ESTIMATION OF MINERAL RESOURCES & MINERAL RESERVES

BEST PRACTICES GUIDELINES

Guidelines Specific to Particular Commodities

Rock Hosted Diamonds

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Preamble

Diamonds are produced commercially from intrusive rock, consisting of kimberlite and lamproite, and from alluvial and marine placer deposits. These guidelines apply to rock deposits; the term "diamonds" herein refers to natural diamonds; "diamond deposits" refers to diamonds hosted in kimberlite and lamproite rocks; and "diamonds" and "stones" are interchangeable.

The CIM Best Practices General Guidelines for other commodities are also applicable to diamond deposits, however, because of diamond's distinguishing aspects, additional guidelines are appropriate as published in the CIM Guidelines for the Reporting of Diamond Exploration Results and these Best Practice Guidelines for estimating Mineral Resources and Mineral Reserves (MRMR).

Diamonds differ from other minerals. Firstly, they occur as discrete particles in concentrations as low as parts per billion. Secondly, the release of diamonds from the kimberlite or lamproite host rock is a function of the excavation and treatment process. Thirdly, the value of diamonds varies from deposit to deposit and varies with stone size within a given deposit. These aspects must be considered when sampling, evaluating the resource and establishing the reserve of a deposit

The product from metallic mineral mines is generally quite liquid in terms of number of potential buyers, and the commodity prices and price structure are published daily. In contrast, most diamonds are valued in the overall market context only 10 times a year in "sights" and the marketing of diamonds is dominated by a small number of organizations. Diamond valuation is more akin to industrial minerals valuation in that process recovery is important at the "assay stage", the impact on price of new goods arriving on the market must be evaluated, and product quality must be acceptable to potential buyers.

A further contrast with base and precious metal evaluation is that diamond-bearing rock e.g. kimberlite is often distinctly different form the enclosing country rocks and does not require an assay cut-off since it is the recovery of marketable stones that determine the economics of extraction. The high value of diamond–bearing rock often means that selective mining within a kimberlite unit is not carried out and that host rock dilution may be tolerated in order to maximize kimberlite extraction.

Table 1 summarizes some of the distinctive aspects of diamonds.

Qualified Person (QP)

It is strongly recommended that a QP, as defined in the CIM Standard Definitions for Resources and Reserves, be familiar with, and adhere to, diamond reporting guidelines established by the Diamond Exploration Best Practices Committee of the Canadian Institute of Mining, Metallurgy and Petroleum. The experience of the QP for diamond reporting should conform to the style of deposit.

A QP should be familiar with:

- Kimberlite/lamproite petrology, terminology and diamond indictor mineralogy.
- Equipment and techniques used in diamond resources exploration, delineation and sampling.
- Diamond recovery processing and appropriate adjustments to stone density (i.e. stone frequency/tonne) distributions for standardizing recovery.
- General methods for Quality Assurance (QA) and Quality Control (QC) as well as those specifically applicable to diamonds such as the use of density tracers, laser marked stones and coloured synthetic stones.
- Grade estimation methods for diamonds and appropriate grade adjustments to reconcile mini bulk sampling with bulk sampling.
- Diamond valuation.

Definitions and Units

CIM classification guidelines, Measured, Indicated and Inferred for Mineral Resources and Proven and Probable for Mineral Reserves apply to diamond deposits.

Table 1 Distinctive Aspects of Diamonds

Element	Definition	Comment, Special Attention, Options
Mineral Type	Diamonds	Diamonds require recognition as discrete particles.
Mineral Source	Diamonds are derived from primary (e.g. kimberlite, lamproite, or ultramafic) and secondary (e.g. alluvial, fluvial, or eluvial) sources	Primary and secondary sources are evaluated differently due to genetic differences.
Mineral Properties	Stone size and stone quality	These variables are linked to host material genetics; unique distributions that may vary within the host material are possible.
Mineral Abundance	Carats per dry metric tonne (cpt).	The selection of estimating either carats or stones per unit is the result of statistical evaluation.
Grade Sampling	Samples used to estimate grade model; frequently termed 'bulk-sampling' by drilling, trenching and underground methods.	Determining optimal sample size and spacing requires assumptions of diamond abundance and geostatistics.
Value Sampling	Several thousand carat samples used to estimate value model (e.g. $US per carat).	Value modelling is possible where statistics show the size frequency distribution and/or the value of the stones are unrepresentative; modelling $US per tonne is also possible.
QA/QC	Methodology to produce integrity and quality of results (e.g. employing blanks, duplicates, density beads, marking of stones).	Procedures exist for QA/QC diamond sampling; often QA/QC is very specific to the selected sampling system.
Sample Security	Gains or losses of natural or synthetic stones.	The combination of product concentration, value and large samples require higher security measures relative to other commodities
Sampling Method	A system that collects the sampled medium (e.g. core, chips, cuttings, muck, loose or blasted material).	Methods require careful standardization to control the bottom aperture size cut-off and to quantify breakage.
Sample Treatment	Technology used to liberate then recover stones from host material (e.g. dense media separation, pans, x-rays, grease tables, hand or mechanical sorting).	Methods require careful standardization to control the bottom aperture size cut-off and to quantify breakage
Mineral Damage	Natural and induced stone damage including breakage.	Natural stone breakage is inherent to most diamond populations; breakage induced by sampling method and/or treatment requires evaluation. Stone damage can also occur without breakage yet still lead to a reduction in value.

