</sup> per day and the expected contribution of surface run-off and rainfall is 450 m<sup>3</sup> per day. This leads the analysis to conclude that pumping requirements at Norrberget should not exceed 1,250 m<sup>3</sup> per day. The estimated area of influence on the local groundwater system has been assessed to have a radius of approximately 450 m to 500 m from the centre of the pit.

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Pumping is planned to use portable pumps to dewater the workings, as required, and waste water will be discharged to the sedimentation dam northwest of the Norrberget pit.

The proposed open pit design is located at the confluence of two minor streams. Stream diversion trenches will be dug north and south of the planned pit to steer water from these two streams around the open pit and reconnect with the original drainage east of the pit design. A further trench will be constructed on the gently sloping west side of the designed pit to redirect surface water drainage away from the proposed pit and into the northern stream channel.

### **MINE EQUIPMENT**

Mine equipment for Norrberget will be provided by mining contractors as needed. As the Norrberget pit is scheduled to be mined in 2027, equipment details have not yet been determined.

### **CONSOLIDATED LIFE OF MINE PLAN**

The LOM plan for Björkdal comprises production from Björkdal underground, open pits at Björkdal and Norrberget, and historic stockpiles and is shown in Table 16-5.

**TABLE 16-5 LIFE OF MINE PRODUCTION PLAN**  
**Mandalay Resources Corporation – Björkdal Mine**

Average/Total			2020	2021	2022	2023	2024	2025	2026	2027	2028
<b>MINING PRODUCTION - UNDERGROUND</b>											
Total Rock	kt	5,755	885	914	978	969	893	873	243		
Waste	kt	346	90	102	93	61	0	0	0		
Ore	kt	5,410	796	812	886	908	893	873	243		
<i>Stope Tonnes</i>	<i>kt</i>	4,646	580	604	666	787	893	873	243		
<i>Development Tonnes</i>	<i>kt</i>	41	19	14	7	0	0	0	0		
Grade	g/t Au	2.10	1.77	2.01	1.94	2.13	2.20	2.33	2.68		
Gold mined	k oz	365	45	52	55	62	63	65	21		
Capital Development	m	8,326	3,230	3,110	1,985						
<b>MINING PRODUCTION - OPEN PIT</b>											
Total Rock	kt	31,584				7,200	7,200	6,865	4,773	4,712	834
Waste	kt	28,427				6,770	6,866	6,322	4,185	3,680	604
Ore	kt	3,157				430	334	543	588	1,033	230
Grade	g/t Au	1.37				1.06	1.16	1.27	1.34	1.35	2.71
Gold mined	k oz	139				15	12	22	25	45	20
Strip Ratio		9				16	21	12	7	4	3
<b>MINING PRODUCTION - STOCKPILE</b>											
Ore Recovered	kt	2,908	504	488	414	6	122	0	469	292	613
Grade	g/t Au	0.64	0.64	0.64	0.64	0.64	0.64	0.00	0.64	0.64	0.64
Gold	k oz	60	10	10	9	0	3	0	10	6	13

		Average/Total	2020	2021	2022	2023	2024	2025	2026	2027	2028
<b>TOTAL</b>											
Ore	kt	11,146	1,300	1,300	1,300	1,300	1,300	1,300	1,300	1,300	746
Grade	g/t Au	2	0	0	0	0	0	0	0	0	0
Gold	k oz	549	56	63	64	76	77	85	56	48	24
<b>PROCESSING FEED</b>											
<b>Underground</b>											
Ore	kt	5,410	796	812	886	908	893	873	243	0	0
Grade	g/t Au	2	1.77	2.01	1.94	2.13	2.20	2.33	2.68	0.00	0.00
<b>Open Pit</b>											
Ore	kt	2,829	0	0	0	387	285	427	588	1,008	134
Grade	g/t Au	1	0.00	0.00	0.00	1.11	1.24	1.43	1.34	1.30	2.70
<b>Stockpile</b>											
Ore	kt	2,908	504	488	414	6	122	0	469	292	613
Grade	g/t Au	1	0.64	0.64	0.64	0.64	0.64	0.00	0.64	0.64	0.64
<b>Total ore</b>	kt	11,146	1,300	1,300	1,300	1,300	1,300	1,300	1,300	1,300	746
Grade	g/t Au	1.53	1.33	1.50	1.53	1.82	1.84	2.03	1.34	1.15	2.05
Gold	k oz	549	56	63	64	76	77	85	56	48	24
Recovery	%	90.41	88.30	90.00	90.20	90.30	90.30	90.30	90.30	90.30	98.50
Gold recovered	k oz	496,075	49,248	56,267	57,509	68,759	69,524	76,716	50,535	43,578	23,937

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## **BJÖRKDAL UNDERGROUND**

The Björkdal underground mine commenced production in 2008 and in the ensuing ten full years of production from 2009 through 2019 has provided an average mill feed of approximately 600,000 tpa.

Mine production in the LOM plan is scheduled from two main sources; stopes and OVD. The underground mine production rate is planned to be between 800,000 tpa and 900,000 tpa. The current underground haulage capacity is in the order of 1.0 Mtpa. The OVD will be carried out over approximately four years and stope production will be carried out over approximately seven years. A drop in production is planned after the sixth year, when underground output decreases to a 243,000 tpa, with the balance being made up with open pit and stockpile tonnes.

Björkdal has a significant amount of underground development workings in place, which allows for flexibility in mine scheduling. Pillar recovery is scheduled for the latter years of production.

## **BJÖRKDAL OPEN PIT**

Open pit mining for Björkdal was suspended in 2019 and is scheduled to restart in 2023. The open pit will deliver between 340,000 tpa and 550,000 tpa, with the final year delivering up to 980,000 tonnes. Ore production is variable as the strip ratio is high and the waste mining has been kept relatively level at approximately 6.7 Mtpa for the first few years. While currently there is a plan to mine the crown pillar, which impacts on the mine accesses, this sequence will be reviewed closer to the restart date. The mine planning allows for sufficient flexibility to always allow at least one portal access entry to the underground workings.

## **NORRBERGET OPEN PIT**

The LOM plan for Norrberget is integrated into the LOM at Björkdal and provides incremental high grade feed of 162,000 tonnes to the mill over seven months. Stripping of surface overburden is scheduled to commence in 2027, which will offset a shortfall of supply from the main Björkdal pit.



# 17 RECOVERY METHODS

## INTRODUCTION

The original plant was designed and built by Davy McKee in 1987 for Terra Mining. There have been a number of major changes made to the processing circuit with the primary objective of increasing plant throughput while maintaining gold recovery. The modifications are summarized in Table 17-1.

**TABLE 17-1 PLANT MODIFICATIONS  
Mandalay Resources Corporation – Björkdal Gold Mine**

<b>Year</b>	<b>Modifications</b>
1989	Plant commenced operation
1990	New 750 kW regrind mill installed
1992	Sala 6.6 m <sup>3</sup> flotation cell installed
1993	2 – 75 kW Sala Agitated Mills (SAM) installed before flotation circuit
1994	A sorting plant and a new mill facility were constructed and commissioned in December 1994
2005	Knelson CD12 and a small regrind mill (7.5 kWh) installed in the gravity section
2009	Knelson XD30 installed before flotation
2013	The Reichert cones were replaced by Rougher spirals; an Outokumpu SkimAir-240 flotation cell and a new double deck screen were installed in the grinding circuit
2017	Flotation expansion installed and commissioned, increased flotation capacity and increased recovery
2018	Expert Process Control System installed (Mintek), commissioning ongoing

## PROCESS DESCRIPTION

A simplified process flowsheet is provided in Figure 17-1.

The concentrator includes primary, secondary, and tertiary crushing, primary, and secondary grinding, a series of gravity concentration steps, regrinding, and flotation to produce three gravity concentrates and a flotation concentrate.

Ore is delivered to a series of small stockpiles that are utilized to campaign ore through the processing facility in order to provide reconciliation data for various parts of the mines. From the stockpiles, a front end loader feeds a jaw crusher. Discharge from the jaw crusher is screened. The screen undersize is nominally minus 8 mm. The material is conveyed to a

5,000 tonne fine ore bin or to an emergency stockpile. Screen oversize is stored in a 400 tonne stockpile. Ore is reclaimed from the stockpile and fed to a secondary cone crusher. Discharge from the cone crusher is conveyed to a second screen. Undersize from the screen is combined with the undersize from the first screen and stored in the fine ore bin or the emergency stockpile. Oversize from the second screen is fed to a tertiary cone crusher. The discharge from the tertiary crusher is combined with the discharge from the secondary cone crusher and fed to the second screen. Thus, the ore is recirculated through the tertiary cone crusher until it meets required product size (i.e., minus 8 mm).

