1.0 INTRODUCTION

Geostat Services (GS) was commissioned by Harmony Gold Operations Ltd (Harmony) to undertake a geostatistical resource estimate of the Maud Creek deposit in March/April 2003. This deposit comprises part of the Burnside Project area, located approximately 200km south of Darwin in the Northern Territory, Australia. The aim of this work was to provide a geostatistical kriged gold resource of the Maud Creek orebody, using the latest available drilling assays and the greater understanding of the deposit geology.

2.0 DATA

A total of 585 exploration drillholes were used for the resource estimate, representing 74,295m. Validation of the drillhole database was not performed, as this was considered to be completed by Harmony prior to receiving the data. Drillholes are based on an irregular grid, with an average 10m spacing along-strike and 20m across-strike in the centre of the deposit, and larger drillhole spacings along-strike up to 50m in other areas of the deposit. In the down-dip direction, drillhole spacings vary from a regular grid of 20m in the top 150m, to occasional holes spaced approximately 100m at depth. All holes defining the Maud Creek resource are oriented 270°, with holes dipping at an average of -60°.

A default density of 2.8 t/m^3 was supplied by Harmony and is applicable to the whole deposit.

3.0 WIREFRAMING

Five grade envelopes were delineated for the Maud Creek deposit by Harmony, corresponding to an approximate 1.5g/t Au cutoff. The main lode (100) comprises a steeply dipping, large continuous thin zone of mineralisation with an average downhole thickness of 11.1m. The second lode, 200 consists of a smaller lode to the south, and is located at depth, with an average downhole thickness of 10.9m. The third lode, 300 is located on the hangingwall side of lode 200, and consists of two small solids averaging 7.9m in downhole thickness. To the north of lode 300 are two solids comprising lode 400, with a large depth extent and 8.4m in average thickness. Lode 500 comprises a series of solids with varying continuity, with some solids based on singular sections only and lacking in strike continuity, and others continuous over up to three drillhole lines, all of which average 6m in total downhole thickness. Sectional interpretations were made using vertical north-south sections, linked to form solids and validated by Harmony.

4.0 STATISTICS

4.1 Descriptive Statistics – Exploration and Grade Control Data

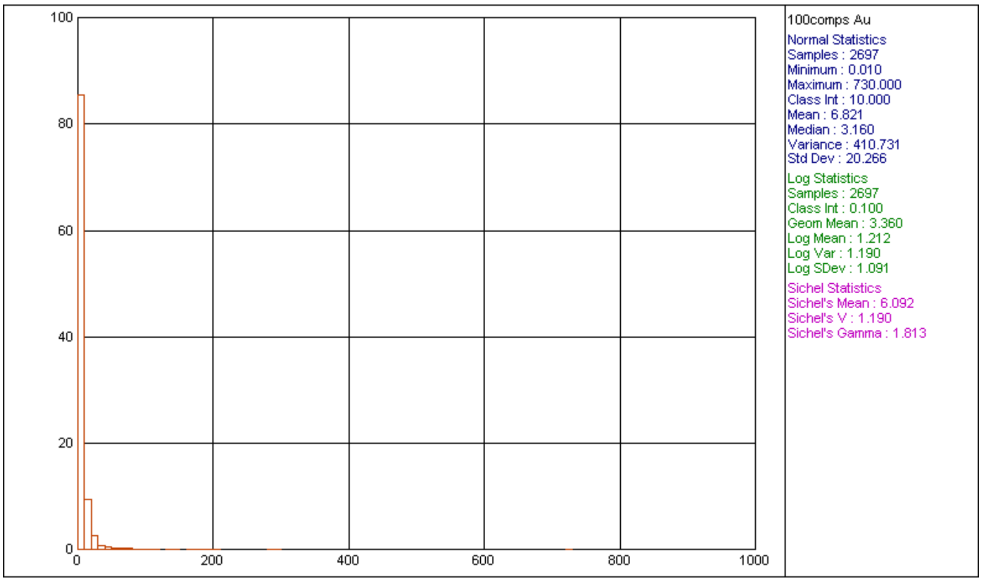
Sample intervals within the exploration database were examined to determine the dominant sample length. The majority of sample intervals were 1m in length, and compositing was performed on the dataset to 1m to ensure all composites within solids were of equal length. Statistics were run within the exploration drillhole database for all constrained composite data by lode, and are presented in Table 4.1, for both cut and uncut data. Only uncut statistics for the 200 lode are presented, as the maximum composite grade within this lode is lower than that of the 20 g/t Au top-cut grade. No other mineralisation indicators were used, as data was extracted from within wireframes.

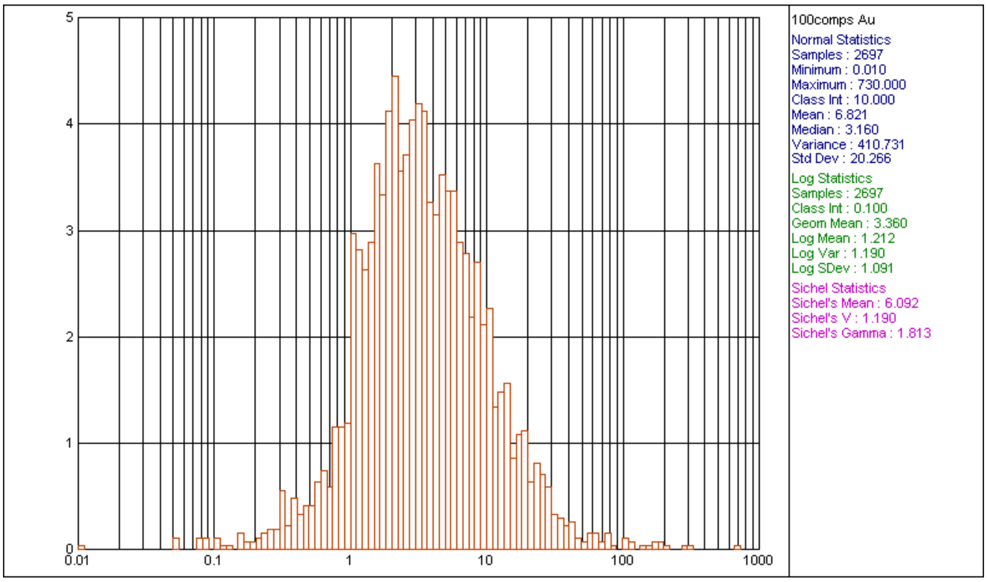
Statistic	100		200	300		400		500	
	Uncut	Cut (30g/t)	Uncut	Uncut	Cut (20g/t)	Uncut	Cut (20g/t)	Uncut	Cut (20g/t)
Number	2697	2697	180	54	54	206	206	222	222
Minimum	0.01	0.01	0.25	0.06	0.06	0.01	0.01	0.1	0.1
Maximum	730	30	16.23	22.08	20	77.6	20	130	20
Mean	6.82	5.54	3.75	7.89	7.85	3.92	3.56	4.99	4.13
Median	3.16	3.16	3.08	6.66	6.66	2.32	2.32	2.74	2.74
Std Deviation	20.27	6.38	2.61	5.50	5.41	6.64	3.90	10.73	4.15
Variance	410.73	40.72	6.80	30.28	29.24	44.07	15.24	115.11	17.24
Coeff Variation	2.97	1.15	0.70	0.70	0.69	1.69	1.10	2.15	1.01

Table 4.1 Exploration composite statistics within solids (g/t Au)

The coefficient of variation (CV) describes the variability of data relative to the raw average grade, and in general, values above 1.0 will indicate that problems may be caused by extreme values. CV values also provide an indication of the need for top-cutting prior to interpolation. However, the coefficient of variation assumes an underlying normal distribution, thus its application is limited. The 100, 400 and 500 lodes at Maud Creek show elevated coefficient of variation values within the uncut dataset, indicating that extreme values could be problematic during interpolation of gold grades.

Exploration composites for the 100 lode suggest a lognormal distribution, as shown by statistical plots in Figure 4.1. Other lodes indicate the presence of more than one peak (Figures 4.2 to 4.5), which is likely a function of low data levels and the discontinuous nature of mineralisation rather than true mixing of separate populations. The distribution is distorted below 1.5g/t Au, with composites below this grade representing internal dilution within the lodes. Lognormal probability plots show a slight inflexion at approximately 1.5g/t Au, which corresponds to the Au grade cutoff used for wireframing the lodes.