All diamond weights should be reported in carats. A carat is one fifth of a gram. Diamond value is defined as $US per carat.

When expressing grade of a Mineral Resource or Mineral Reserve, the bottom cut-off of the recovery plant and the nature (square, round or slotted) and size of the screen must be given e.g. 1 mm nominal square mesh.

Expressing carats retained on a particular sieve brand or by sieve name is not recommended in order to eliminate size ambiguity. Sieve size should be expressed in terms of mesh opening in millimeters and should specify mesh dimensions. The terms micro-diamond and macro-diamond should not be used when stating a resource or reserve estimate to eliminate confusion in the use of these terms.

Resource Database

Resource databases typically contain data from delineation drilling, large diameter drilling and surface and underground bulk sampling. Relatively large drill hole diameters or long sample intervals are needed to capture a statistically adequate number of stones. Fewer holes may be drilled and fewer samples collected as a result of the expense of drilling and processing the large samples. The QP should be satisfied that the design of the sampling program and amount of sampling is appropriate to the scale and the diversity of host rock facies and related stone densities and grades, the irregularity of contacts and degree of country rock inclusion and dilution of the primary host rock.

A typical diamond database therefore has relatively few samples from which to estimate grade and delineation holes may or may not be sampled for diamonds and may only be in sufficient number to provide a reasonable outline of host body contacts. Bulk sampling results may only be available from portions of the host body but should be as representative as possible of identified diamond bearing phases or facies of the host intrusive.

Mining of bulk samples from pits or underground workings is generally undertaken to confirm smaller bulk samples from drilling and to provide sufficient stones for market valuation.

For fissure evaluation, bulk sampling may have to be extensive since narrow widths may not allow drilling to recover a sufficient number of stones in samples to be representative of grade.

Testing and Analysis

Independent diamond recovery facilities should be named and any accreditation given. Depending on the sample size, sampling for diamonds may include an in-house pilot

diamond treatment facility. In-house facilities should be reported where used and should conform to CIM guidelines for sample QA and QC.

The QP should account for the relationship that exists between sample collection type (drilling, trenching, drifting etc.) and the selected method(s) of sample treatment (dense media separation, x-ray, grease table, hand sorting) in a pre-development (pilot) diamond treatment facility with regard to diamond recoveries, breakage and losses.

Results of total dissolution methods should not be used for MRMR estimation unless they are supported by bulk sampling and/or mining that has demonstrated diamonds of commercial size exist, and that a reasonably consistent relationship (size distribution) can be shown to exist between dissolution-recovered diamonds and plant-recoverable stones.

Geological Interpretation and Modelling

Similar to other mineral deposits, diamonds may occur at differing grades, (stone size distribution and stone densities) and quality related to separate phases or facies within host rock intrusives. It is fundamental to a MRMR estimate, that the QP establish a valid geological interpretation of the host rock facies and related diamond stone density and stone size distribution characteristics, and determine a geological model for the host intrusion (pipe, fissure, fissure-blow complex etc.).

Mineral Resource Estimation

The General Guidelines of the Estimation of Mineral Resources and Mineral Reserves document apply to diamond deposits. In addition, the following guidelines apply as generalized resource estimation methodology for diamond deposits:

- The QP should verify the system of identifying and eliminating gains and losses of natural diamonds to samples due to contamination (both natural and synthetic), as well as the integrity of collection systems from acquisition, liberation to final recovery. Any adjustments to size distribution and stone density data that is necessary to reconcile plant recoveries should be reported.
- The QP should determine optimum sample size and interpolator e.g. stone density or grade in carats per tonne.
- The value of diamonds is fundamental to resource estimation, however, it may not be known with accuracy at any given time. At the resource estimation stage at least a preliminary valuation of a representative parcel of diamonds should be completed to comply with the CIM resource definitions requirement that the resource has economic potential. The QP should ensure that the diamond value used in a MRMR estimate is in line with available pricing information and that a valuation and model of an appropriate sized parcel of representative diamonds has been made by a reputable expert in diamond valuation.
- Issues relevant to the reporting of diamond exploration results apply equally to reporting diamond Mineral Resources (Table 2). It is accepted that data may not be available in support of all the criteria summarized in Table 2.