Crushed ore is reclaimed from the fine ore bin and passed across a series of two screens prior to being fed to the primary grinding circuit. The screen oversize is directed to an oversize material stockpile. The screen undersize is split and fed to the primary ball mill and primary rod mill that are operated in parallel. Discharge from the primary mills is fed to a classifying screen. The screen oversize is returned to the primary ball mill for additional grinding. Screen undersize has a particle size of approximately 80% passing ( $P_{80}$ ) 560  $\mu\text{m}$ . The slurry is pumped to hydrocyclones for additional classification.

The cyclone underflow ( $P_{80}$  800  $\mu\text{m}$ ) is fed to rougher spiral concentrators. Tailings from the rougher spirals are returned to the secondary ball mill hydrocyclone. Underflow from the cyclone is fed to the secondary ball mill. Overflow from the cyclone bypasses the secondary mill, is combined with the discharge from the ball mill, and is fed to the classifying screen along with the discharge from the primary mills.

Concentrate from the rougher spirals is fed to the cleaner spiral classifiers. Tailings from the cleaner spirals are combined with the tailings from the rougher spirals and processed in the secondary ball mill circuit. Concentrate from the cleaner spirals is cleaned on shaking tables. Tailings from the shaking table are fed to a regrind mill. The discharge from the regrind mill is fed to a Knelson centrifugal gravity concentrator. Tailings from the Knelson concentrator are combined with the tailings from the rougher and cleaner spiral concentrators and processed in the secondary ball mill circuit. Concentrate from the shaking tables and the Knelson concentrator are fed to the cleaner shaking table where two concentrate grades are produced. The gravity concentrate contains approximately 60% gold and the middlings from the cleaner shaking table contain approximately 1,500 g/t Au.

Overflow from the cyclone that follows the classifying screen ( $P_{80}$  230  $\mu\text{m}$ ) is further classified in the flotation cyclones. The flotation cyclone underflow ( $P_{80}$  410  $\mu\text{m}$ ) is fed to a Knelson concentrator. The Knelson concentrate is fed to a single SkimAir flash flotation cell. The SkimAir flotation concentrate reports to the final flotation product thickener, while the tailings from the SkimAir cell are combined with the flotation cyclone overflow ( $P_{80}$  125  $\mu\text{m}$ ) as feed to three banks of conventional rougher flotation cells that operate in series. Tailings from the rougher flotation circuit feed the scavenger flotation circuit that contains three conventional flotation cells. Concentrate from the scavenger flotation circuit is recombined with the feed to the rougher flotation circuit. Tailings from the scavenger flotation circuit are the final tailings from the plant. Rougher flotation concentrate is cleaned in the first cleaner flotation circuit that consists of one bank of four conventional flotation cells and the second cleaner flotation circuit that consists of one tank flotation cell. Tailings from the first cleaner flotation circuit are returned to the feed of the rougher flotation circuit and tailings from the second cleaner flotation circuit are returned to the feed of the first cleaner flotation circuit. The second cleaner flotation concentrate is collected in the final flotation product thickener along with the SkimAir flotation concentrate. The flotation concentrate is dewatered in the flotation concentrate thickener and filtered prior to shipment.

17-4

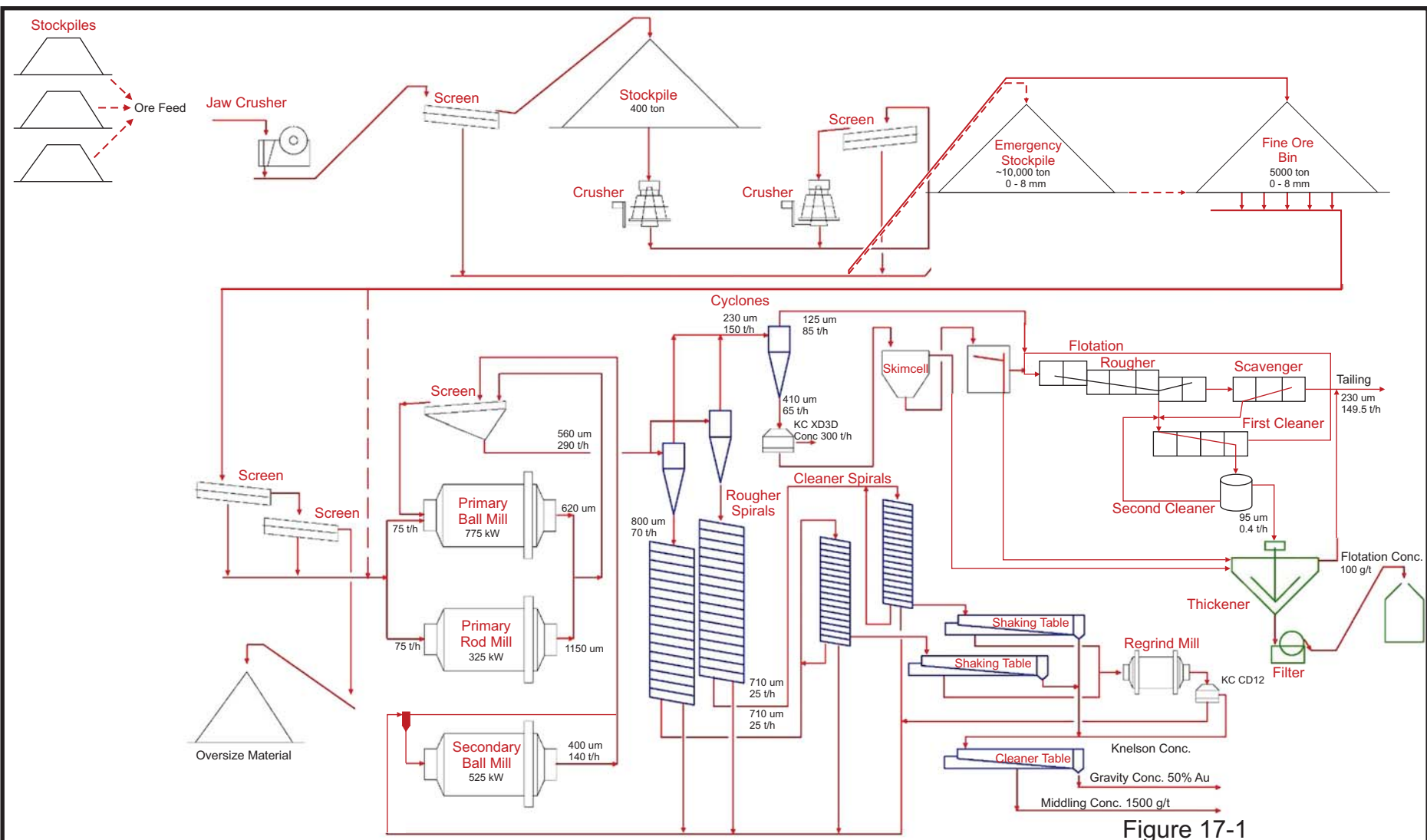


Figure 17-1

**Mandalay Resources Corporation**

**Björkdal Gold Mine**  
Västerbotten, Sweden  
**Process Flowsheet**

# 18 PROJECT INFRASTRUCTURE

## BJÖRKDAL

A site surface plan based on a LIDAR survey conducted in July 2016 shows the overall extent of the Mine operation and infrastructure and is presented in Figure 18-1.

### TAILINGS MANAGEMENT FACILITY

The TMF is located in an area of gently undulating relief approximately 1.5 km north of the processing plant.

The current TMF will reach full capacity in mid-2020. Further expansion of the TMF has been approved under the latest environmental operating permit that was received on December 11, 2018 and remains valid for a period of ten years.

TMF expansions have been designed by the independent consultants, Tailings Consultants Scandinavia (TCS).

During 2019 the Western Barrier Dam was raised by 2.5 m, which provides sufficient tailings capacity up to April 2022.

The raising of dam K1 will be carried out in two stages and the Stage 1 raise will be initiated during 2020 and will be completed by the end of 2021. Stage 2 is scheduled to be completed during 2023. At the planned plant throughput of 1.3 Mtpa, this will provide sufficient tailings storage capacity for ten more years of mine life up to 2031.



18-2

Figure 18-1

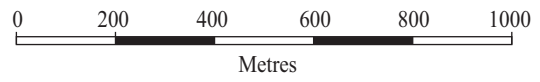
**Mandalay Resources Corporation**

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***Björkdal Gold Mine***  
*Västerbotten, Sweden*  
**Site Infrastructure Layout**

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(Imagery current as at July 2016)



March 2020

Source: Mandalay Resources Corporation, 2016.