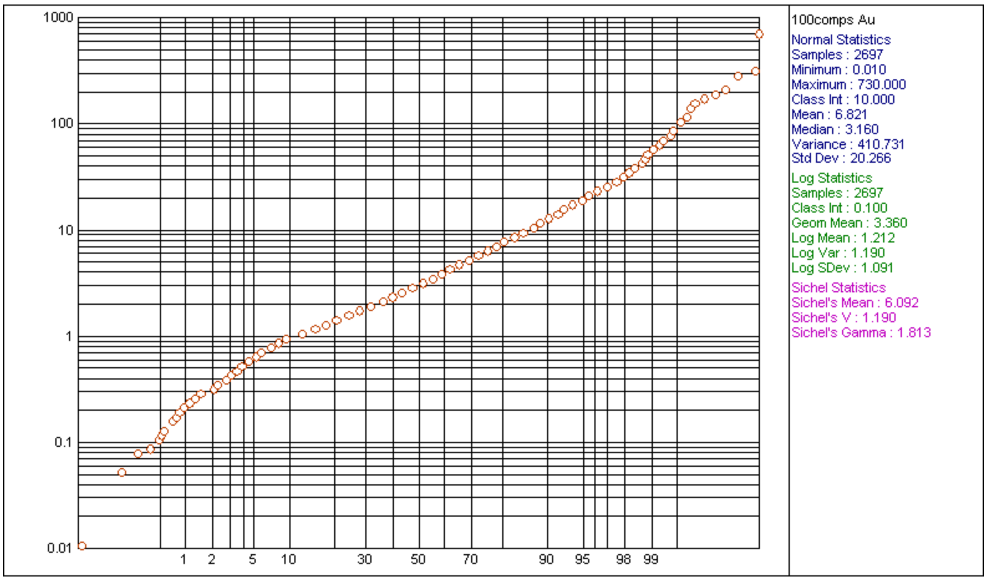
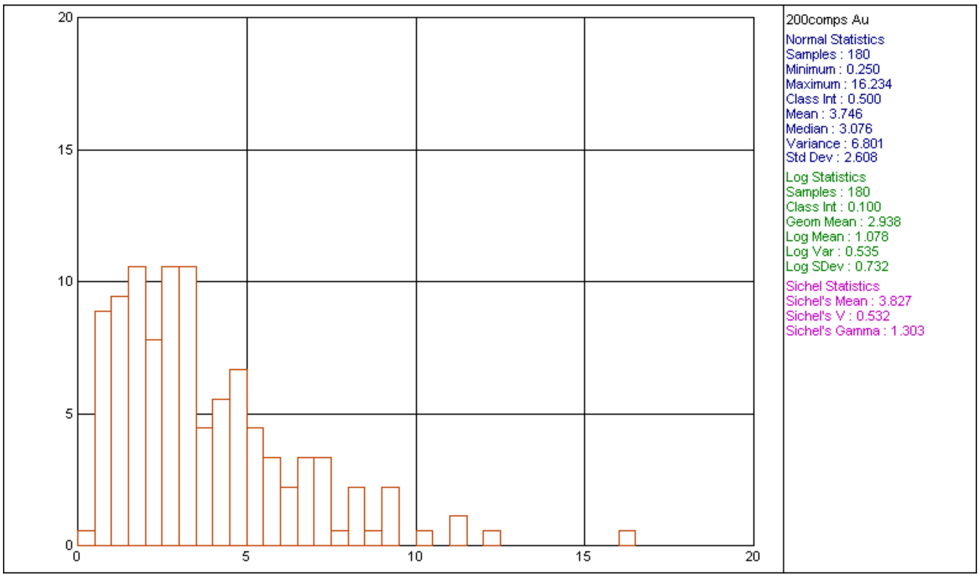
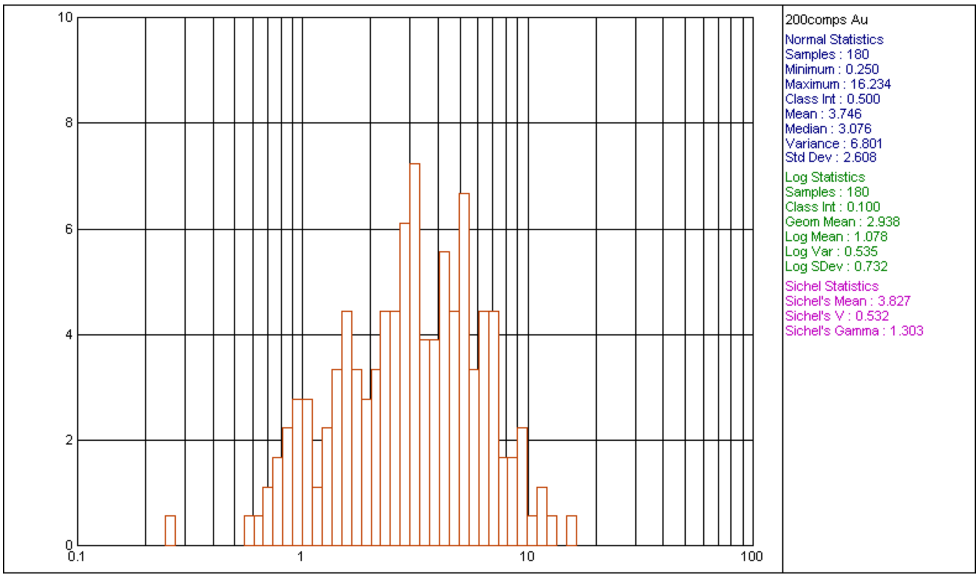


Figure 4.1 Normal and log histograms, and lognormal probability plots – 100 Lode





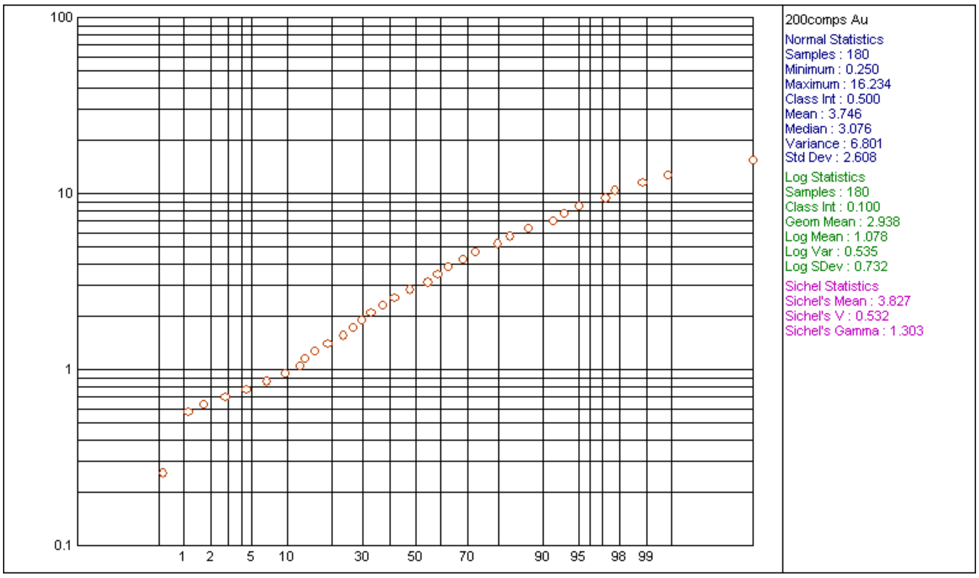
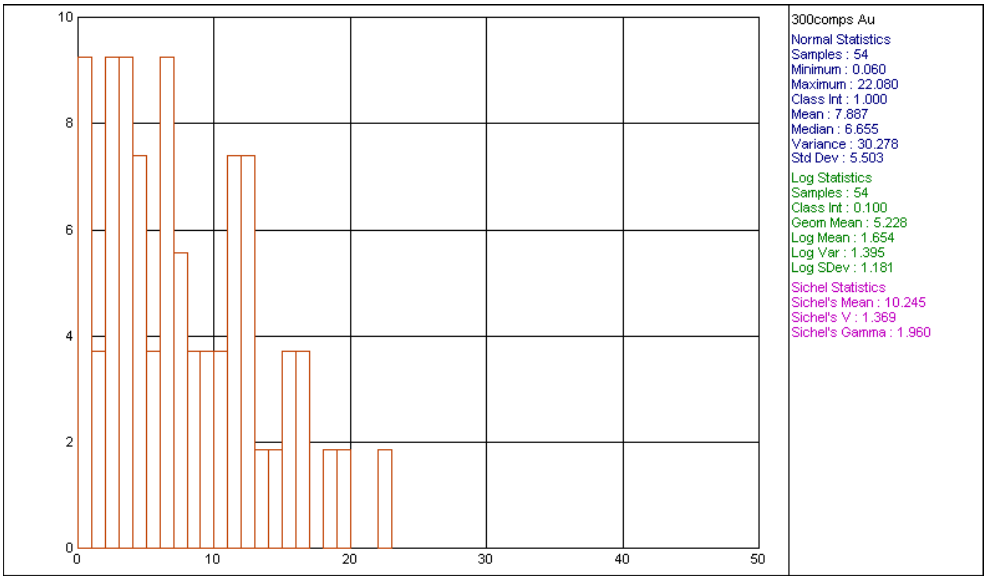
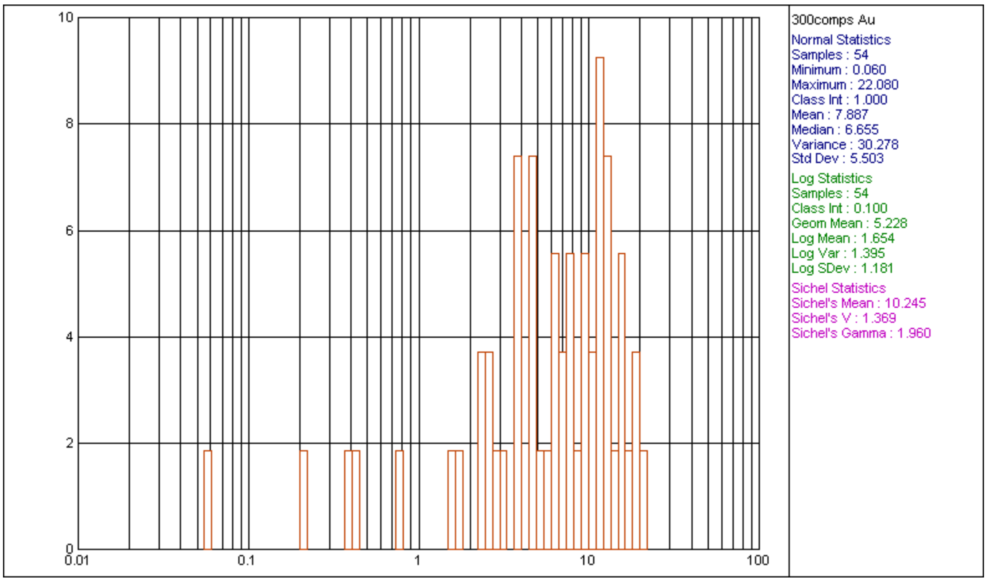


