

**CANADIAN INSTITUTE OF MINING,  
METALLURGY AND PETROLEUM**

**CIM STANDARDS ON  
MINERAL RESOURCES AND RESERVES**

*DEFINITIONS AND GUIDELINES*

**Prepared By The  
CIM Standing Committee  
On Reserve Definitions**

**Presented to CIM Council August 19, 2000**

## **INTRODUCTION**

The Committee's proposed standards establish definitions and guidelines for the reporting of Exploration Information, Mineral Resources and Mineral Reserves in Canada and are identified as the "CIM Standards" and referred to as such hereafter in this document. To provide additional clarification to Qualified Persons, guidelines have been included with the respective definitions. All definitions are printed in bold text, whereas the guidelines are printed in italics. The CIM Standards are applicable to all minerals including industrial minerals, diamonds and other gemstones. Reserve definitions for bitumen, natural gas and oil are not included in these Standards. The CIM Standards are not intended to cover mineral inventory estimates that will be reported to government agencies.

## **CIM STANDARDS**

The CIM Standards presented herein provide guidelines for the classification of Mineral Resource and Mineral Reserve estimates into various categories. The category of an estimate implies confidence in the geological information available on the mineral deposit; the quality and quantity of data available on the deposit; the level of detail of the technical and economic information which has been generated about the deposit, and the interpretation of the data and information.

## **HISTORY**

The Canadian Institute of Mining, Metallurgy and Petroleum (CIM) published "Mineral Resource Reserve Classification: Categories, Definitions, and Guidelines" in September 1996. This report, prepared by the CIM Ad Hoc Committee on Reserve Definitions, is now widely used as a reference and a system for classifying and reporting Resources and Reserves in Canada. Since the publication of that report there have been several meetings sponsored by the Council of Mining and Metallurgical Institutes (CMMI) of which CIM is a member, to develop a Resource/Reserve classification, definition and reporting system that would be similar in Australia, Canada, Great Britain, South Africa and the United States.

The recent history of the development of Resource and Reserve definitions in Canada was discussed in the Ad Hoc Committee Report and is summarized as follows:

- The most widely accepted Canadian reserve classification system through the period 1970 to date has been the one required by the Canadian Securities Administrators (CSA) under National Policy 2-A.
- Geological Circular 831, Principles of a Resource/Reserve Classification for Minerals, which was published in 1980 by the U.S. Bureau of Mines and the U.S. Geological Survey, introduced a classification system that distinguished between resources and reserves.
- The Australian Code for Reporting of Identified Mineral Resources and Ore Reserves (the JORC code), first published in 1989, was similar to the U.S. system in structure but included some important modifications, particularly by including reference to the competence of the person responsible for a resource or reserve estimate. This code prescribed reporting requirements.
- In 1991, CIM, through its Mineral Economics Society, formed a Special Committee on Reserve Definitions. The report of the Special Committee was presented to CIM Council in May 1994 and published in October 1994. In June 1994, CIM established an Ad Hoc Committee to review and revise the Special Committee Report.
- The Society of Mining Engineers in the United States issued “A Guide for Reporting Exploration Information, Resources and Reserves” in 1994.

The Ad Hoc Committee report was accepted by CIM Council in February 1996 and at that time Council established a Standing Committee (the Committee) on Reserve Definitions administered by the Mineral Economics Society. The Ad Hoc Committee Report was published in the September 1996 CIM Bulletin.

In 1993, CMMI sponsored an initiative to obtain consensus on the resource/reserve definitions used in Australia, Canada, Great Britain, South Africa and the United States. The CMMI reserve definition committee met in 1994 and again in November 1997 in Denver, Colorado. At the

Denver meeting in 1997, the representatives agreed on definitions for the major Mineral Resource and/or Reserve categories. The proposed CMMI definitions were published in the CIM Bulletin in February 1998.

The Australasian Institute of Mining and Metallurgy (AusIMM) and the Joint Ore Reserves Committee (JORC) of the AusIMM, the Australian Institute of Geoscientists and the Minerals Council of Australia published a revised draft JORC Code in July 1998. This document proposed the use of the CMMI definitions, with some wording changes. In January 1999, the JORC Code was published, to take effect in September 1999. The SME published revised definitions in January 1999 which follows the CMMI definitions. These definitions have not been adopted for use in the United States by the Securities and Exchange Commission, at this point.