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## PROCESS WATER SUPPLY

Water for the process plant is supplied from two sources. Two submersible pumps located at the Kåge River supply approximately 700,000 m<sup>3</sup> of raw water annually to plant water tanks via two pipelines. Existing water rights allow Björkdal to withdraw up to 50 L/s, equivalent to 180 m<sup>3</sup>/h and 1.58 million m<sup>3</sup>/yr. A second pump station located at the TMF recycles cleared water to the processing plant. Approximately 59% of the process water is recycled from the tailings system and the remaining 41% is drawn from the Kåge River.

At present, the Björkdal Mine is diverting approximately 800,000 m<sup>3</sup> per year of water from the underground and open pit mines to the tailings facility and this allows a 59:41 ratio to prevail throughout the year. The result is that less water is discharged from the tailings system and less fresh make-up water is required.

## POWER SUPPLY

The power supply for the site is provided by Skellefteå Kraft AB, the local power company. The electricity is sourced from relatively low-cost hydro power and is delivered to Björkdal via the Swedish power grid.

## COMMUNICATIONS

On-site communications include mobile services, internal radio communication, and internet service. Back-up of the Björkdal computer servers is completed automatically through high speed internet to a service company in Skellefteå.

## WASTE ROCK DUMPS

The waste rock from open pit mining and low grade ore stockpiles currently amount to more than 60 million tonnes. An additional moraine stockpile amounts to more than one million tonnes.

Previous characterization studies conducted have shown that waste rock contains very low levels of heavy metals and sulphur and concluded that the waste should be considered inert.

There are currently two active waste dump areas; the North and South waste dumps, as shown in Figure 18-1. Under the new operating permit application, the capacity of the waste rock

dumps has been expanded to over 53 million tonnes. This capacity is sufficient to cover the needs of the current mine life.

## **SURFACE FACILITIES**

The Björkdal Mine operation has all the facilities associated with an open pit and underground gold mine and includes the items listed below:

- Well-kept gravel site roads,
- An administrative building consisting of office space, kitchen facilities, and a mine dry,
- An open pit with ramp access to the underground operations,
- Underground development consisting of ramps and sub-levels,
- Raw ore stockpile facility containing eleven 5,000 tonne to 7,000 tonne capacity raw ore stockpiles,
- Primary jaw crushing facility with 400 tonne coarse ore stockpile,
- Secondary crushing facility,
- 5,000 tonne fine ore stockpile and reclaim facility,
- 3,600 tpd mill, gravity gold plant, and flotation plant,
- An internal metallurgical assay laboratory,
- Company and contractor maintenance facilities,
- A core logging facility with covered storage, sample preparation laboratory, and grade control assay laboratory,
- 250 ha TMF,
- Raw water supply and storage,
- Water treatment plant,
- Explosive magazine and mixing facilities
- Storage facilities for chemical reagents and bulk supplies,
- An off-site covered core storage facility,
- Swedish grid electrical power,
- Fresh water access.

## **NORRBERGET**

There is little existing infrastructure at Norrberget aside from a forest access road, currently used for forestry and hunting access to the surrounding area. Given the small size of the deposit and short mine life, it is envisaged that the bulk of the required infrastructure will be able to be somewhat temporary in nature.



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## **MINE WATER SUPPLY**

Water to support Norrberget mining operations is planned to be sourced from Lillträsket, a small surface lake approximately two kilometres northwest of the proposed operation. Lillträsket is planned to be used as a sedimentation clearing pond for the Björkdal TMF and appropriate land purchases have been made to facilitate its conversion to this use. As the pit progresses deeper, it is expected that much of the water required for mining can be recycled from dewatering operations.

A pipeline is planned to follow the existing track between Lillträsket and the deposit as this will obviate the need to construct a dedicated maintenance track. The pipeline will be constructed to service both the dewatering discharge needs of the Mine and the supply of mining operations water.

Fresh water supply for drinking and washing is planned to be trucked in. On the Björkdal Mine site, fresh water is provided from an on-site bore and this may prove to be the most economical option for fresh water supply at Norrberget. No investigations as to water quality for this purpose have yet been carried out.

## **POWER SUPPLY**

The power supply for Norrberget is planned to be an extension of the existing Swedish electricity grid from Nylunds (approximately 3.5 km east). The major power supplier in the region is Skellefteå Kraft AB, the energy supply mix is dominated by locally sourced hydro power and is relatively low cost.

The planned route for the cable extension follows the course of the existing access road and a small sub-station is planned to service the operation of the site.

Other options for site power supply are being further investigated by Björkdal staff; this may provide opportunities to reduce required capital investment or unlock operational benefits.

## **COMMUNICATIONS**

A system of three radio repeater stations is planned to integrate the Norrberget site into the larger Björkdal radio system. This system is required for safe operations to be overseen by

management and technical staff and will allow ore haulage trucks to operate around the existing open pit.

In addition to the radio system, cellular phone signal is available in the area. A GPS base station will be installed to facilitate surveying of the surface mine and allow GPS excavator control and communication. This can be integrated into the current system at Björkdal.

## **WASTE ROCK DUMPS**

Based on the current Mineral Reserves, it is forecast that approximately 0.5 million tonnes of loose glacial cover and approximately 1.95 million tonnes of solid waste rock will be removed from the Norrberget open pit. This material is planned to be stockpiled on both the north and south sides of the designed open pit. These piles will be designed to function as sound attenuation barriers to reduce the impact on the amenity of the small village of Norra Bastuträsk, approximately 1.7 km to the northeast of the proposed workings.

## **SURFACE FACILITIES**

There is little requirement for permanent surface facilities at Norrberget. The short mine life and proximity to existing facilities at Björkdal minimize the need for any extensive construction. Office space for technical and management staff will be accommodated within the extant buildings at the Björkdal Mine. Portable units are planned to be used to supply the required toilet/shower block, change house, and heated muster room.

Other surface infrastructure that would typically be required will be shared with the Björkdal site.

## **ORE HAULAGE ROAD**

The existing forest access track will be widened and upgraded to a standard suitable for heavy vehicle access from Route 870 (Fällfors Road) to the deposit at Norrberget, a stretch of approximately 3.5 km. Existing access tracks will be suitable for ore haulage from Route 870 to the primary crusher stockpile area.

Construction of the road upgrade will require culverts in three places, to allow the passage of a surface stream and for two of the surface water diversion trenches described in Section 16.

# 19 MARKET STUDIES AND CONTRACTS

## MARKETS

The principal commodity at Björkdal is gold, which is freely traded at prices that are widely known, so that prospects for sale of any production are virtually assured.

## CONTRACTS

Björkdal produces four salable products: a gravity concentrate, a middlings concentrate, a Knelson concentrate, and a flotation concentrate. The sales agreements are summarized in Table 19-1.

**TABLE 19-1 SUMMARY OF SALES AGREEMENTS  
Mandalay Resources Corporation – Björkdal Mine**

<b>Product</b>	<b>Counter Party</b>	<b>Gold Payable (%)</b>	<b>Silver Payable (%)</b>
Gravity Concentrate	Aurubis	99.75	98.50
Middlings Concentrate	Aurubis	97.50	97.00
Knelson Concentrate	Aurubis	98.00	97.00
Flotation Concentrate	Boliden	95.00	95.00

The above mentioned sales agreements provide for a concentrate treatment charge, refining charges for gold and silver, and minor penalty provisions for any excessive amounts of bismuth, tellurium, and fluorine contained in the concentrates.

The terms of the concentrate sales agreement are confidential but have been reviewed by RPA and are considered appropriate for the product and within industry norms. The specific terms of the agreements are included in the RPA assessment of the economic viability of the LOM plan.

Other contracts that exist between the Mine and suppliers include those for:

- Underground Ore Transport: Renfors AB is responsible for the haulage to the surface of all underground mined material and haulage from stockpiles to crusher.
- Skellefteåbränslen AB: supplies diesel and gas to site.
- Blasting: EPC Sverige AB for the supply of emulsion explosives and blast hole loading for underground.

- Byggbetong AB: Shotcrete for underground
- Exploration Diamond Drilling: Contracted on an as-needed basis.
- ALS laboratory service on-site.
- Variety of leased mining equipment.

## 20 ENVIRONMENTAL STUDIES, PERMITTING, AND SOCIAL OR COMMUNITY IMPACT

### ENVIRONMENTAL STUDIES

A full environmental audit is carried out every three years by an independent consultant and the local authorities. The monitoring, control, and management policies and procedures are well documented and entirely appropriate to the type of operation.

The Mine has low sulphide content and, as a result, no acid rock drainage (ARD) potential exists. Gold is recovered by mechanical and gravity processes with no use of cyanide. There are no harmful elements associated with the Mine tailings and the tailings have been declared non-toxic by the authorities. Previous characterization studies conducted have shown that waste rock from open pit mining contains very low levels of heavy metals and sulphur and have concluded that the waste should be considered inert.