Figure 4.2 Normal and log histograms, and lognormal probability plots – 200 Lode





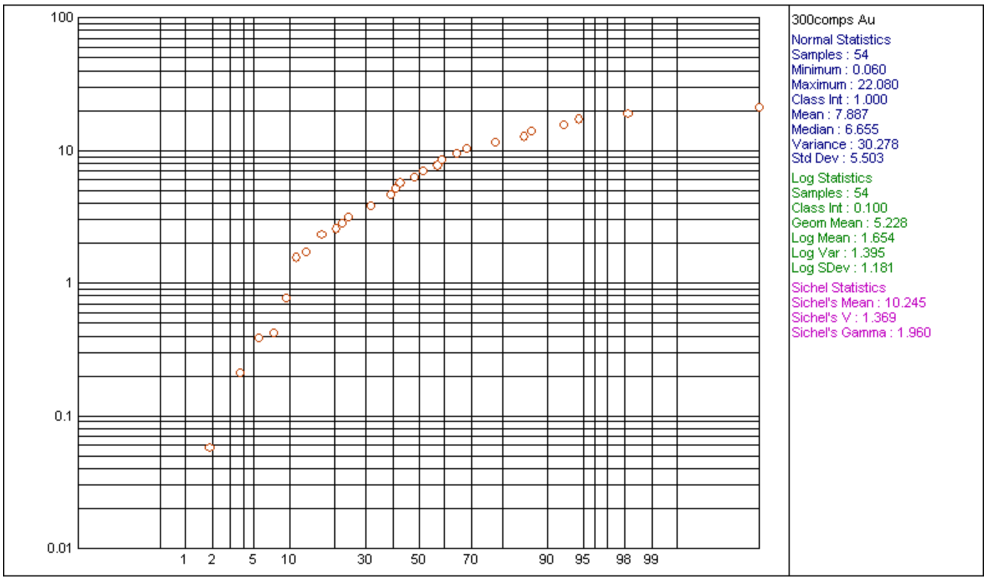
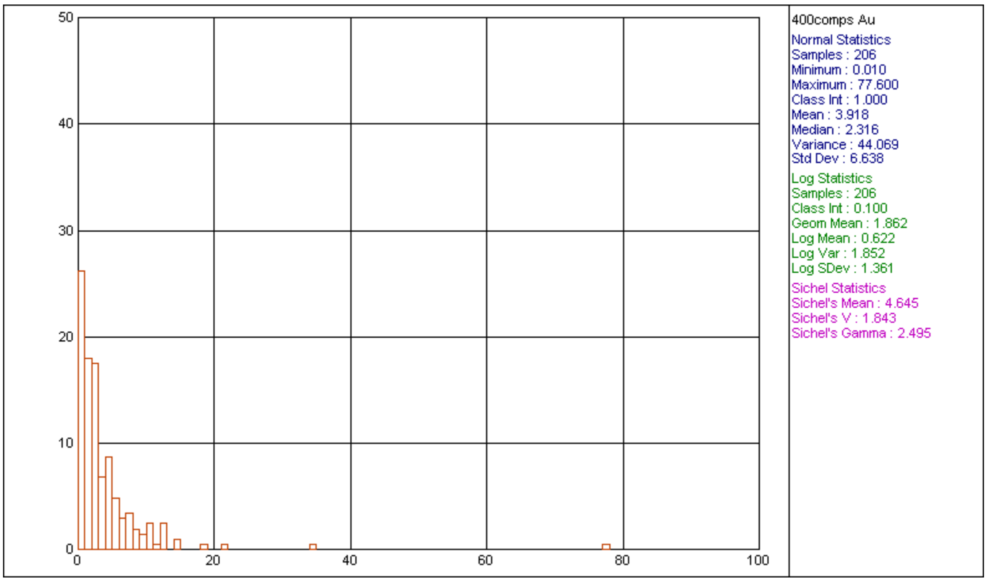
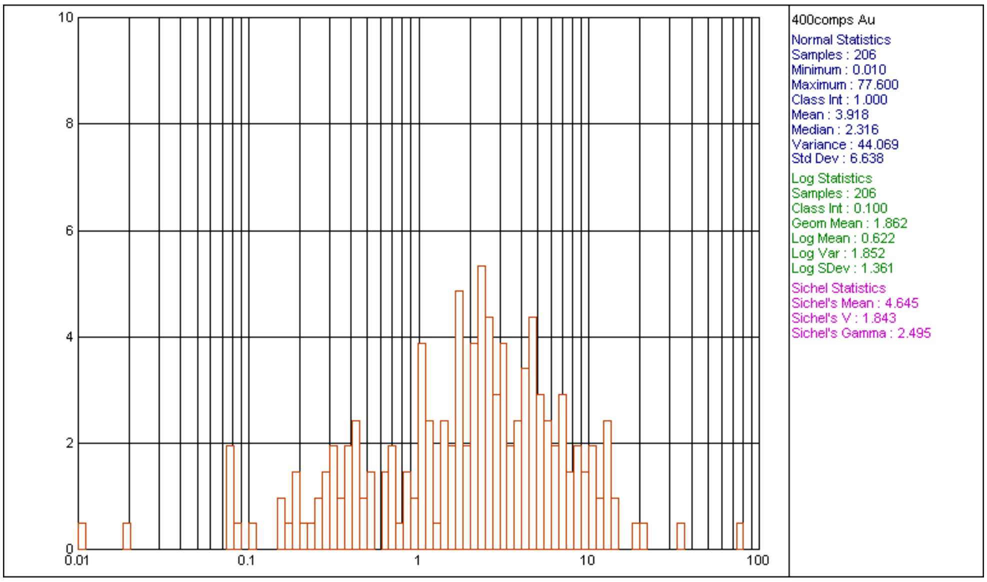


