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MINERAL RESOURCE EVALUATION OF A PLATINUM TAILINGS RESOURCE: A CASE STUDY.

by

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ABSTRACT

The project investigated the application of geostatistical techniques in evaluating a mechanically deposited platinum tailings resource. The project was undertaken on one of the Anglo American Platinum tailings dams, the identity of which cannot be revealed, due to the agreement in place or permission given.

Remnant unrecovered minerals of economic potential still exist in tailings dams. These unrecovered minerals have influenced several mining companies to turn their attention to the economic potential that still exists in tailings, making them a key strategic component of their resources and reserves.

Geostatistics has been developed and thoroughly tested or improved to address challenges experienced in estimating *in situ* geological ore bodies. The main aim of this Research Project is to test whether these fundamental principles and theories of geostatistics are relevant and appropriate in evaluating man-made ore bodies, such as a Platinum tailings dam, without any significant changes needed on the underlying principles or estimation algorithms. The findings on the Case Study tailings resource can be applied in the evaluation of other tailings dams, as well as any other man-made structures such as low grade rock dumps, muck piles, with related characteristics.

A standard approach (methodology) was followed to evaluate the Case Study tailings resource. Drilling and sampling was conducted through sonic drilling. It is a dry drilling technique that is suitable for sampling unconsolidated particles such as tailings. Thereafter,

samples were sent to the laboratory to establish grade (concentration) of Platinum Group Metals (Platinum, Palladium and Rhodium), Gold and Base Metals (Copper and Nickel). Density was also measured, and comprehensively analysed as part of variables of interest in this research.

Statistical analyses were performed on all variables of interest contained in the dam: which are Platinum (Pt), Palladium (Pd), Gold (Au), 3E (two PGMs plus Gold), Copper (Cu), Nickel (Ni) and Density. The underlying statistical distributions of all metals and density were found to be non-symmetrical and slightly positive skewed. The skewness of the distributions was established to be marginal. Differences between raw data (untransformed) averages and the log-normal estimates were analysed and found to be insignificant. As such Ordinary Kriging of untransformed data was concluded to be the appropriate geostatistical technique for Case Study tailings resource.

Analysis of mineralisation continuity (variography), a pre-requisite for geostatistical techniques such as Ordinary Kriging applied on the case study tailings resource, was also performed. Reasonable and sufficient mineralisation continuity was established to exist in the Case Study tailings resource. Although characterised by high nugget effect, these spatial correlations were established to be continuous with ranges of influence well beyond 450 m in all variables. Anisotropic variograms were modelled for all variables and are comprised of nested structures with two to three spherical models.

Resource estimation was conducted through Ordinary Kriging in Datamine. All the seven variables were successfully interpolated into each cell of the 5m x 5m x 5m block model.

Rigorous validation of the resource model was performed to establish the quality and reliability of the estimation carried out. Estimated resource model was analysed against the original borehole data, through comparison of grade profiles, statistical analysis, QQ Plots and histograms.

The grade profile was recognised to be similar between boreholes (5 m composites) and the adjacent cells that have been estimated. Furthermore, statistical analyses revealed minimal differences between means of the estimated model and the original borehole data: the highest difference being 1.7% realised on 3E, followed by 1.1% on Density and Gold (Au). The rest of the variables (Pt, Pd, Cu, and Ni) have differences that are below 1%.

QQ plots and histogram were plotted from resource model with 5m x 5m x 5m cells and 5 m composited boreholes. Although these data sets are of different (slightly incompatible) supports, the intended purpose of comparing distributions was achieved. QQ plots and histograms revealed approximately identical shaped distributions of the two data sets, with some minor deviations noticeable in graphs of only two variables (Au and Density) that are underlain by two populations.

The validation process carried out gave a compelling assurance on the quality and reliability of the resource model produced. The Case Study tailings resource therefore is successfully estimated by Ordinary Kriging.

The results achieved on the Case Study tailings dam has successfully proved that geostatistical principles and theories can confidently be applied, in their current form or understanding, to any man-made tailings resource.