Water quality is monitored on a regular basis at eight strategically placed monitoring stations. The Upper Lillträsk Creek and Upper Kåge River stations are located upstream of the mining area and provide reference water quality data; two stations on the mine property monitor discharge quality from the mine water system (PP1) and the TMF (PP2); and four additional stations located in Lower Lillträsk Creek, Kåge River, and Røjmyr Creek to monitor changes in the receiving watershed.

Sampling is performed by certified samplers and the protocol includes analyses for a suite of twenty-one metals; pH; temperature; ammonium-nitrogen, phosphates and phosphorus; nitrogen, nitrates and nitrites; oil and total suspended solids (TSS).

Björkdal reports that the discharge water quality from both the mine water management system (PP1) and the TMF (PP2) have historically exceeded permissible levels for nitrates and TSS. Elevated levels of phosphorus and phosphates have also been noted at PP1.

The Mine has conducted several studies to establish the cause for these elevated values and to address elevated nitrogen and TSS levels. In 2015, the underground mine water discharge was diverted into the tailings pond and nitrogen levels declined as a result of degradation of

nitrogen due to a longer residence time and dilution. Since 2018, all mine discharge water has been discharged to the TMF through PP2, and PP1 removed from the control and monitoring system. This change has been approved by the environmental court and is anticipated to resolve all issues with elevated nitrites and TSS.

## PERMITTING

All operations are fully permitted in accordance with Swedish environmental, health, and safety legislation.

The current environmental permit (M 771-17) was granted in December 2018 and remains valid for a period of ten years from that date.

Under the existing long-term water-use permit, Björkdal is permitted to use the Kåge River as a water source for the processing plant. The allowed amount is 50 L/s (180 m<sup>3</sup>/h). The plant uses approximately 150 m<sup>3</sup>/h and half of this is recycled from the tailings facility. Water used at the mine site for purposes other than the processing plant is sourced from dug wells.

The current two permits required for the operation are shown in Table 20-1.

**TABLE 20-1 PERMITS**  
**Mandalay Resources Corporation – Björkdal Gold Mine**

Permits	Valid from Date	Valid to Date	Type
M 771-17	2018-12-03	2028-12-03	Environmental permit
VD DVA 9/87	1987-05-26	No expiry date	Water-use permit

## SOCIAL OR COMMUNITY REQUIREMENTS

There are no issues with community impact. The Mine is located in a part of Sweden that has a long history of mining activity and mining is accepted as a socially responsible and necessary contributor to the local economy.

The Björkdal property is located in an area where the Svaipa Sami village (the local indigenous group) retains winter grazing rights for their reindeer herds. A compensation agreement for

lost grazing land and increased operating costs for the reindeer herders was signed in April 2017. This agreement remains valid for the planned operating life of the Björkdal Mine.

The Norrberget deposit is not covered by the above agreement. A new mining concession has been granted that covers Norrberget and is valid until January 2044.

## HEALTH AND SAFETY MANAGEMENT PLAN

The management at Björkdal has a strong focus on the safety of all personnel employed at, or visiting, the operation and is committed to the following fundamental objectives:

- No personnel employed by Björkdal or its contractors should suffer either injury or illness arising from being employed at the Björkdal site.
- All personnel, contractors, service providers, and suppliers must rate safety and the protection of the environment as core values.

Safety meetings to discuss workplace Occupational Health and Safety (OHS) issues are conducted by relevant department or contractor supervisors and presented to individual work groups. Safety meetings are held weekly and are attended by all members of the work group.

All managers and employees at Björkdal have completed the DuPont STOP safety system training and any hazards identified are treated with high priority.

In 2018, all Björkdal staff undertook a comprehensive program focused on safety culture and improving attitudes towards safe work habits. The program was carried out by a boutique safety consultancy, RMS Switzerland.

Other safety related initiatives being, or having been, introduced in 2018/2019 include:

- The introduction of self-rescuers for all personnel working or entering the underground mine.
- An updated and improved site induction for all Björkdal employees and contractors has been introduced. This is available online and can be undertaken prior to personnel coming to the site.
- General induction training days that include company safety culture.
- A maintenance planning system has been implemented which is resulting in the proactive maintenance of all equipment and ensures the completion of pre-start checks.
- Regular maintenance of all light vehicles is now being undertaken.

The safety statistics reporting at Björkdal is based on the following classifications:

- Medical Treatment Injury Frequency Rate (MTIFR),
- Lost Time Injury Frequency Rate (LTIFR).
- Total Reportable Injury Frequency Rate (TRIFR),

The incident classification is presented in Table 20-2. MTIFR and LTIFR statistics for 2015 through 2019 are presented in Table 20-3.

**TABLE 20-2 INCIDENT CLASSIFICATION**  
Mandalay Resources Corporation – Björkdal Gold Mine

Incident Classification	Statistical Grouping		
	TRIFR	MTIFR	LTIFR
First Aid	✓	✓	
Medical Treatment	✓	✓	
Restricted Duties	✓		
Lost Time	✓		✓
Fatality(s)	✓		✓

**TABLE 20-3 STATISTICS FOR MTIFR AND LTIFR**  
Mandalay Resources – Björkdal Gold Mine

Year	MTIFR	LTIFR
2015	22.24	16.68
2016	0	12.28
2017	9.73	12.97
2018	13.91	6.94
2019	13.75	12.16

The Björkdal health and safety statistics for 2019 are summarized in Table 20-4.

**TABLE 20-4 2019 HEALTH AND SAFETY STATISTICS**  
Mandalay Resources – Björkdal Gold Mine

Class	Value
Fatalities	0
Lost Time Incidents (LTI)	6
Restricted Work Incidents (RW)	0
Medical Treatment (MT)	5
Total Hours, Contracted Time Björkdal	349,351
Total Hours, Worked for Contractors	145,948
Total Recordable Incident Rate (TRIFR)	25.91
Medical Treatment Incident Rate (MTIFR)	13.75



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<b>Class</b>	<b>Value</b>
Lost Time Incident Rate (LTIFR)	12.16

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## **MINE CLOSURE REQUIREMENTS**

Mine closure and reclamation plans are submitted and approved as an Annex to the Environmental Permit. The approved plan provides an overview of reclamation requirements that follow the July 2004 European Commission guidelines for Best Available Practice for the management of tailings and waste rock in mining activities. Six months prior to mine closure, a detailed remediation plan is to be submitted to the regulator.

The 2018 environmental permit includes an updated closure and reclamation plan. Mandalay presently has US\$4.43 million (SEK 43 million) in a secured reclamation account held by the Swedish authorities.

## 21 CAPITAL AND OPERATING COSTS

### CAPITAL COSTS

#### BASIS OF ESTIMATE

The Björkdal Mine is an on-going operation with the necessary facilities, equipment, and manpower in place to produce gold. The basis for the LOM plan is the Probable Mineral Reserve estimate outlined in Section 15. RPA has reviewed the LOM and cost estimates in sufficient detail to be satisfied that economic extraction of these Probable Mineral Reserves is justified. The majority of the capital cost estimates contained in this report are based on quantities generated from the open pit and underground development requirements and data provided by Björkdal.

A summary of capital requirements anticipated over the LOM is summarized in Table 21-1.

**TABLE 21-1 CAPITAL COST SUMMARY**  
**Mandalay Resources Corporation – Björkdal Gold Mine**

Description	Value (US\$000)
Sustaining Capital Fixed Assets	41,062
Capital Development Underground	22,572
Pre-Strip Open Pit	45,052
<b>Total Sustaining Capital</b>	<b>108,685</b>
Growth Capital Fixed Assets	8,011
<b>Total LOM Capital Expenditure</b>	<b>116,696</b>

#### SUSTAINING CAPITAL

The sustaining capital cost estimate provides for the periodic addition of capital required to maintain the operations at its existing levels. Sustaining capital is broadly divided between three areas: spending on fixed assets, ongoing underground development, and open pit pre-stripping. Pre-stripping costs include the removal of approximately 4.9 million tonnes of open pit waste rock and overburden, while underground development includes the advancement of 8,326 m of cross-cuts and ramps to facilitate access to future mining areas. Costs are estimated based on actual cost history at Björkdal. The fixed asset estimate includes provision for equipment replacement; maintenance of the underground ventilation, electrical distribution, and mine water management systems; equipment replacement in the process plant and the

replacement of items associated with tailings disposal, water treatment, and other general items.

## GROWTH CAPITAL

Growth capital for this reporting year is solely to support the establishment of the open pit at the Norrberget satellite deposit. Initial capital investments for the Norrberget deposit are scheduled to begin in 2027.