Figure 4.3 Normal and log histograms, and lognormal probability plots – 300 Lode





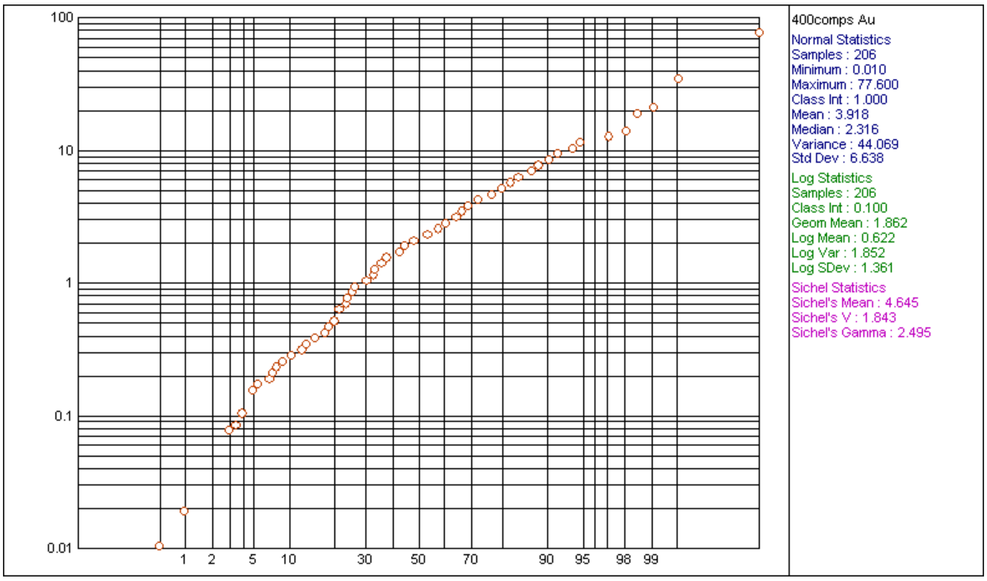
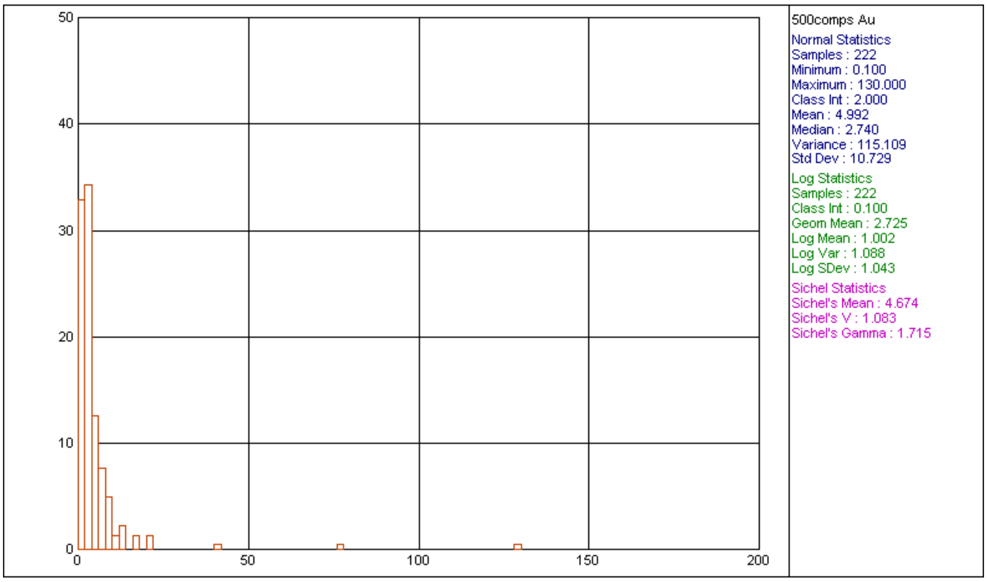
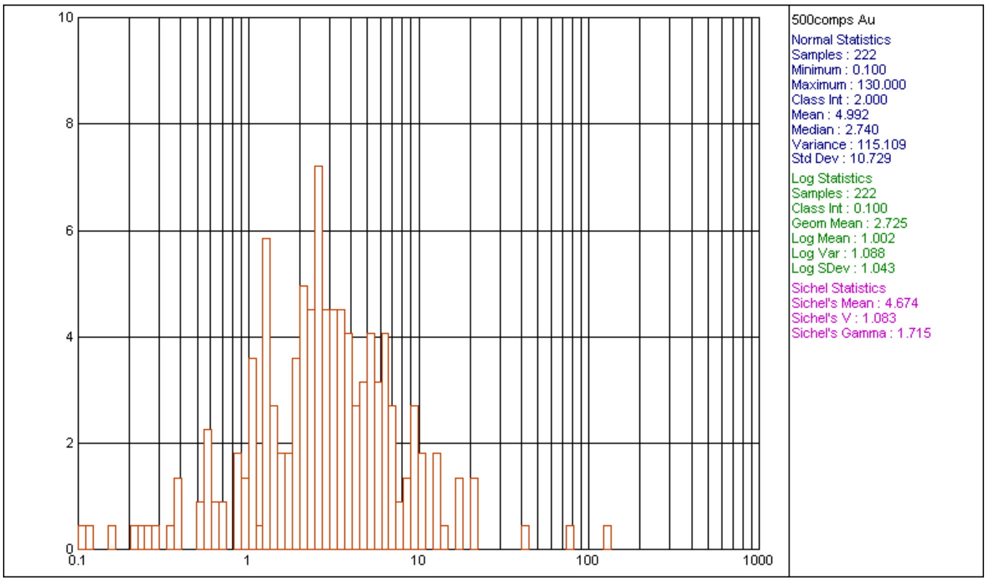


Figure 4.4 Normal and log histograms, and lognormal probability plots – 400 Lode





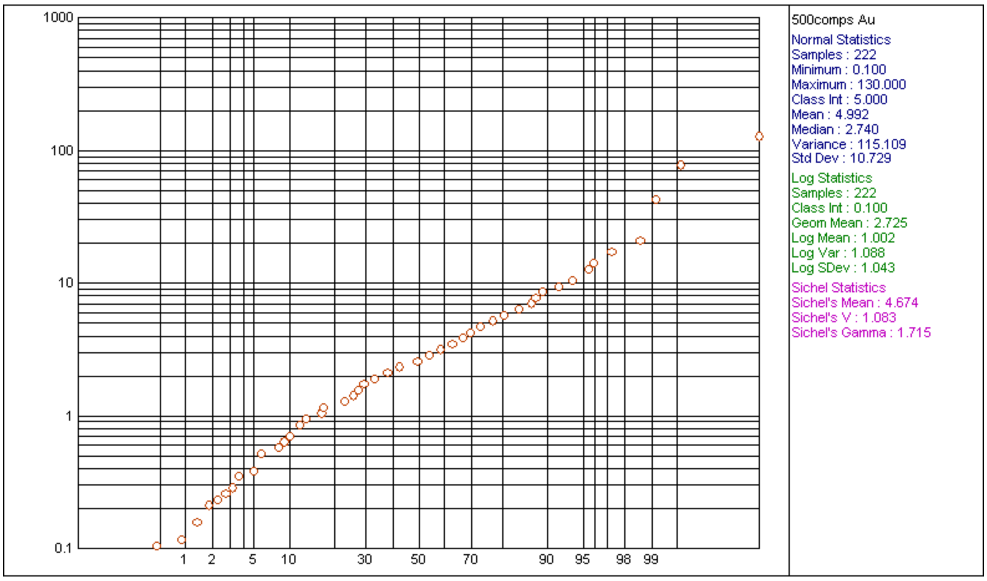


Figure 4.5 Normal and log histograms, and lognormal probability plots – 500 Lode

4.2 Top-cutting of exploration composite data

Composite data within the exploration database was assessed for the need of a top-cut to be applied to data prior to grade estimation. The determination of a high-grade cut is made on the basis of probability plots, with the general criteria for the top-cuts being a marked change, a kink, or pronounced disintegration at the higher end of the probability distribution.

Since Au composites exhibit several high-grade extreme values, with an elevated coefficient of variation, top-cutting of Au data is necessary to reduce the impact of extreme values on estimation of Au grades. It is recommended that a top-cut of 30g/t Au is used for the main 100 lode. A lower cutoff of 20g/t Au is recommended for all other lodes, as these lodes comprise a lower variance, and a smaller spread of values. These top-cuts of 30g/t Au and 20g/t Au lower the CV for all lodes close to 1.0, thus providing a more representative dataset for accurate interpolation of grades.

5.0 VARIOGRAPHY

Variography analysis using traditional variograms was performed on composite data for the resource model. Exploration composites within the 100 lode only were analysed for variography. Other lodes were not analysed due to insufficient data levels, and variogram parameters for these lodes are based on those determined for the 100 lode. Fan interpretation of variograms in the horizontal plane show a north-south strike, with across-strike plane interpretations showing a dip of -60° towards 090°.

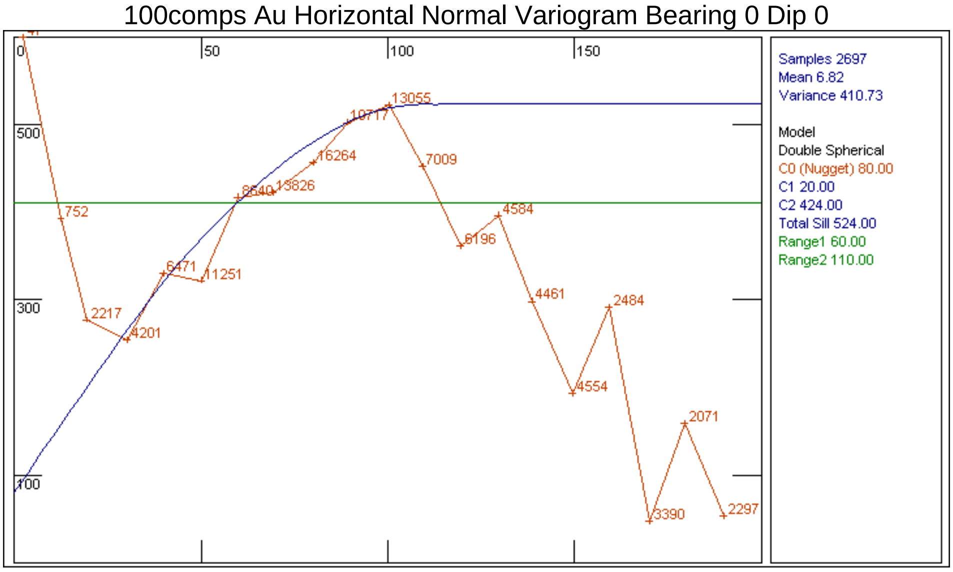
Variograms with two spherical structures were modelled, with results in Table 5.1. The quality of variograms was reasonable in the along-strike and downhole directions. However, the across-strike variography was very poor, due to the lack of data continuity in this direction, and large uninformed areas not covered by drillholes. This is an area of concern, and more data is required to provide reliable spatial continuity down-dip and thus increase confidence in model grades.