The United Nations Economic Commission for Europe (UN-ECE) published a “United Nations International Framework – Classification for Reserves/Resources” in November 1996. This report is very complex and utilizes ten different categories for classifying resources and reserves. In October 1998, CMMI and UN-ECE representatives met and agreed to use the CMMI definitions in the UN-ECE classification system for the five categories of resources and reserves with the UN-ECE definitions for the remaining UN-ECE categories being retained and used for reporting national mineral inventories.

In Canada in June 1997, the Ontario Securities Commission (OSC) and the Toronto Stock Exchange (TSE) established the Mining Standards Task Force (MSTF). The MSTF released a draft report in June 1998 and a final report entitled “Setting New Standards” in January 1999. One of the primary recommendations of the MSTF Report was the “adoption, by the Canadian Securities Administrators in National Instrument 43-101, of the CIM guidelines for the estimation, classification and reporting of resources and reserves, as amended from time to time”. On July 3, 1998, the Canadian Security Administrators (CSA) published a first draft of National Instrument 43-101 (NI 43-101) as the replacement for National Policy 2-A and National Policy 22. A second draft was published on March 27, 2000. The CIM and the CIM Standing

Committee have provided substantial commentary on the 43-101 drafts, particularly in the area of Mineral Resource and Mineral Reserve definitions.

The following proposed CIM standards include many significant changes to the CIM Ad Hoc Committee Report including the inclusion of modified CMMI definitions for Resource and Reserve categories and the elimination of the Possible Reserve category. In addition, these proposed standards have used the JORC Code description material for guidelines for reports that include discussion of tonnage and grades of mine fill, stockpiles, remnants, pillars and low grade mineralization with appropriate modifications. The proposed CIM Standards also reference Paper 88 –21 of the Geological Survey of Canada for the reporting of coal resources and reserves and the report, Reporting of Diamond Exploration Results, Identified Mineral Resources and Ore Reserves published by the Association of Professional Engineers, Geologists and Geophysicists of the Northwest Territories.

## **DEFINITIONS**

Throughout the CIM Standards, where appropriate, ‘quality’ may be substituted for ‘grade’ and ‘volume’ may be substituted for ‘tonnage’

### **Qualified Person**

Mineral Resource and Mineral Reserve estimates and resulting Technical Reports must be prepared by or under the direction of, and dated and signed by, a Qualified Person.

**A “Qualified Person” means an individual who is an engineer or geoscientist with at least five years of experience in mineral exploration, mine development, production activities and project assessment, or any combination thereof, including experience relevant to the subject matter of the project or report and is a member in good standing of a Self-Regulating Organization.**

*The Qualified Person(s) should be clearly satisfied that they could face their peers and demonstrate competence and relevant experience in the commodity, type of deposit and situation*

*under consideration. If doubt exists, the person must either seek or obtain opinions from other colleagues or demonstrate that he or she has obtained assistance from experts in areas where he or she lacked the necessary expertise.*

*Determination of what constitutes relevant experience can be a difficult area and common sense has to be exercised. For example, in estimating Mineral Resources for vein gold mineralization, experience in a high-nugget, vein-type mineralization such as tin, uranium etc. should be relevant whereas experience in massive base metal deposits may not be. As a second example, for a person to qualify as a Qualified Person in the estimation of Mineral Reserves for alluvial gold deposits, he or she would need to have relevant experience in the evaluation and extraction of such deposits. Experience with placer deposits containing minerals other than gold, may not necessarily provide appropriate relevant experience for gold.*

*In addition to experience in the style of mineralization, a Qualified Person preparing or taking responsibility for Mineral Resource estimates must have sufficient experience in the sampling, assaying, or other property testing techniques that are relevant to the deposit under consideration in order to be aware of problems that could affect the reliability of the data. Some appreciation of extraction and processing techniques applicable to that deposit type might also be important.*

*Estimation of Mineral Resources is often a team effort, for example, involving one person or team collecting the data and another person or team preparing the Mineral Resource estimate. Within this team, geologists usually occupy the pivotal role. Estimation of Mineral Reserves is almost always a team effort involving a number of technical disciplines, and within this team mining engineers have an important role. Documentation for a Mineral Resource and Mineral Reserve estimate must be compiled by, or under the supervision of, a Qualified Person(s), whether a geologist, mining engineer or member of another discipline. It is recommended that, where there is a clear division of responsibilities within a team, each Qualified Person should accept responsibility for his or her particular contribution. For example, one Qualified Person could accept responsibility for the collection of Mineral Resource data, another for the Mineral*