## OPERATING COSTS

### BASIS OF ESTIMATE

The Mine maintains detailed and all-inclusive operating cost records that provide an excellent basis for the estimate of future operating costs. Björkdal produced a cash flow estimate based on the budgeted costs for 2020. This estimate was checked against the 2017 to 2019 costs provided by Björkdal. The majority of operating costs at Björkdal are expended in Swedish Kroner. All costs have been converted to US dollars using exchange rate assumptions of 9.0 SEK/US\$.

Unit costs used to estimate LOM operating costs are summarized in Table 21-2. RPA notes that the annual fluctuation in production levels is relatively low, such that the effect of fixed versus variable expenses is minimized.

**TABLE 21-2 UNIT COST INPUTS**  
**Mandalay Resources Corporation – Björkdal Gold Mine**

<b>Activity</b>	<b>Units</b>	<b>Value</b>
Open Pit Mining	US\$/t moved	2.33
Open Pit Mining	US\$/t ore moved	8.49
Underground Mining	US\$/t ore	18.61
Stockpile Mining	US\$/t moved	1.11
Processing and refining	US\$/t processed	8.65
G&A	US\$/t processed	8.20
<b>Total Cost</b>	<b>US\$/t processed</b>	<b>29.03</b>

## LIFE OF MINE OPERATING COSTS

RPA has used the Björkdal unit costs to estimate LOM operating costs. Average LOM plan operating costs are shown in Table 21-3.

**TABLE 21-3 LIFE OF MINE OPERATING COSTS**  
**Mandalay Resources Corporation – Björkdal Gold Mine**

Description	LOM (US\$000)	Annual Average (US\$000)	Unit Cost (US\$/t processed)
Mining	135,406	16,926	12.15
Processing	86,693	10,837	7.78
G&A	91,345	11,418	8.20
Royalties and Refining	10,150	1,269	0.91
<b>Total Operating Cost</b>	<b>323,594</b>	<b>40,449</b>	<b>29.03</b>

The LOM has been prepared on the basis that all planned mining activities can be carried out using the existing Björkdal manpower. It is assumed that current contract prices will remain unchanged for mining activities performed by a contractor such as open pit mining and underground rock haulage.

Cost inputs have been priced in real Q4 2019 dollars, without any allowance for inflation or consideration to changes in foreign exchange rates.

## 22 ECONOMIC ANALYSIS

This section is not required as the property is currently in production, Mandalay is a producing issuer, and there is no material expansion of current production. RPA has verified the economic viability of the Mineral Reserves via cash flow modelling, using the inputs discussed in this report.

## 23 ADJACENT PROPERTIES

There are no adjacent properties relative to this Report.

## 24 OTHER RELEVANT DATA AND INFORMATION

No additional information or explanation is necessary to make this Technical Report understandable and not misleading.

## 25 INTERPRETATION AND CONCLUSIONS

The Björkdal plant has processed approximately 32.5 million tonnes of ore to December 31, 2019 to produce a total of approximately 1.44 million ounces of gold at an average feed grade of 1.38 g/t Au. Both open pit and underground mining methods have been employed on the property.

### GEOLOGY AND MINERAL RESOURCES

#### BJÖRKDAL

- Historically, the gold mineralization at the Mine occurs as a large number of sub-parallel, steeply dipping, narrow quartz veins that are hosted by footwall intermediate volcanic units. The veining is locally structurally complex with many Reidel-type vein geometries as well as small quartz veinlets and pods. The strike limits of the veins are bounded largely by the Björkdal shear, a shallow to moderately north (true) dipping structure.
- On-going exploration and development work has been successful in locating and delineating additional gold-bearing mineralization in the adjoining fault block located beyond the Björkdal shear. This newly discovered mineralization (known as the Aurora Zone) is hosted by a series of mafic and intermediate volcanic units which form parts of the hangingwall of the historically known mineralized veins. This hangingwall unit has traditionally been regarded as having little potential for hosting potentially economic gold mineralization.
- On-going exploration and development work has also been successful in locating and delineating gold mineralization that is hosted by skarn units which are part of the marble sequence that forms the upper contact of the historically recognized mineralized quartz veins. From the available information, these skarn units are currently interpreted to be oriented as stratiform units with shallow to moderate northerly (true) dips.
- Many areas of the Björkdal Mine property are unexplored or under-explored and so are considered to offer good exploration potential. Along with the down-plunge projection, the upper limits of the Aurora Zone to surface have not been defined by drilling.
- Work is underway to understand the controls on the location and distribution of the skarn units. Given the flat-lying orientation of these units, their orientations are not conducive to being fully evaluated by the current drill hole patterns. Potential remains for the discovery of additional mineralization of this type.
- The Björkdal OP wireframes were based on a nominal 0.3 g/t Au cut-off grade over a minimum of two metres. The UG wireframes were based on a nominal two metre minimum width at a cut-off grade of 0.5 g/t Au. A total of 544 mineralized wireframe models were created for the underground mine and 488 wireframe models were created for the open pit mine.
- The dual capping value approach was continued to be used for estimation of the gold grades contained within the mineralized wireframe models in the underground mine.



In this approach, the composited assays for DDH and RC drill holes are capped to values of 60 g/t Au and 40 g/t Au. Two different area of influences are then used when estimating the block grades for each mineralized wireframe. The higher grade capped composites are used within a first pass search ellipse with a 15 m radius, while the lower grade capped composites are used for subsequent estimation passes. A single capping value of 40 g/t Au was applied to the composited samples contained within the chip sample database. A value of 30 g/t Au has been selected as the capping value for the DDH, RC, and chip samples contained within the OP wireframes. This capping value was also applied to all samples contained within the dilution domain volume.

- Mandalay carried out an exercise whereby the stope volumes in the underground mine determined using the CMS were compared with the planned excavation designs. This program has been successful in yielding detailed information regarding the quantities of unplanned dilution and underbreak.
- Comparison of the predicted tonnages and grades from the year end 2018 Long Term block model against the realized tonnages and grades from the 2019 Grade Control model demonstrates that the sample collection, assaying, and estimation procedures used to prepare the Long Term Mineral Resource estimates continue to provide acceptable results for the underground mine.
- Reconciliation results for the open pit mine resulted in reinterpretation of the East Pit mineralized wireframes, however, production from the open pit mine was suspended in July 2019.

## NORRBERGET

- The primary gold mineralization at Norrberget is contained within bands of veinlets and alteration containing amphibole in a package of interbedded mafic tuffs and volcanoclastics.
- Mineralization wireframes were generated using a 0.4 g/t Au cut-off grade and a two metre minimum horizontal width. The wireframes represented a primary band of continuous mineralization and two limited footwall bands of mineralization.
- Samples within the Norrberget domains were capped at 24 g/t Au, affecting seven out of the 311 samples within the mineralized domains. Intercepts within the domain were composited to 1.0 m lengths with a minimum sample length of 0.5 m.
- Bulk density applied to the block model was based on average densities for each lithology. The mineralization has an average density of 2.78 g/cm<sup>3</sup>.
- The low number of mineralized samples at Norrberget necessitated the use of inverse distance weighted interpolation rather than the ordinary kriging method. Continuity analysis of grade contours was reviewed to help define high grade trends that were used to inform the interpolation parameters.

## MINERAL RESOURCE ESTIMATE

- The Mineral Resource estimate for Björkdal and Norrberget effective December 31, 2019 is listed in Table 25-1.

**TABLE 25-1 MINERAL RESOURCES AT THE BJÖRKDAL MINE AND  
NORRBERGET DEPOSIT AS OF DECEMBER 31, 2019  
Mandalay Resources Corporation – Björkdal Gold Mine**

Location	Area	Tonnage (kt)	Grade (g/t Au)	Contained Au (koz)
<b>Indicated Mineral Resources</b>				
Björkdal	Open Pit	3,114	2.08	208
	Underground	9,656	2.58	799
	Stockpile	2,644	0.64	54
	Subtotal	15,414	2.14	1,062
Norrberget	Open Pit	144	3.29	15
<b>Total, Indicated</b>		<b>15,558</b>	<b>2.15</b>	<b>1,077</b>
<b>Inferred Mineral Resources</b>				
Björkdal	Open Pit	3,338	1.30	139
	Underground	2,143	2.36	163
	Subtotal	5,480	1.71	302
Norrberget	Open Pit	3	4.03	0.5
<b>Total, Inferred</b>		<b>5,483</b>	<b>1.71</b>	<b>302</b>

Notes:

1. Björkdal Mineral Resources are estimated using drill hole and sample data as of September 30, 2019 and account for production to December 31, 2019.
2. Norrberget Mineral Resources are estimates using drill hole and sample data as of September 30, 2017
3. CIM (2014) definitions were followed for Mineral Resources.
4. Mineral Resources are inclusive of Mineral Reserves.
5. Mineral Resources are estimated using an average gold price of US\$1,500/oz and an exchange rate of 9.0 SEK/US\$.
6. High gold assays were capped to 30 g/t Au for the open pit mine.
7. High gold assays for the underground mine were capped at 60 g/t Au for the first search pass and 40 g/t Au for subsequent passes.
8. High gold assays at Norrberget were capped at 24 g/t Au.
9. Interpolation was by inverse distance cubed utilizing diamond drill, reverse circulation and chip channel samples.
10. Open pit Mineral Resources are estimated at a cut-off grade of 0.34 g/t Au for Björkdal and 0.35 g/t Au for Norrberget and constrained by a resource pit shell.
11. Underground Mineral Resources are estimated at a cut-off grade of 0.80 g/t Au.
12. A nominal two metres minimum mining width was used to interpret veins using diamond drill, reverse circulation, and underground chip sampling.
13. Stockpile Mineral Resources are estimated at a cut-off grade of 0.40 g/t Au and are based upon surveyed volumes supplemented by production data.
14. Mineral Resources that are not Mineral Reserves do not have demonstrated economic viability.
15. Numbers may not add due to rounding.