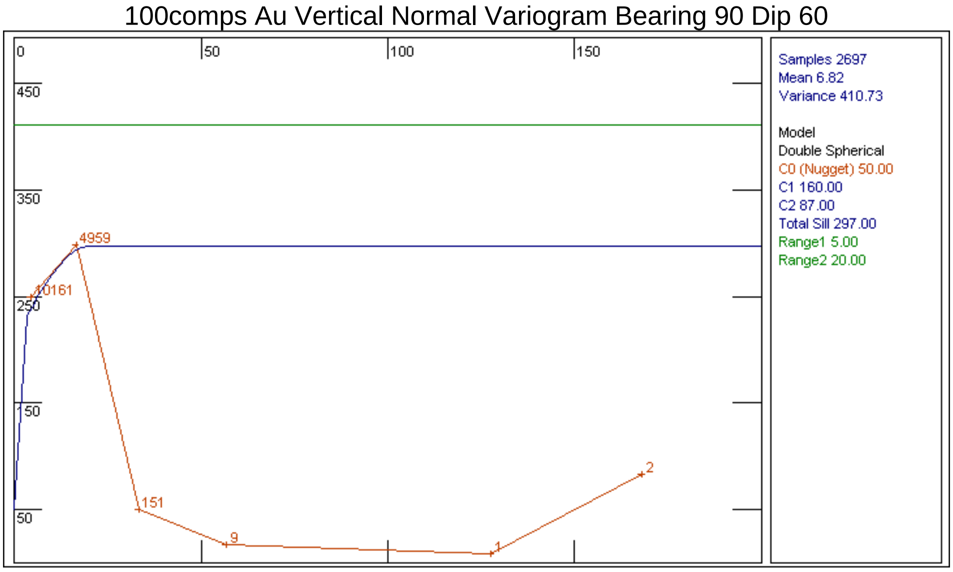
Nugget Effect	Sill 1	Range 1*	Sill 2	Range 2*
0.22	0.35	60m x 5m x 3m	0.43	110m x 20m x 6m

*Note: Ranges are expressed as strike x down-dip x downhole

Table 5.1 Model variogram parameters for Maud Creek deposit

Maximum continuity ranges indicate that a high degree of grade continuity is present along-strike (110m) as compared to down-dip (20m). More drillhole data is needed to increase confidence in the variograms obtained, particularly infill drilling in the down-dip direction. Variogram model plots are included as Figure 5.1.





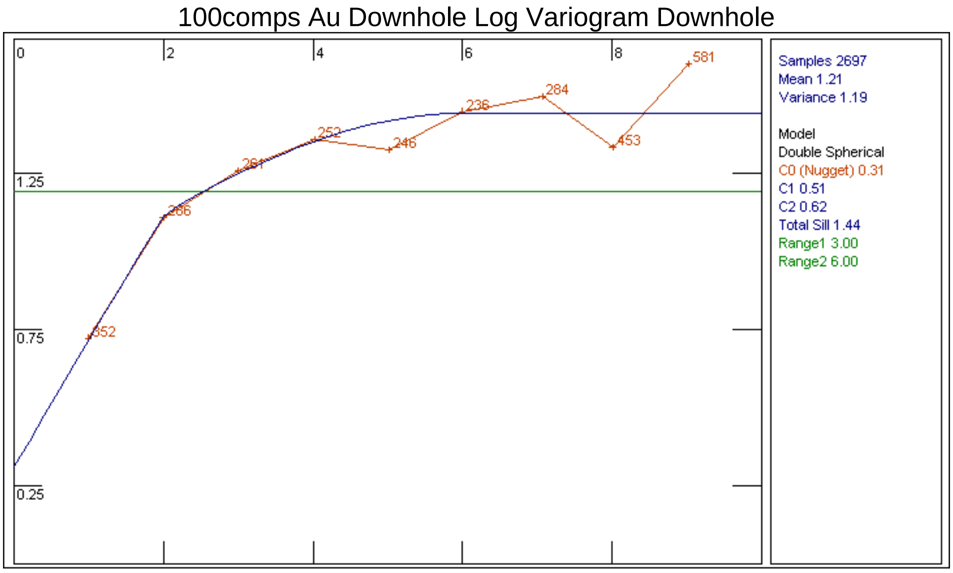


Figure 5.1 Variogram models for 100 Lode – Maud Creek deposit

6.0 BLOCK MODELLING AND GRADE INTERPOLATION

6.1 Block sizes and modelling parameters

Block size dimensions were considered for the Maud Creek deposit, taking into account drilling density and distribution of assay data within wireframes. A block size of 5m x 10m x 2.5m (E x N x RL) is recommended as being the optimum overall block size for all lodes, given the average along-strike drill spacing of 10-20m. As all lodes are relatively narrow in width, a block size of 5m in the across-strike dimension was considered to best fit this variable width, taking into account the across-strike drill spacing of 20m, and irregular spacing at depth.

Block model origin and extents are defined below in Table 6.1.

Model Limits	Extent of Model	No of Blocks	Block Size
8845-9565N	710m	72	10m
19220-19570E	350m	70	5m
135-(-405)mRL	540m	108	5m

Table 6.1 Maud Creek Resource Model Extents

A percent model method was used, which calculates the percent of a block as belonging to a particular lode rockcode for use in volume/tonnage calculations. The narrow, thin nature of the lodes at Maud Creek makes this method ideal and eliminates over-estimation of tonnage whilst maintaining the same grade interpolation as that for the standard block modelling method. The solid wireframes were used to limit the blocks available for grade interpolation.

Ordinary kriging, using parameters derived from the traditional variograms was chosen to interpolate grades into blocks for all lodes. The skewed nature of the data distribution makes this technique ideal, whereas other techniques such as inverse distance interpolation assume a normal distribution, which can lead to errors if the data is not cut appropriately. Inverse distance techniques also do not utilise the information obtained from the variogram in interpolation of blocks, and thus the spatial correlation between composites is not taken into account.

Each lode was treated as a separate hard boundary, restricting the Au grade interpolation to drillhole data located within each solid. A minimum of 2 composites and a maximum of 20 composites were used to interpolate each block grade for all lodes. A discretisation array of 5 (north) by 5 (east) by 5 (RL) was used to refine the kriging weights for each model block.

A search ellipse was used to select the composites to estimate a particular block. Generally, this is close to or equal to the maximum range parameters for the three principal directions modelled in the variography. All lode search ellipses were slightly increased from variography maximum range parameters, with dimensions of 110m (N) x 30m (E) x 15m (RL).

The search ellipse orientations are usually based on strike and dip directions determined from fan contours and variograms during variography analysis of the dataset. However, since the variography is based on a single lode dataset, set directional increments and overall lode orientations, with the resulting interpretations not always reflecting local variations in geometry, some fine-tuning of the search ellipse orientations is often required to best fit the actual geometry of the individual lodes. The lodes were subdivided into six interpolation domains by northing and depth to reflect the changing geometry of the lodes with respect to strike and dip. Table 6.3 below lists the strike and dip orientations employed for each lode and interpolation domain.

Domain/Lode	**100**		**200**		**300**		**400**		**500**	
	Strike	Dip	Strike	Dip	Strike	Dip	Strike	Dip	Strike	Dip
8850N – 8980N	020	-60/110	020	-60/110	020	-60/110	-	-	-	-
8980N – 9030N; -262.5RL to -405RL	340	-60/070	340	-60/070	-	-	-	-	-	-
8980N – 9030N; 135RL to -262.5RL	005	-60/095	005	-60/095	-	-	-	-	-	-
9030N – 9140N	350	-60/080	350	-60/080	-	-	020	-60/110	000	-60/090
9140N – 9380N	025	-70/115	-	-	-	-	020	-60/110	000	-60/090
9380N – 9560N	002.5	-70/92.5	-	-	-	-	-	-	000	-60/090

Table 6.3 Strike and dip orientations for all lodes – Maud Creek deposit

The 100 and 200 lodes show changing strike orientations with strike, necessitating the subdivision into five domains to reflect each change in strike. A steepening of dip from -60° to -70° occurs towards the north, whereas towards the south, a rotation in strike geometry from 005° to 340° is present with depth. All other lodes (300, 400, 500) comprise a consistent strike and dip over their lode length, and as such were not subdivided for interpolation.

6.2 Block model validation

The Maud Creek block model was validated by several methods, including visual validations on-screen, global statistical comparisons of input and block grades, and local grade/depth and grade/easting relationships. The model was validated visually by viewing vertical sections and plans of the block model, with spatial comparison of kriged block grades against input composite grades to ensure grade trends were represented correctly.

6.2.1 Global statistical validations

Input average composite grades were weighted by sectional volume, and statistically compared with mean block grades by lode, with summary results tabulated in Table 6.4 below.

Lode	Number of Composites	Block Volume	Block Mean Grade	Composite Mean Grade	% Difference
100	2697	1,356,570	4.75	5.11	-7.0%
200	180	392,960	3.43	3.65	-5.7%
300	54	68,347	8.17	7.85	4.1%
400	206	177,811	3.83	3.56	7.6%
500	222	35,136	3.83	4.13	-7.3%
TOTAL	**3,359**	**2,030,824**	**4.51**	**4.77**	**-5.5%**

Table 6.4 Statistical validation of Au interpolated grades – Maud Creek deposit

Slightly underestimated model grades are reported for the 100, 200 and 500 lodes in comparison with the global composite grade, whereas model mean grades for the 300 and 400 lodes show a small overestimation. Several factors are responsible for these grade differences, those being:

- Lack of composites located at depth. The sparsity of drillhole data at depth has resulted in the few composites present having a disproportionate influence on interpolation of adjacent blocks as compared to composites located near the surface.
- Low grades of composites at depth. Composite grades at depth are low relative to the mean grade, and due to their large spatial influence in grade interpolation, a high proportion of blocks at depth report low grades, thus lowering the mean block grade.