*Reserve estimation process, another for the mining study, and the project leader could accept responsibility for the overall document. It is important that the Qualified Person accepting overall responsibility for a Mineral Resource and/or Mineral Reserve estimate and supporting documentation, which has been prepared in whole or in part by others, is satisfied that the other contributors are Qualified Persons with respect to the work for which they are taking responsibility and such persons are provided adequate documentation.*

### **Preliminary Feasibility Study**

The CIM Standards describe completion of a Preliminary Feasibility Study as the minimum prerequisite for the conversion of Mineral Resources to Mineral Reserves.

**A Preliminary Feasibility Study is a comprehensive study of the viability of a mineral project that has advanced to a stage where the mining method, in the case of underground mining, or the pit configuration, in the case of an open pit, has been established, and where an effective method of mineral processing has been determined. This Study must include financial analysis based on reasonable assumptions of technical, engineering, operating, and economic factors and evaluation of other relevant factors which are sufficient for a Qualified Person acting reasonably, to determine if all or part of the Mineral Resource may be classified as a Mineral Reserve.**

### **Exploration Information**

**For the purposes of this report, Exploration Information is a term used to describe information derived from initial activities undertaken to locate and investigate a prospect or deposit and resulting estimates of tonnage and grade that cannot be classified as a Mineral Resource or a Mineral Reserve. If a Qualified Person reports Exploration Information in the form of tonnage and grade, it must be clearly stated that these estimates are conceptual or order of magnitude.**

*It is recognized that in the review and compilation of data on a project or property, previous or historical estimates of tonnage and grade, not meeting the minimum requirement for Mineral Resources, may be encountered. If these estimates are referenced, it must be clearly stated that these estimates are order-of-magnitude and expressed so as not to misrepresent them as an estimate of Mineral Resources or Mineral Reserves.*

### **Mineral Resource**

*Mineral Resources are sub-divided, in order of increasing geological confidence, into Inferred, Indicated and Measured categories. An Inferred Mineral Resource has a lower level of confidence than that applied to an Indicated Mineral Resource. An Indicated Mineral Resource has a higher level of confidence than an Inferred Mineral Resource but has a lower level of confidence than a Measured Mineral Resource.*

**A Mineral Resource is a concentration or occurrence of natural, solid, inorganic or fossilized organic material in or on the Earth's crust in such form and quantity and of such a grade or quality that it has reasonable prospects for economic extraction. The location, quantity, grade, geological characteristics and continuity of a Mineral Resource are known, estimated or interpreted from specific geological evidence and knowledge.**

*The term Mineral Resource covers mineralization and natural material of intrinsic economic interest which has been identified and estimated through exploration and sampling and within which Mineral Reserves may subsequently be defined by the consideration and application of technical, economic, legal, environmental, socio-economic and governmental factors. The phrase 'reasonable prospects for economic extraction' implies a judgement by the Qualified Person in respect of the technical and economic factors likely to influence the prospect of economic extraction. A Mineral Resource is an inventory of mineralization that under realistically assumed and justifiable technical and economic conditions, might become economically extractable. These assumptions must be presented explicitly in both public and technical reports.*

### **Inferred Mineral Resource**

**An ‘Inferred Mineral Resource’ is that part of a Mineral Resource for which quantity and grade or quality can be estimated on the basis of geological evidence and limited sampling and reasonably assumed, but not verified, geological and grade continuity. The estimate is based on limited information and sampling gathered through appropriate techniques from locations such as outcrops, trenches, pits, workings and drill holes.**

*Due to the uncertainty which may attach to Inferred Mineral Resources, it cannot be assumed that all or any part of an Inferred Mineral Resource will be upgraded to an Indicated or Measured Mineral Resource as a result of continued exploration. Confidence in the estimate is insufficient to allow the meaningful application of technical and economic parameters or to enable an evaluation of economic viability worthy of public disclosure. Inferred Mineral Resources must be excluded from estimates forming the basis of feasibility or other economic studies.*