## MINING AND MINERAL RESERVES

- The Mineral Reserve estimate for Björkdal and Norrberget effective December 31, 2019 is listed in Table 25-2.

**TABLE 25-2 MINERAL RESERVES AT THE BJÖRKDAL MINE AND NORRBERGET DEPOSIT AS OF DECEMBER 31, 2019**  
**Mandalay Resources Corporation – Björkdal Gold Mine**

Location	Area	Tonnage (kt)	Grade (g/t Au)	Contained Au (koz)
<b>Probable Mineral Reserves</b>				
Björkdal	Open Pit	2,875	1.23	114
	Underground	5,410	2.10	365
Norrberget	Open Pit	162	2.80	15
Stockpile	Stockpile	2,644	0.64	54
<b>Total, Probable</b>		<b>11,090</b>	<b>1.54</b>	<b>548</b>

Notes:

1. Mineral Reserves are estimated using drill hole and sample data as of September 30, 2019 and depleted for production through December 31, 2019.
  2. Norrberget Mineral Reserves are estimated using data as of September 30, 2017.
  3. CIM (2014) definitions were followed for Mineral Reserves.
  4. Open Pit Mineral Reserves are based on mine designs carried out on an updated resource model, applying a block dilution of 100% at 0.0 g/t Au for blocks above 1.0 g/t Au and 100% at in-situ grade for blocks between 0.4 g/t Au and 1.0 g/t Au. The application of these block dilution factors is based on historical reconciliation data. A cut-off grade of 0.4 g/t Au was applied. Open Pit Mineral Reserves for Norrberget are based on 15% dilution at zero grade and 100% extraction.
  5. Underground Mineral Reserves are based on mine designs carried out on an updated resource model. Minimum mining widths of 3.85 m for stopes (after dilution) and 4.35 m for development (after dilution) were used. Stope dilution was applied by adding 0.5 m on each side of stopes as well as an additional 10% over break dilution. Further dilution, ranging from 10% to 100%, was added on a stope by stope basis depending on their proximity with other stopes. An overall dilution factor of 14.5% was added to development designs. Mining extraction was assessed at 95% for contained ounces within stopes and 100% for development. A cut-off grade of 0.92 g/t Au was applied. An incremental cut-off grade of 0.4 g/t Au was used for development material.
  6. Stockpile Mineral Resources are estimated at a cut-off grade of 0.40 g/t Au and are based upon surveyed volumes supplemented by production data.
  7. Mineral Reserves are estimated using an average long-term gold price of US\$1,300/oz, and an exchange rate of 9.0 SEK/US\$.
  8. Tonnes and contained gold are rounded to the nearest thousand.
  9. Totals may appear different from the sum of their components due to rounding.
- The current Mineral Reserves for Björkdal support a mine life of approximately ten years at approximately 1.3 Mtpa, with the exception of the last year of production. Gold production averages approximately 55,000 ounces per year. A number of opportunities that could further extend the mine life exist:
    - Continue upgrading Inferred Mineral Resources to Indicated Mineral Resources.
    - Analyze the potential to relocate surface infrastructure which could result in additional open pit mining.
    - Identify remnant underground mining areas with in-situ Mineral Resources that could be extracted in a safe and cost effective manner.
  - The Björkdal open pit mining operation was suspended in July 2019 and is now scheduled to recommence in 2023.
  - The open pit mining operation employs contractors for most unit operations. RPA considers that, there may be an opportunity to reduce open pit operating costs by converting to a mine-owned fleet when the open pit operation restarts in 2023.

- The current mine plan includes the recovery of the crown pillar during the final years of open pit mining. The pillar contains infrastructure servicing the underground operations that will be disrupted by mining of the crown pillar. It also contains a large number of voids from previous underground mining that may cause some operational issues during mining and potentially some high wall stability concerns. To allow the crown pillar to be mined in parallel to underground extraction, an additional portal will be developed to access the underground mine. The mining sequence will be re-examined closer to the restart date of open pit mining.
- The underground mine is scheduled to produce approximately 795,000 tonnes of run-of-mine ore during 2020 and an average of approximately 874,000 tonnes of ore over the following five years of the underground operations. Underground production will reduce and end in year seven of the current LOM (2026).
- The low grade stockpile will be used to provide the additional ore needed to allow the mill to operate at full capacity. Additional material is expected to be placed into the stockpile over the remaining LOM, which will allow Björkdal to run at or near capacity in all years (except the final year) of the current LOM.
- Due to the variable quality of the material that comprises the low grade stockpiles, grade variations in the feed to the mill are anticipated.
- The underground Mineral Reserves at Björkdal are based on a minimum mining width of 3.5 m. There are currently a number of areas in the mine where multiple stopes are in close proximity to each other. This could result in certain stopes having additional dilution. In RPA's opinion, additional drilling is required in these areas to collect the additional grade, structural, and geotechnical data necessary to safely maximize reserve extraction and minimize dilution.
- Structural features such as folding and their impact on metal distribution are not well understood and are therefore not considered in the current underground mining method. Advanced knowledge of such features could result in a change in mining method and Mineral Reserves.
- RPA considers it essential that continued attention be given to local and global rock mechanics issues during future mine design as underground stresses are redistributed.
- A detailed reconciliation that compared the design and actual tonnes (using CMS) and grade from a large number of stopes was carried out during 2018 and 2019. This indicated that ore tonnage was under-estimated by approximately 5% and Au content by approximately 13%. Dilution averages 50%. This is consistent with factors used in the mine design.
- Mining losses were included as direct gold losses and not ore tonne losses.
- The nature of the mining method is such that development ore will always represent a large proportion of the underground tonnage production.
- As presently planned, mining of the Norrberget open pit will be carried out with the same contract mining fleet used at Björkdal. The total mine life for Norrberget is estimated to be seven months.

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## PROCESSING

- Björkdal has been successful in recovering nearly 90% of the gold, with approximately 73% of the gold recovered in gravity concentrates (i.e., gravity concentrate, middlings, and Knelson concentrate) and an additional 12% to 17% of the gold recovered in flotation concentrates.
- Recent additions to the processing equipment, reagent changes, and improvements in the processing strategy have improved the gold recovery by 1% to 2%.
- Preliminary metallurgical tests using samples from Norrberget show that the mineralogy is more complex and the gold grain sizes are smaller which requires a finer grind size to achieve liberation. Since the deposit is small, it is not anticipated that modifications to the existing processing plant will be cost effective. Therefore, the data indicates that the average gold recovery for Norrberget will be approximately 75%.

## PERMITTING

- A new environmental permit was granted in December 2018 and remains valid for ten years. Expansion of the TMF and its continuing operation is covered by the new permit.
- A compensation agreement for lost grazing land and increased operating costs for the reindeer herders was signed in April 2017. This agreement is valid for the planned operating life of the Björkdal Mine.
- The Norrberget deposit is not covered by the above agreement. A new mining concession has been granted that covers Norrberget and is valid until January 2044.
- The newly granted environmental permit includes an updated closure and reclamation plan.

## RISKS

- The Mine has been in production for over 30 years and is a mature operation. In RPA's opinion, there are no significant risks or uncertainties that could reasonably be expected to affect the reliability or confidence in the exploration information, Mineral Resource or Mineral Reserve estimates, or projected economic outcomes.