- Irregular spacing of composites along-strike and down-dip. The absence of a regular drilling pattern has resulted in some interpolated grades being based on composites from a greater distance than those for other blocks.
- Wide grade variability across lodes. The across-lode and along-strike grade variability present at Maud Creek is responsible for large differences between composite and model grades on some sections. Small areas of internal dilution on some sections are also responsible for producing lower model grades than of the composite grades, an example being that of the 100 lode on 9170N, which is illustrated below in Figure 6.1. This internal dilution is located next to high composite grades, with other low grades also present across the lode, thus making representative grade interpolation very difficult.

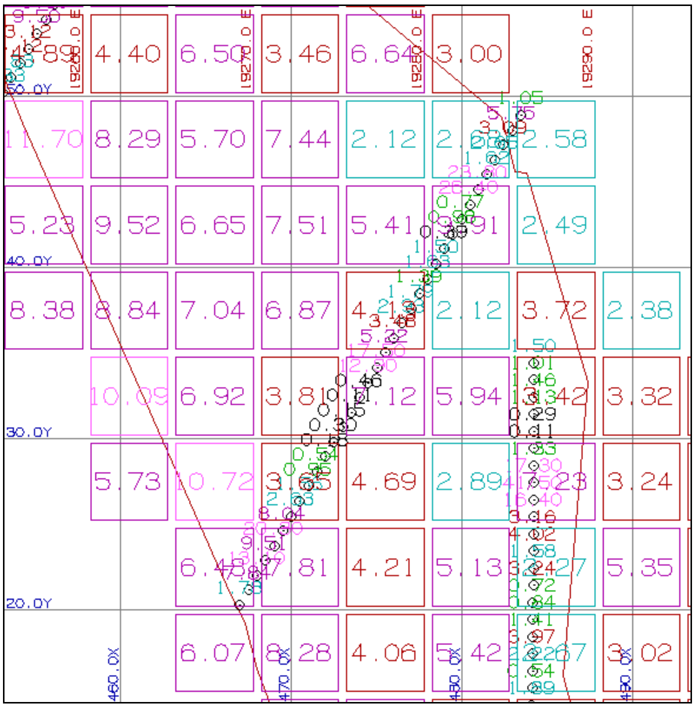


Figure 6.1 Section 9170N showing internal dilution adjacent to high grades within the 100 lode

- Poor variography for the down-dip direction. The lack of a good quality, reliable variogram for the down-dip direction has resulted in reduced spatial continuity parameters for this direction, thus restricting the linking of composites down-dip.

6.2.2 Grade/Depth and Grade/Northing validations

Figures 6.2 to 6.3 illustrate the grade/depth relationship averaged within 10m RL increments for both input data and model grade data, together with the number of composites for the 100 lode, and other combined lodes respectively within the Maud Creek deposit. Figures 6.4 to 6.5 illustrate the grade/northing relationship averaged within 10m northing increments for input composite data and model grade data, together with the number of composites for the 100 lode, and other combined lodes respectively.

With respect to the 100 lode, a comparison of model grades with composite grades by bench show a close reconciliation, with the broad grade trends reproduced (Figure 6.2). This trend reproduction is partly a result of the restricted variography parameters applied in the down-dip direction, with grade interpolations based on composites at close distances. An information/edge effect is present at the bottom of the model, with depressed model grades caused by the presence of low-grade composites amongst the few composites present in these areas. Comparison of model grades with composite grades with respect to northing (Figure 6.4) illustrates a reasonable reconciliation, with a slight smoothing of composite grades present. Composite grades are highly variable from northing to northing, reflecting the large variation in grade along-strike. Hence, the smoothing of the variable composite grades by the block model has resulted in the underestimation of the global composite grade by the block model.

The grade/depth relationship for all other lodes shows a very similar trend to that for the main 100 lode, with model grades showing a slight smoothing of composite grades (Figure 6.3). The grade/northing relationship plot (Figure 6.5) illustrates a reasonable validation of composite grades by the block model, with a smoothing of local composite grade fluctuations by the resource model. The small, discontinuous nature of some of the solids comprising the lodes has created difficulties in reconciliation of grades, due to the lack of data support along-strike and down-dip for representative grade interpolations, and the low data levels present.