### **Indicated Mineral Resource**

**An ‘Indicated Mineral Resource’ is that part of a Mineral Resource for which quantity, grade or quality, densities, shape and physical characteristics, can be estimated with a level of confidence sufficient to allow the appropriate application of technical and economic parameters, to support mine planning and evaluation of the economic viability of the deposit. The estimate is based on detailed and reliable exploration and testing information gathered through appropriate techniques from locations such as outcrops, trenches, pits, workings and drill holes that are spaced closely enough for geological and grade continuity to be reasonably assumed.**

*Mineralization may be classified as an Indicated Mineral Resource by the Qualified Person when the nature, quality, quantity and distribution of data are such as to allow confident interpretation of the geological framework and to reasonably assume the continuity of mineralization. The Qualified Person must recognize the importance of the Indicated Mineral*

*Resource category to the advancement of the feasibility of the project. An Indicated Mineral Resource estimate is of sufficient quality to support a Preliminary Feasibility Study which can serve as the basis for major development decisions.*

### **Measured Mineral Resource**

**A ‘Measured Mineral Resource’ is that part of a Mineral Resource for which quantity, grade or quality, densities, shape, physical characteristics are so well established that they can be estimated with confidence sufficient to allow the appropriate application of technical and economic parameters, to support production planning and evaluation of the economic viability of the deposit. The estimate is based on detailed and reliable exploration, sampling and testing information gathered through appropriate techniques from locations such as outcrops, trenches, pits, workings and drill holes that are spaced closely enough to confirm both geological and grade continuity.**

*Mineralization or other natural material of economic interest may be classified as a Measured Mineral Resource by the Qualified Person when the nature, quality, quantity and distribution of data are such that the tonnage and grade of the mineralization can be estimated to within close limits and that variation from the estimate would not significantly affect potential economic viability. This category requires a high level of confidence in, and understanding of, the geology and controls of the mineral deposit.*

### **Mineral Reserve**

*Mineral Reserves are sub-divided in order of increasing confidence into Probable Mineral Reserves and Proven Mineral Reserves. A Probable Mineral Reserve has a lower level of confidence than a Proven Mineral Reserve.*

**A Mineral Reserve is the economically mineable part of a Measured or Indicated Mineral Resource demonstrated by at least a Preliminary Feasibility Study. This Study must include adequate information on mining, processing, metallurgical, economic and other**

**relevant factors that demonstrate, at the time of reporting, that economic extraction can be justified. A Mineral Reserve includes diluting materials and allowances for losses that may occur when the material is mined.**

*Mineral Reserves are those parts of Mineral Resources which, after the application of all mining factors, result in an estimated tonnage and grade which, in the opinion of the Qualified Person(s) making the estimates, is the basis of an economically viable project after taking account of all relevant processing, metallurgical, economic, marketing, legal, environment, socio-economic and government factors. Mineral Reserves are inclusive of diluting material that will be mined in conjunction with the Mineral Reserves and delivered to the treatment plant or equivalent facility. The term ‘Mineral Reserve’ need not necessarily signify that extraction facilities are in place or operative or that all governmental approvals have been received. It does signify that there are reasonable expectations of such approvals.*

#### **Probable Mineral Reserve**

**A ‘Probable Mineral Reserve’ is the economically mineable part of an Indicated, and in some circumstances a Measured Mineral Resource demonstrated by at least a Preliminary Feasibility Study. This Study must include adequate information on mining, processing, metallurgical, economic, and other relevant factors that demonstrate, at the time of reporting, that economic extraction can be justified.**

#### **Proven Mineral Reserve**

**A ‘Proven Mineral Reserve’ is the economically mineable part of a Measured Mineral Resource demonstrated by at least a Preliminary Feasibility Study. This Study must include adequate information on mining, processing, metallurgical, economic, and other relevant factors that demonstrate, at the time of reporting, that economic extraction is justified.**

*Application of the Proven Mineral reserve category implies that the Qualified Person has the highest degree of confidence in the estimate with the consequent expectation in the minds of the*

*readers of the report. The term should be restricted to that part of the deposit where production planning is taking place and for which any variation in the estimate would not significantly affect potential economic viability.*

## **RESOURCE AND RESERVE CLASSIFICATION**

Technical Reports dealing with estimates of Mineral Resources and Mineral Reserves must use only the terms and the definitions contained herein. Figure 1, displays the relationship between the Mineral Resource and Mineral Reserve categories.