## 26 RECOMMENDATIONS

RPA presents the following recommendations:

### GEOLOGY AND MINERAL RESOURCES

- Improve the precision of the duplicate sample assay results by examining the impact of using a larger aliquot or a finer grind size.
- Investigate using conventional fire assay method to determine the gold grades of the assays obtained from the on-site PAL1000 unit to quantify the amount of gold remaining in the LeachWELL residues.
- Consider the preparation of a two kilogram pulp from the coarse reject material at a frequency of approximately one sample in 50, to permit a review of the precision of the analytical method.
- Review and update as appropriate the validation procedures for the drill hole management protocol.
- Use the actual as-mined volumes as determined from the CMS surveys to code the block model rather than the design shapes. Use of the actual excavated volumes will improve the block model reconciliation results for those stopes which are accessed by means of a bottom drive only (i.e., the “blind” stopes).
- Create a new category for the Confidence Interval of the drill hole collar table of the drill hole database. This new category will be used to identify grab samples or other sample information that do not have a meaningful sample length associated with them.
- Continue efforts to construct a full three-dimensional digital model of the distribution of the host rocks in the vicinity of the mine area. Use of immobile element geochemical signatures (e.g., Ti vs Zr plots) may be useful in assisting to discriminate between the footwall intermediate volcanic and the hangingwall mafic volcanic units.
- Ensure that all wireframe interpretations are fully “snapped” to the sampled assay intervals, as doing so will improve the accuracy of the local tonnage and grade estimates.
- Use the graphical compositing function of the Surpac software package as a guide to selection of the optimal wireframe widths and to minimize the amount of dilution introduced into the mineralized wireframes.
- Further divide the SKS-series wireframes into shear-hosted units versus skarn-hosted units, and group them by open pit or underground mining methods. These further divisions will be of great assistance for future geostatistical studies and block modelling efforts.
- Examine the two metre minimum width criteria used to create the vein interpretations in light of the reconciliation information being collected for the excavated stopes. Consideration may be given to modifying this minimum width to better reflect the thinnest openings that are being achieved on a day-to-day operational basis.

- Collect additional samples of the Aurora Zone and of the Skarn Zone mineralization for density measurements as development activities continue to progress. RPA also recommends that samples be collected from selected exploration drill holes for density measurements.
- Re-examine and reclassify as appropriate the confidence classification for chip/channel samples collected for the LZA group of wireframes.
- Examine the distribution of the gold contents within the mineralized wireframes by contouring the gold grades longitudinal projections. The results will be useful in short term planning and will improve the targeting of exploration and in-fill drilling programs.
- Continue collecting information regarding the distribution of the gold grades in the walls of the development headings by means of the POD-series drill holes.
- Carry out studies to examine the impact of the spacing of the POD-series drill holes on the accuracy of the local grade estimate.
- Examine whether the use of assay information from the sludge samples collected from development drilling can be used to improve the accuracy of the long-term Mineral Resource block model estimate.
- Continue collecting chip samples across the full width of the face for underground development headings and entering all chip sample information into the drill hole database as pseudo-drill holes that span the full width of the face of the development heading.
- Harmonize the across-strike dimensions (i.e., the northing, or Y-direction) of the blocks with the minimum widths selected for preparation of the mineralized wireframes to reduce the amount of dilution being introduced into the block model.
- Evaluate alternate parameters for the search strategies to reduce the presence of estimation artifacts and improve the accuracy of the local estimate.
- Continue drilling programs to both search for new areas of mineralization on the Mine property and expand the limits of the known mineralization.
- Continue to collect high quality scans of all stope voids on a regular and timely basis. This information should then be integrated into the material tracking and metal accounting systems to permit comparisons to be made for the block model versus the mine actual production and then the mill output. The information will also be useful in evaluating the accuracy of the excavation voids against the designed excavations.
- Consider expanding the time period for the reconciliation studies. The current reconciliation studies evaluate the predictive accuracy of the year-end 2018 LT block model over the most recent 12-month production period. Use of the year-end 2017 block model for comparison with the production data for 2018 and 2019 will enable the quantification of the accuracy of the estimation procedures and parameters over a 24-month period.
- Amend the Mineral Resource reporting criteria for the underground mine to include the use of constraining volumes for defining the potentially economic portions of the mineralized wireframes as use of such constraining volumes will improve the accuracy of the Mineral Resource statements.
- At Norrberget, carry out additional drilling to delineate the mineralization at depth and along strike.

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## **MINING AND MINERAL RESERVES**

- Adjust the mining loss estimate to include an estimate of lost ore tonnes.
- Review all the proximal stopes and update the dilution estimate in those stopes.
- Continue reconciliation and production management work to improve future grade and dilution forecasts.

## **PROCESSING**

- Continue to monitor the performance of all unit operations and to optimize plant performance to achieve the highest economic outcome possible.
- Continue to evaluate historic data and to use the results to estimate future plant gold recovery and operating costs.
- In future, metallurgical tests for Norrberget, should use variability samples with a range of head grades from throughout the deposit, using test conditions that evaluate what the metallurgical response will be in the existing processing facility.



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## 28 DATE AND SIGNATURE PAGE

This report titled “Technical Report on the Björkdal Mine, Sweden” and dated March 26, 2020 was prepared and signed by the following authors:

**(Signed and Sealed) *Reno Pressacco***

Dated at Toronto, ON  
March 26, 2020

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**(Signed and Sealed) *Jack P. Lunnon***

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Principal Metallurgist

## 29 CERTIFICATE OF QUALIFIED PERSON

### RENO PRESSACCO

I, Reno Pressacco, M.Sc(A), P.Geo., as an author of this report entitled “Technical Report on the Björkdal Mine, Sweden”, prepared for Mandalay Resources Corporation and dated March 26, 2020, do hereby certify that:

1. I am a Principal Geologist with Roscoe Postle Associates Inc., now part of SLR Consulting Ltd, of Suite 501, 55 University Ave., Toronto, ON, M5J 2H7.
2. I am a graduate of Cambrian College of Applied Arts and Technology, Sudbury, Ontario, in 1982 with a CET Diploma in Geological Technology, Lake Superior State College, Sault Ste. Marie, Michigan, in 1984, with a B.Sc. degree in Geology and McGill University, Montreal, Québec, in 1986 with a M.Sc.(A) degree in Mineral Exploration.
3. I am registered as a Professional Geologist in the Province of Ontario (Reg. #939). I have worked as a geologist for a total of 34 years since my graduation. My relevant experience for the purpose of the Technical Report is:
  - Review and report as a consultant on numerous exploration and mining projects around the world for due diligence and regulatory requirements, including preparation of Mineral Resource estimates and NI 43-101 Technical Reports.
  - Numerous assignments in North, Central and South America, Europe, Russia, Armenia and China for a variety of deposit types and in a variety of geological environments; commodities including Au, Ag, Cu, Zn, Pb, Ni, Mo, U, PGM, REE, and industrial minerals.
  - A senior position with an international consulting firm, and
  - Preparation of the Mineral Resource estimates for open pit and underground mines for the three prior years.
4. I have read the definition of "qualified person" set out in National Instrument 43-101 (NI 43-101) and certify that by reason of my education, affiliation with a professional association (as defined in NI 43-101) and past relevant work experience, I fulfill the requirements to be a "qualified person" for the purposes of NI 43-101.
5. I visited the Björkdal Mine on September 20 to 22, 2016 and most recently on November 18 to 21, 2019.
6. I am responsible for Sections 2 through 12, 14 (Björkdal Mine Mineral Resources), 23, and 24, and relevant disclosure in Sections 1, 25, 26, and 27 of the Technical Report.
7. I am independent of the Issuer applying the test set out in Section 1.5 of NI 43-101.
8. I have previously prepared public domain Mineral Resource estimates for the property that is the subject of the Technical Report.
9. I have read NI 43-101, and the Technical Report has been prepared in compliance with NI 43-101 and Form 43-101F1.

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10. At the effective date of the Technical Report, to the best of my knowledge, information, and belief, the Technical Report contains all scientific and technical information that is required to be disclosed to make the Technical Report not misleading.

Dated this 26<sup>th</sup> day of March, 2020

**(Signed and Sealed) Reno Pressacco**

Reno Pressacco, M.Sc.(A), P.Geo.