Table 2 REPORTING OF DIAMOND RESOURCES
(Adapted from SAMREC*, 2006, Table 2)

CRITERIA	EXPLANATION
Geology.	Demarcated area of potential. Relative priority of target. Petrology and petrography, geochemistry, geochronology and mineralogy. Ore/waste contact model, emplacement model, facies model and waste model. Diamond paragenesis.
Geotechnical.	Geotechnical bore holes with orientation and hydrology. Logging in terms of structure. Weathering test and hydrological parameter model. Selection of core for physical parameter testing. Slope and initial mine design.
Grade estimation.	Bulk sampling results, global grade per facies. Spatial structure analysis and grade distribution. Stone size and number distribution per facies. Sample headfeed and tailings particle granulometry. Sample bulk density determination. Percent concentrate and undersize per sample. Grade with change in Bottom Cut-off Screen Size. Geostatistical techniques applied.
Value estimation.	Diamonds parceled per facies or depth. Valuation per parcel, parcel value and size distribution. Estimation of value with size. Diamond breakage. Average US$/carat and US$/tonne value with change in bottom cut-off. Diamond valuation to be done by internationally accepted valuator.
Resource volume.	Geological model by facies, volume and bulk density per facies, bench or estimation block. Dilution per facies. Number of lithological intersections for each facies and contact definition.
Metallurgy.	Conceptual plant design. Comminution characteristics, per facies or globally. Recrush, Top, Middle and Bottom Cut-off Screen Size. Reference ore dressing studies.
Classification.	State classification of resource in view of level of information. Take account of most important characteristics, geological, grade, size distribution, value, sample treatment, spatial sampling density and estimation. Results of spatial simulation, non-conditional or conditional. Magnitude of grade, value and average diamond size differential between facies.

*South African Code For Reporting of Mineral Resources and Mineral Reserves

Mineral Reserve Estimation

In estimating a Mineral Reserve, the preceding guidelines for estimating a Mineral Resource, and the CIM Best Practices General Guidelines of the Estimation of Mineral Resources and Mineral Reserves document apply. Diamond value estimation is a key factor in the reserves estimate for a diamond deposit and valuation of a significantly-sized and statistically representative parcel of diamonds should be carried out and reported by a suitably qualified expert. Grade and diamond value are integral to establishing mining cut-off grade.

The QP responsible for applying process system diamond size, quality, and quantity recovery efficiencies should consider the relationship that exists between the resource grade from a pilot facility or laboratory and the reserve grade.

Diamond Valuation

The value per carat is of critical importance in demonstrating project value and estimating MRMR. Assessment of the diamond assortment (the shape, colour, and size mix of stones in the run-of–mine population) and average diamond value should be based an adequate parcel size. The minimum representative size of the valuation parcel depends on the characteristic stone size distribution and quality of stones in the deposit, however, empirical experience indicates that parcels of at least 3,000 to 5,000 carats are necessary to achieve reasonable valuation.

During the early stage of project evaluation, an average diamond value may be based on smaller sized parcels. In such cases, the valuator may model the diamond size distribution and/or the diamond value per sieve class to obtain a more representative average diamond value. If the diamond value is modelled, then the method of modelling should be described, any adjustment for stone size and value reported, and a quantitative or qualitative assessment of confidence in the value estimate given.

Caution should be expressed when an average diamond value is based on small parcels since very large stones in the diamond size distribution may not be represented and insufficient stones may be present to adequately estimate the diamond value of medium and large stones which contribute most to the average diamond value.

Diamond valuation should involve the assistance of a creditably sized diamond producer, or an accredited Government Diamond Valuator currently providing service for a diamond producing country, or an experienced, reputable independent valuer. The CIM committee acknowledges that exploration companies will not necessarily want to show their diamonds to another producer since the data is commercially sensitive. The most important aspect of selecting valuation assistance or an independent valuation is the capability of modelling the values received in order to generate an average price estimate. The QP should confirm that the diamond parcel valued is complete and, in all respects, representative of the recovered sample, that industry standard QA/QC procedures have been followed and a valuation report by a suitable industry expert has been prepared. Such valuation reports include:

- Details of parcel valued, number of valuations, number of stones, carats and bottom size cut-off per geological domain or depth.
- Average $/carat and $/tonne value at the selected bottom size cut-off.
- The average price (US$ per carat) of the parcel, the overall weight (carats) and value (US$) of the parcel.
- The lower cut-off size of the parcel valued, the number of valuators used to generate the average value estimate.