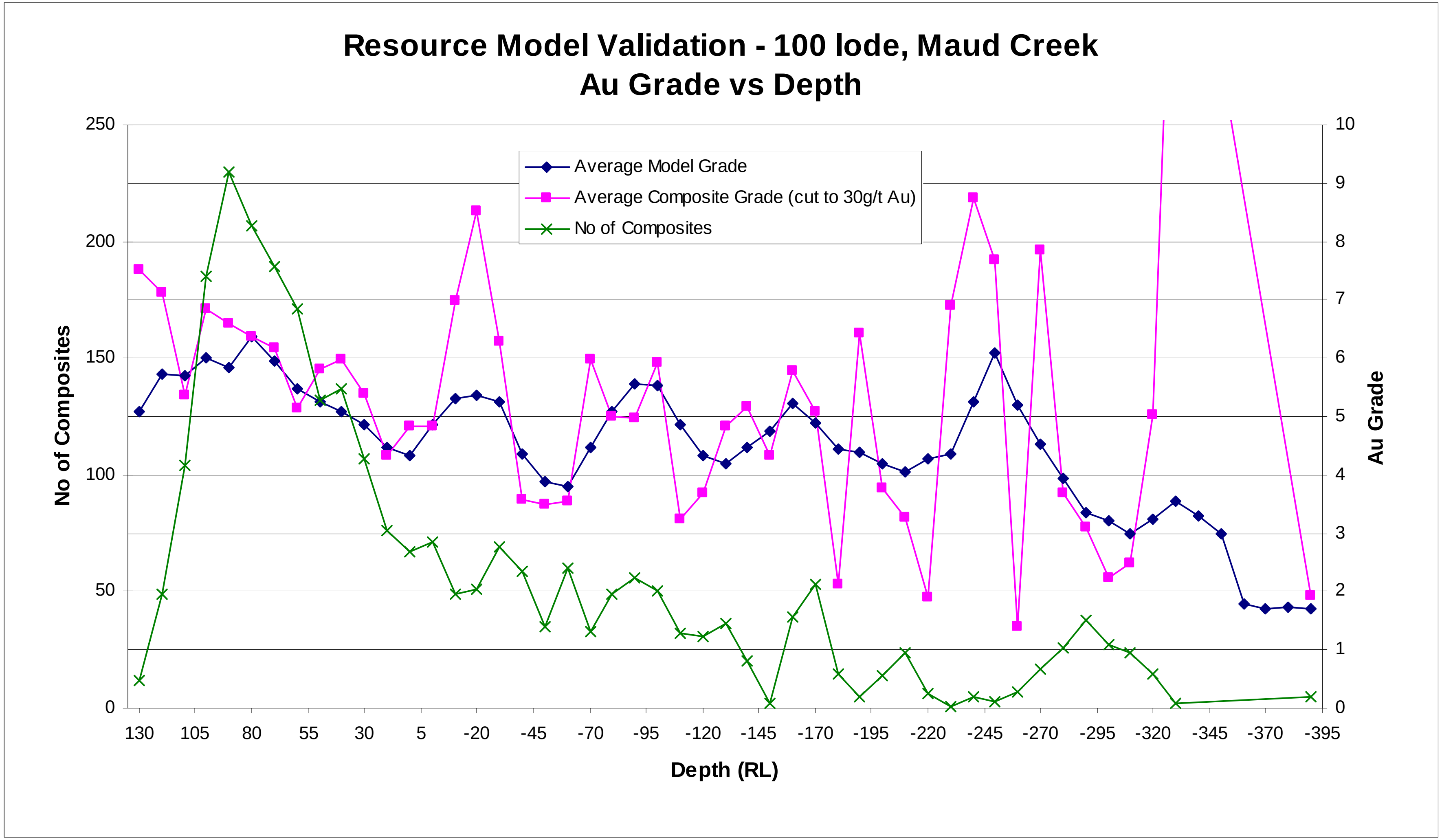


Figure 6.2 Au Grade vs Depth validation plot – 100 lode, Maud Creek deposit

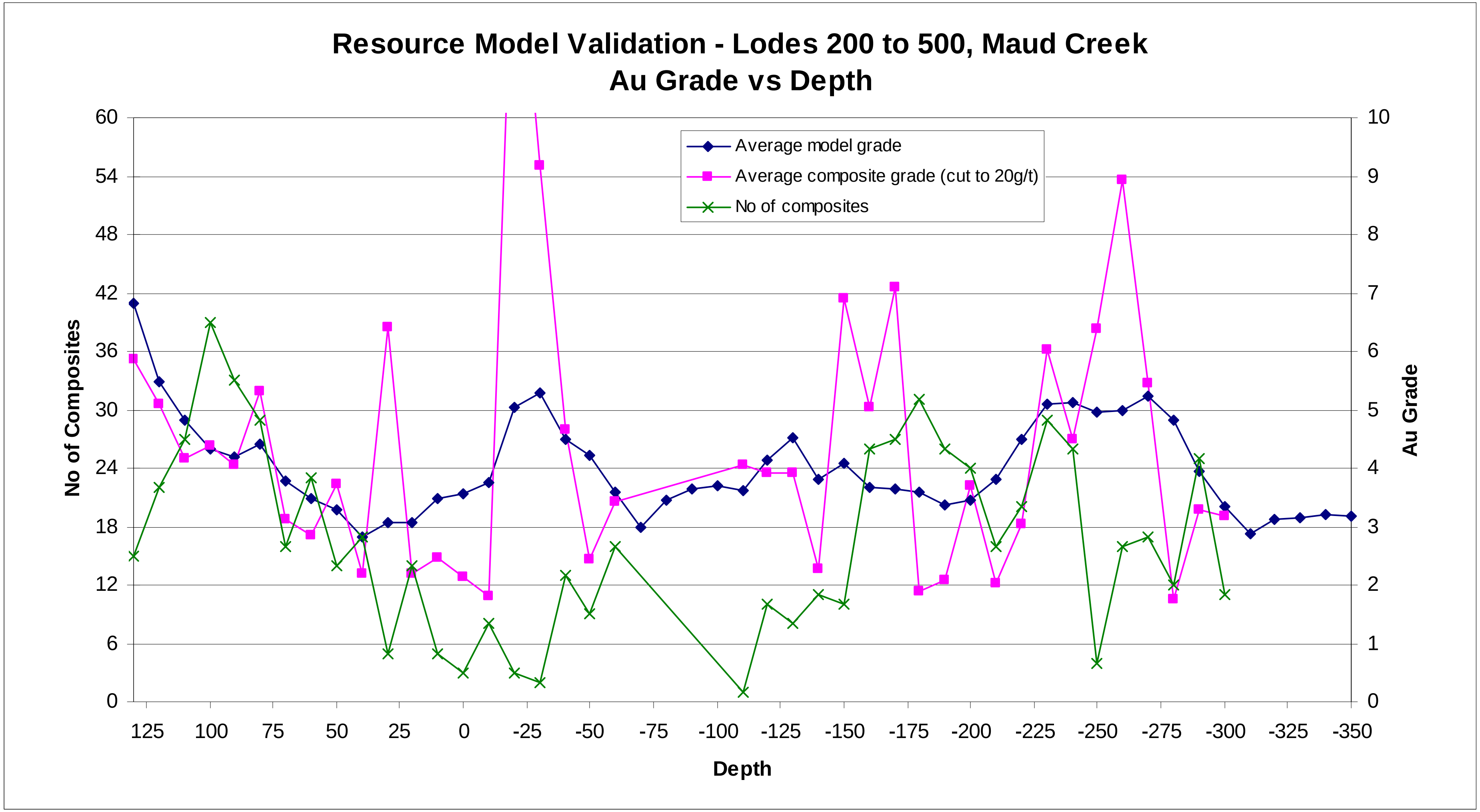


Figure 6.3 Au Grade vs Depth validation plot – Lodes 200 to 500, Maud Creek deposit