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**JACK P. LUNNON**

I, Jack P. Lunnion, CGeol, EurGeol, as an author of this report entitled “Technical Report on the Björkdal Mine, Sweden”, prepared for Mandalay Resources Corporation and dated March 26, 2020, do hereby certify that:

1. I am a Senior Geologist of RPA UK Ltd, now part of SLR Consulting Ltd, of 29 Throgmorton Street, Suite 2.9, Warnford Court, London, UK EC2N 2AT.
2. I am a graduate of the University of Southampton, United Kingdom, in 2009 with a Master of Geology (MGeol).
3. I am registered as a Chartered Geologist with the Geological Society of London (Reg. #1022611) and European Geologist with the Federation of European Geologists (Reg. #1456). I have worked as a Geologist for a total of ten years since my graduation. My relevant experience for the purpose of the Technical Report is:
  - Mineral Resource estimation and reporting on deposits worldwide for due diligence and regulatory requirements.
  - Experienced user of geological and resource modelling software.
  - Supervision of exploration properties in Africa and the Middle East.
4. I have read the definition of "qualified person" set out in National Instrument 43-101 (NI 43-101) and certify that by reason of my education, affiliation with a professional association (as defined in NI 43-101) and past relevant work experience, I fulfill the requirements to be a "qualified person" for the purposes of NI 43-101.
5. I visited the Björkdal Mine and Norrberget Project from September 22 to 25, 2017.
6. I am responsible for parts of Section 14 (Norrberget Mineral Resources) and relevant disclosure in Sections 1, 25, 26, and 27 of the Technical Report.
7. I am independent of the Issuer applying the test set out in Section 1.5 of NI 43-101.
8. I have prepared a previous Technical Report dated March 28, 2019 on the property that is the subject of the Technical Report.
9. I have read NI 43-101, and the Technical Report has been prepared in compliance with NI 43-101 and Form 43-101F1.
10. At the effective date of the Technical Report, to the best of my knowledge, information, and belief, the Technical Report contains all scientific and technical information that is required to be disclosed to make the Technical Report not misleading.

Dated this 26<sup>th</sup> day of March, 2020

**(Signed and Sealed) Jack P. Lunnion**

Jack P. Lunnion, CGeol, EurGeol

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**DAVID J.F. SMITH**

I, David J.F. Smith, CEng, as an author of this report entitled “Technical Report on the Björkdal Mine, Sweden”, prepared for Mandalay Resources Corporation and dated March 26, 2020, do hereby certify that:

1. I am Principal Mining Engineer and Technical Director – Mining Advisory with RPA UK Ltd, now part of SLR Consulting Ltd, of 29 Throgmorton Street, Suite 2.9, Warnford Court, London, UK EC2N 2AT.
2. I am a graduate of the University of Newcastle upon Tyne, United Kingdom in 1978 with a BSc(Eng) in Mining Engineering.
3. I am registered as a Chartered Engineer in the UK with the Engineering Council and am a Fellow of the Institute of Materials, Minerals and Mining (Membership #43860). I have worked as a mining engineer for a total of 41 years since my graduation. My relevant experience for the purpose of the Technical Report is:
  - Review and report as a mining consultant involved in numerous consulting and engineering assignments including; project technical evaluations, technical report preparation for project financing and fund-raising, IPOs, merger and acquisitions, due diligence reviews and engineering studies from scoping to basic engineering
  - Numerous consulting assignments on gold and base metal mine development projects and operating mines
  - Senior positions with a leading international mining and tunnelling contractor, managing international mine and tunnel construction projects as well as developing a successful engineering consulting business
  - Board director for an international mining consulting firm, responsible for leading the UK technical staff, and ensuring the technical quality of the firm’s consulting assignments across the consulting division
4. I have read the definition of "qualified person" set out in National Instrument 43-101 (NI 43-101) and certify that by reason of my education, affiliation with a professional association (as defined in NI 43-101) and past relevant work experience, I fulfill the requirements to be a "qualified person" for the purposes of NI 43-101.
5. I previously visited the Björkdal Mine on September 22 to 25, 2017.
6. I share responsibility with my co-authors on Sections 15, 16, and 18 to 22 and parts of Sections 1, 25, 26, and 27 of the Technical Report.
7. I am independent of the Issuer applying the test set out in Section 1.5 of NI 43-101.
8. I have prepared a previous Technical Report dated March 28, 2019 on the property that is the subject of the Technical Report.
9. I have read NI 43-101, and the Technical Report has been prepared in compliance with NI 43-101 and Form 43-101F1.



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10. At the effective date of the Technical Report, to the best of my knowledge, information, and belief, the Technical Report contains all scientific and technical information that is required to be disclosed to make the Technical Report not misleading.

Dated this 26<sup>th</sup> day of March, 2020

**(Signed and Sealed) David J.F. Smith**

David J.F. Smith, CEng

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**DEREK HOLM**

I, Derek Holm, FSAIMM, as an author of this report entitled “Technical Report on the Björkdal Mine, Sweden”, prepared for Mandalay Resources Corporation and dated March 26, 2020, do hereby certify that:

1. I am Senior Mining Engineer with RPA UK Ltd, now part of SLR Consulting Ltd, of 29 Throgmorton Street, Suite 2.9, Warnford Court, London, UK EC2N 2AT.
2. I am a graduate of the University of Witwatersrand, South Africa, in 2000, with a B.Sc. (Honours) degree in Mining Engineering.
3. I am a Fellow of the Southern African Institute of Mining and Metallurgy (Reg.# 402974). I have worked as a mining engineer for a total of 19 years since my graduation. My relevant experience for the purpose of the Technical Report is:
  - Four years of gold production experience
  - Mine design and scheduling for various underground gold mines over a period of ten years
  - Mineral Reserve estimation in accordance with regulatory requirements
  - Operational and feasibility study reviews for operators, lenders, and for legal proceedings
4. I have read the definition of "qualified person" set out in National Instrument 43-101 (NI 43-101) and certify that by reason of my education, affiliation with a professional association (as defined in NI 43-101) and past relevant work experience, I fulfill the requirements to be a "qualified person" for the purposes of NI 43-101.
5. I visited the Björkdal Mine from January 22 to 24, 2020.
6. I am responsible for portions of Sections 15, 16, 21, and 22 regarding underground operations and relevant disclosure in Sections 1, 25, 26, and 27 of the Technical Report.
7. I am independent of the Issuer applying the test set out in Section 1.5 of NI 43-101.
8. I have had no prior involvement with the property that is the subject of the Technical Report.
9. I have read NI 43-101, and the Technical Report has been prepared in compliance with NI 43-101 and Form 43-101F1.
10. At the effective date of the Technical Report, to the best of my knowledge, information, and belief, the Technical Report contains all scientific and technical information that is required to be disclosed to make the Technical Report not misleading.

Dated this 26<sup>th</sup> day of March, 2020

**(Signed and Sealed) Derek Holm**

Derek Holm, FSAIMM

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**KATHLEEN A. ALTMAN**

I Kathleen A. Altman, Ph.D., P.E., as an author of this report entitled "Technical Report on the Björkdal Mine, Sweden", prepared for Mandalay Resources Corporation and dated March 26, 2020, do hereby certify that:

1. I am Principal Metallurgist with RPA (USA) Ltd., now part of SLR Consulting Ltd, of Suite 505, 143 Union Boulevard, Lakewood, Co., USA 80228.
2. I am a graduate of the Colorado School of Mines in 1980 with a B.S. in Metallurgical Engineering. I am a graduate of the University of Nevada, Reno Mackay School of Mines with an M.S. in Metallurgical Engineering in 1994 and a Ph.D. in Metallurgical Engineering in 1999.
3. I am registered as a Professional Engineer in the State of Colorado (Reg. #37556). I have worked as a metallurgical engineer for a total of 39 years since my graduation. My relevant experience for the purpose of the Technical Report is:
  - Review and report as a metallurgical consultant on numerous mining operations and projects around the world for due diligence and regulatory requirements.
  - I have worked for operating companies, including the Climax Molybdenum Company, Barrick Goldstrike, and FMC Gold in a series of positions of increasing responsibility.
  - I have worked as a consulting engineer on mining projects for approximately 20 years in roles such a process engineer, process manager, project engineer, area manager, study manager, and project manager. Projects have included scoping, prefeasibility and feasibility studies, basic engineering, detailed engineering and start-up and commissioning of new projects.
  - I was the Newmont Professor for Extractive Mineral Process Engineering in the Mining Engineering Department of the Mackay School of Earth Sciences and Engineering at the University of Nevada, Reno from 2005 to 2009.
4. I have read the definition of "qualified person" set out in National Instrument 43-101 (NI 43-101) and certify that by reason of my education, affiliation with a professional association (as defined in NI 43-101) and past relevant work experience, I fulfill the requirements to be a "qualified person" for the purposes of NI 43-101.
5. I visited the Björkdal Mine from September 22 to 25, 2017.
6. I am responsible for Sections 13 and 17 and relevant disclosure in Sections 1, 25, 26, and 27 of the Technical Report.
7. I am independent of the Issuer applying the test set out in Section 1.5 of NI 43-101.
8. I have prepared previous Technical Reports dated January 16, 2017, March 29, 2018, and March 28, 2019 on the property that is the subject of the Technical Report.
9. I have read NI 43-101, and the Technical Report has been prepared in compliance with NI 43-101 and Form 43-101F1.

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10. At the effective date of the Technical Report, to the best of my knowledge, information, and belief, the Technical Report contains all scientific and technical information that is required to be disclosed to make the Technical Report not misleading.

Dated this 26<sup>th</sup> day of March, 2020

**(Signed and Sealed) Kathleen A. Altman**

Kathleen A. Altman, Ph.D., P.E.