The CIM Standards provide for a direct relationship between Indicated Mineral Resources and Probable Mineral Reserves and between Measured Mineral Resources and Proven Mineral Reserves. In other words, the level of geoscientific confidence for Probable Mineral Reserves is the same as that required for the in situ determination of Indicated Mineral Resources and for Proven Mineral Reserves is the same as that required for the in situ determination of Measured Mineral Resources.

Figure 1  
Relationship between Mineral Resources and Mineral Reserves

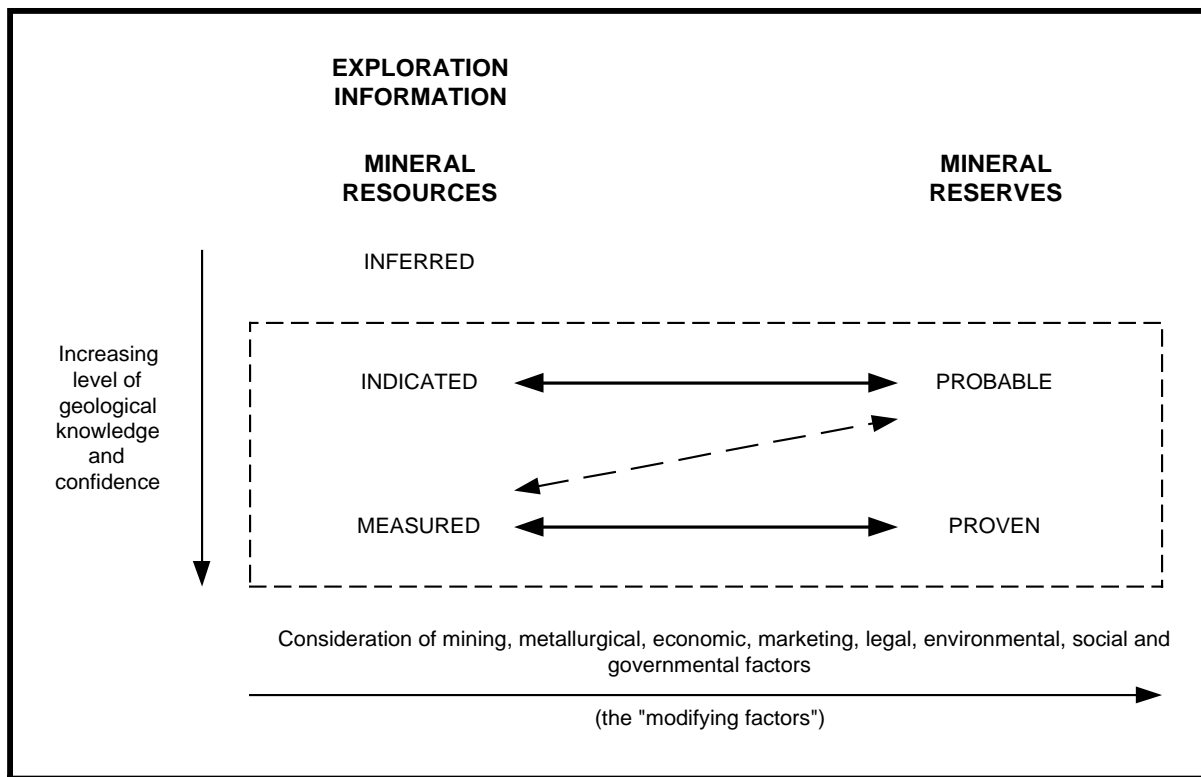


Figure 1 sets out the framework for classifying tonnage and grade estimates so as to reflect different levels of geological confidence and different degrees of technical and economic evaluation. Mineral Resources can be estimated by a Qualified Person, with input from persons in other disciplines, as necessary, on the basis of geoscientific information and reasonable assumptions of technical and economic factors likely to influence the prospect of economic extraction. Mineral Reserves, which are a modified sub-set of the Indicated and Measured Mineral Resources (shown within the dashed outline in Figure 1), require consideration of factors affecting profitable extraction, including mining, processing, metallurgical, economic, marketing, legal, environmental, socio-economic and governmental factors, and should be estimated with input from a range of disciplines. Additional testwork, e.g. metallurgy, mining, environmental is required to classify a resource as a reserve.