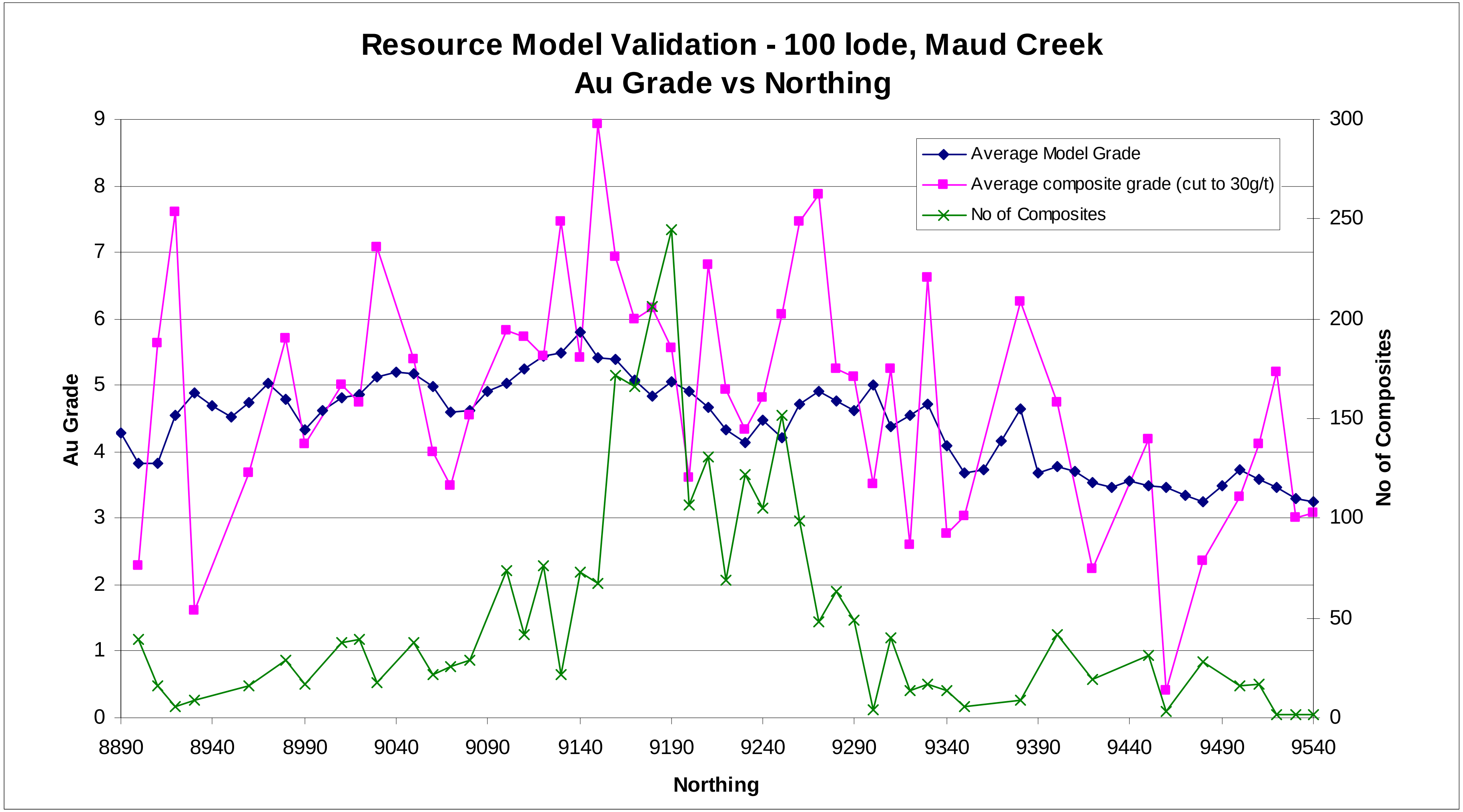


Figure 6.4 Au Grade vs Northing validation plot – 100 lode, Maud Creek deposit

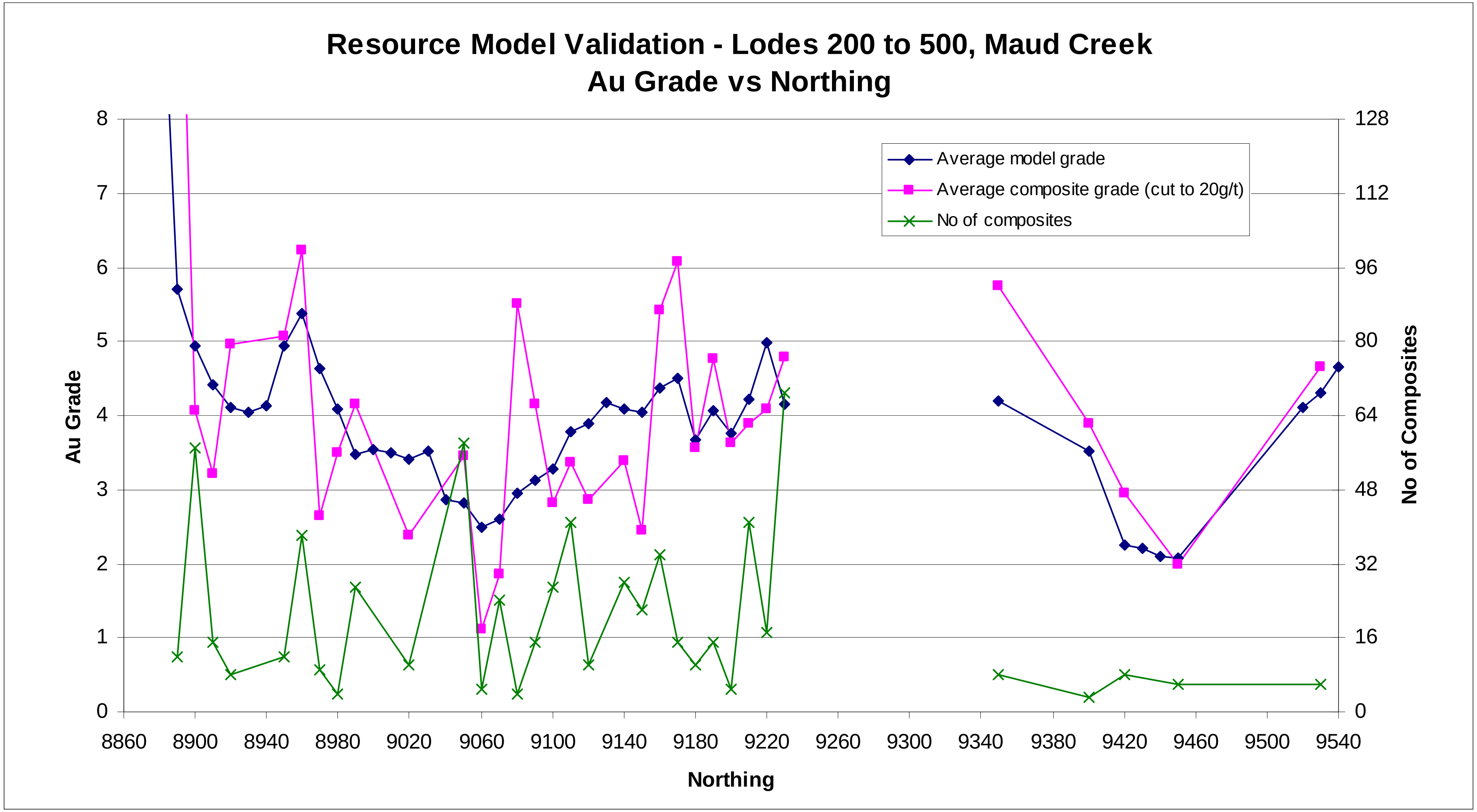


Figure 6.5 Au Grade vs Northing validation plot – Lodes 200 to 500, Maud Creek deposit

7 RESOURCE CLASSIFICATION AND REPORTING

The Maud Creek model resource has been classified into Indicated and Inferred categories according to the JORC code, using a combination of kriging variance, drilling density and confidence in grade continuity between drill sections. An Inferred category was applied to the 500 lode, as few drillhole intercepts are located within this lode, and there is uncertainty in lode continuity with poor definition by drilling. Blocks within these solids were interpolated by drillhole data on single sections without supporting composite data along strike, and given the small, discontinuous nature of these solids, an Inferred category was considered appropriate for these blocks. All other lodes were classified on the basis of kriging variance.

The kriging variance is used as an objective measure of the geostatistical confidence in a given block, and represents the value of the squared error between the actual grade and the estimated grade generated by the kriging process. It is dependent on a number of criteria, including block size, internal block discretisation, sample numbers and the variogram parameters but is independent of the actual grade. Thus, using the Maud Creek variography as a guide, blocks for the Maud Creek deposit were suitable to be classified as Indicated if they were spaced approximately within 40m along-strike from drillholes, and 20m down-dip between drillholes. An Inferred classification is appropriate for those blocks located more than 40m along-strike from drillholes, and greater than 20m down-dip between drillholes. The ranges above represent a guideline only for the classifications, and actual ranges used to determine the threshold between Indicated and Inferred blocks were applied to modified distances from those above, using the spatial distribution of composite data as an additional guideline.

The classified Mineral Resource is reported in Table 7.1 as at 16th April 2003. A default density of 2.8t/m^3 was used in reporting of model tonnage and grades.

Lode	Category	Volume	Tonnage	OK Au g/t
100	Indicated	957,111	2,679,911	5.00
	Inferred	399,459	1,118,485	4.16
200	Indicated	116,010	324,827	3.43
	Inferred	276,950	775,461	3.43
300	Indicated	16,050	44,940	8.16
	Inferred	52,298	146,433	8.18
400	Indicated	56,573	158,404	3.78
	Inferred	121,238	339,467	3.86
500	Inferred	35,136	98,382	3.83
Total Indicated		**1,145,744**	**3,208,083**	**4.82**
Total Inferred		**885,081**	**2,478,227**	**4.11**
GRAND TOTAL		**2,030,824**	**5,686,308**	**4.51**

Table 7.1 Maud Creek Classified Mineral Resource as at 16th April 2003

Table 7.2 below outlines the sub-division of the Maud Creek resource by weathering category into oxide, transitional and fresh materials, both within the current open pit and below/outside the pit. A bench RL of 110mRL was used as the base of oxide, with 95mRL used to define the top of the fresh material zone.

Area	Material	Volume	Density	Tonnage	Au Grade
WITHIN PIT	Oxide	12,681	2.8	35,507	5.49
	Transitional	15,516	2.8	43,445	6.84
	Fresh	2,360	2.8	6,608	7.58
	Sub-total	**30,557**	**2.8**	**85,560**	**6.34**
BELOW & OUTSIDE PIT	Oxide	3,632	2.8	10,169	5.78
	Transitional	24,006	2.8	67,217	4.94
	Fresh	1,972,630	2.8	5,523,363	4.48
	Sub-total	**2,000,267**	**2.8**	**5,600,748**	**4.48**
GRAND TOTAL:		**2,030,824**	**2.8**	**5,686,308**	**4.51**

Table 7.2 Maud Creek Resource by weathering category as at 16th April 2003

A breakdown of this model resource by bench, and also by Au grade and classification category within each bench is included as Appendix 1.

Figure 7.1 illustrates the grade-tonnage relationship for all combined lodes for Maud Creek at a range of cut-off grades, to test the sensitivity of the model to the cut-off grade applied. Cutoff grades are bracketed next to points representing the tonnage and average grade applicable at these cut-off grades.

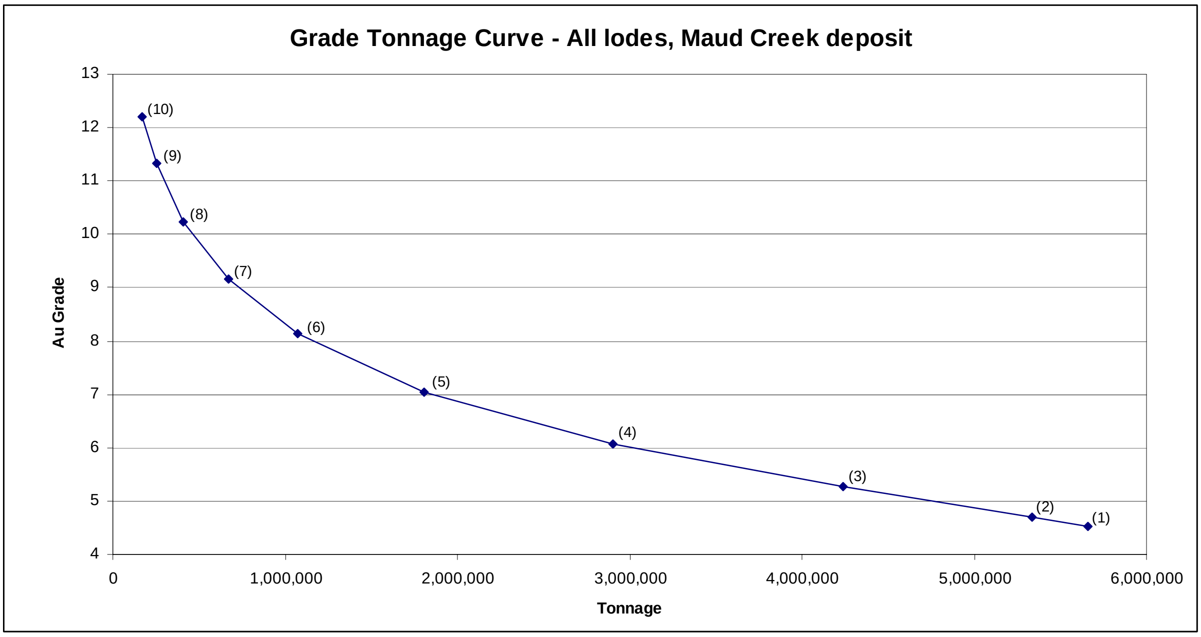


Figure 7.1 Grade Tonnage Curve for all lodes, Maud Creek deposit

8 RECOMMENDATIONS

A number of recommendations are made, in light of the completed resource model for Maud Creek, including infill drilling, additional drilling to extend and link wireframes, and improved solids modelling.

The current average drilling density of 10m along-strike and 20m across-strike at Maud Creek is sufficient for an Indicated and Inferred classification of the orebody, following JORC guidelines. However, the irregular drill spacing, particularly in the down-dip direction, has created problems in representative grade interpolation. In addition, the effects of across-lode and along-strike variability are difficult to constrain with the current data levels and drill spacing. It is recommended that infill drilling is carried out on existing drill-lines, to provide information down-dip, and to infill uninformed areas at depth. The benefits of this infill drilling are summarised as follows:

- increased size of the composite database;
- reduced effects of across-lode and along-strike grade variability;
- verification of high grade areas within the orebody eg sections 9855E, 9930E, 10080E;
- improved quality of variograms, particularly those down-dip;
- scope for Measured classification of the orebody; and
- more robust wireframes.

The quality of variograms modelled for Maud Creek is fair in the along-strike and downhole directions; however, variography is particularly poor in the down-dip direction, with erratic, unreliable variograms present. The current variogram structures for the three principal directions are adequate for an Indicated and Inferred classification of the Maud Creek orebody, however, an increased short-range definition of spatial continuity is required in order to potentially achieve a Measured classification of the orebody. Infill drilling as described above would provide a more robust dataset for variography analysis, and increase confidence in variogram parameters.

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