- The method used to calculate the average price (rejection of outliers etc).
- The basis of the value estimation.
- The dates on which market price estimates were obtained.
- The qualitative opinion of the uncertainty envelope of the result reflecting:
    - Variation between individual valuations.
    - The effects of parcel size.
    - The effects of a truncated or biased diamond size/weight distribution.
    - The impact of diamond breakage and damage.
    - The impact of market volatility.

Natural (pre-existing) diamond breakage is a feature common to primary diamond deposits inherent from the emplacement process. During the characterization of diamond samples for grade and value studies to determine reasonable prospects for extraction, the QP must report results of any diamond breakage studies where mechanical breakage is a modifying factor in the diamond population.

Value of individual stones constituting more than 5% of the overall value of the parcel should be reported separately.

Modelling of commercial grades and prices is progressively more uncertain with smaller parcels of diamonds. The calculation and disclosure of confidence limits is of prime importance in conveying their meaning. When modelling of sample results to project commercial "grade", the QP should explain the methodology and state the confidence envelope on the estimate at a prescribed confidence level as well as the lower cut-off size for the grade estimate. Modelling to estimate likely values for commercial production should be carried out, and reported in writing, by a reputable, qualified expert explaining the modelling methodology, stating the lower cut-off size and confidence envelope of the modelled price.

Reporting

The QP reporting on a MRMR estimate of a diamond deposit should make the reader aware of database limitations and economic considerations including diamond valuation. With respect to the database, the adequacy of diamond specific sampling procedures, types of equipment employed, recovery plant design, minimum (bottom) and top cut screen sizes and crushing characteristics for mini bulk and mined bulk samples and any other pertinent characteristics should be clearly elucidated. Economic considerations with respect to diamond valuation and pricing, market supply/demand projections or constraints to marketing, political concerns and permitting may be of special significance for a diamond deposit. Grade measurements and declarations in carats per dry metric tonnes are recommended for primary deposits. The practice of expressing grades in carats per hundred tonnes should be avoided for reporting MRMR. Table 3 summarizes Mineral Reserves reporting criteria.

Reconciliation of Mineral Reserves

In reconciling a Mineral Reserve estimate with mine-mill production, the General Guidelines of the Estimation of Mineral Resources and Mineral Reserves apply. Reconciliation for diamonds may not be possible on an annual basis depending on production rate, grade the diamond size distribution and diamond value. In some cases, production data for several years may be needed for meaningful reconciliation of reserves.

Selected References

The Committee considers that there are a number of documents and publications which are essential or useful in dealing with best practice requirements for the estimation of MRMR.

CIM Exploration Best Practice Guidelines

CIM Guidelines for the Reporting of Diamond Exploration Results

CIM Standards on Mineral Resources and Reserves – Definitions and Guidelines. Prepared by the CIM Standing Committee on Reserve Definitions, October 2000.

CIM Definition Standards on Mineral Resources and Mineral Reserves, November 27, 2005.

National Instrument 43-101 Standards for Disclosure of Mineral Projects

South African Code For Reporting of Exploration Results, Mineral Resources and Mineral Reserves (The SAMREC Code, 2006 Edition)

South African Code For Reporting of Mineral Resources and Mineral Reserves (The SAMREC Code, March 2000)

The Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves (JORC Code, 2004 edition)

Table 3 REPORTING OF DIAMOND MINERAL RESERVES
(Adapted from SAMREC*, 2006, Table 2)

CRITERIA	EXPLANATION
Geotechnical.	State all slope angles per facies. If underground mine, specify draw control strategy.
Mine planning.	Define business plan strategy and life of mine plan. Mining methods considered. Mineability of facies. Capital cost estimates. Working cost estimates and contractor strategy. Revenue per facies with depth and block contributions. Mining efficiency and dilution factors. Pit optimization. Underground plan. Ore blending, mine stockpile strategy. Environmental constraints. Waste disposal. Machine replacement plan. Closure plan. Risk analysis.
Metallurgy.	Plant location and design. Recovery factors per facies. Comminution factors per facies. Plant capital and operating costs. Stockpile/tailings strategy per facies. Current treatment flow sheet. Treatment rates per facies. Ore blending definitions, all facies. Head feed tonnage. Gangue composition and behavior. Preliminary mine planning collaboration.
Cost and revenue.	Cost and Revenue models per facies.
Market aspects.	Contracts.
Classification.	Identify Mineral Reserve. Identify high and low risk areas. Specify reasons for high/low risk. Identify Probable and Proven Diamond Mineral Reserves. List items needing more info for reclassification from Probable to Proven Diamond Mineral Reserves. List items that could possibly change Diamond Mineral Reserves from Proven to Probable.

*South African Code For Reporting of Mineral Resources and Mineral Reserves