*In certain situations, Measured Mineral Resources could convert to Probable Mineral Reserves because of uncertainties associated with the modifying factors that are taken into account in the conversion from Mineral Resources to Mineral Reserves. This relationship is shown by the dashed arrow in Figure 1 (although the trend of the dashed arrow includes a vertical component, it does not, in this instance, imply a reduction in the level of geological knowledge or confidence). In such a situation these modifying factors should be fully explained. Under no circumstances can an Indicated Resources convert directly to Proven Reserves.*

*In certain situations previously reported Mineral Reserves could revert to Mineral Resources. It is not intended that re-classification from Mineral Reserves to Mineral Resources should be applied as a result of changes expected to be of a short term or temporary nature, or where company management has made a deliberate decision to operate in the short term on a non-economic basis. Examples of such situations might be a commodity price drop expected to be of short duration, mine emergency of a non-permanent nature, transport strike etc.*

## **GUIDANCE FOR REPORTING MINERAL RESOURCE AND MINERAL RESERVE INFORMATION**

Qualified Persons preparing public reports must follow the rules and guidelines presented in Form 1 (copy attached) of National Instrument 43-101. The following discussion is included for additional guidance when preparing a Technical Report.

For the CIM Standards a Technical Report is defined as a report that contains the relevant supporting documentation, estimation procedures and description of the Exploration Information, or the Mineral Resources and Mineral Reserve estimate. The CIM standards recognize the importance of quality Resource and Reserve estimates to the profitable operation of a mine. The CIM Standards encourage practitioners to strive for excellence in the preparation of these estimates.

A Technical Report, with documentation describing the estimates of Mineral Resources and Mineral Reserves must be prepared by or under the direction of, and dated and signed by, a Qualified Person(s). When undertaking exploration programs and generating information required to prepare Mineral Resource and Mineral Reserve estimates, Qualified Persons must comply with the Mineral Exploration “Best Practices” Guidelines prepared by the Mineral Industry Best Practices Committee (Table 2).

*Qualified Persons are encouraged to provide information that is as comprehensive as possible in their Technical Reports on Exploration Information, Mineral Resources and Mineral Reserves. Table 1 provides, in a summary form, a list of the main criteria which should be considered when reporting Exploration Information, Mineral Resources and Mineral Reserve estimates. All of these criteria need not be discussed unless they materially affect estimation or classification of the Mineral Resources and Mineral Reserves. Certain fundamental data such as commodity price used, cut-off grade (where applicable) must be disclosed.*

*Table 1 is a checklist, and is not prescriptive. While it may not be necessary to comment on each item in the table, the need for comment on each item should be considered. It is essential to discuss any matters that might materially affect the reader’s understanding of the estimates being reported. Problems encountered in the collection of data or with the sufficiency of data must be clearly disclosed at all times, particularly when they affect directly the reliability of, or confidence in, a statement of Exploration Information or an estimate of Mineral Resources and Mineral Reserves; for example, poor sample recovery, poor repeatability of assay or laboratory results, limited information on tonnage factors etc.*

*Mineral Resource or Mineral Reserve estimates are sometimes reported after adjustment by cutting of high grades or after the application of modifying factors arising from reconciliation with mill data. If any of the data are materially adjusted or modified for the purpose of making the estimate, the nature of the adjustment or modification should be clearly described.*

*Mineral Resource and Mineral Reserve estimates are not precise calculations, being dependent on the interpretation of limited information on the location, shape and continuity of the occurrence and on the available sampling results. To emphasize the imprecise nature of a Mineral Resource or Mineral Reserve estimate, the final result should always be referred to as an estimate, not a calculation.*

*Reporting of tonnage and grade figures should reflect the order of accuracy of the estimate by rounding off to appropriately significant figures. There will be occasions, however, where rounding to one significant figure may be necessary in order to convey properly the uncertainties in estimation. This would usually be the case with Inferred Mineral Resources.*

Technical Reports of a Mineral Resource must specify one or more of the categories of ‘Inferred’, ‘Indicated’ and ‘Measured’ and Technical Reports of Mineral Reserves must specify one or both of the categories of ‘Proven’ and ‘Probable’. Categories must not be reported in a combined form unless details for the individual categories are also provided. Inferred Mineral Resources cannot be combined with other categories and must always be reported separately. Mineral Resources must never be added to Mineral Reserves and reported as total Resources and Reserves. Mineral Resources and Mineral Reserves must not be reported in terms of contained metal or mineral content unless corresponding tonnages, grades and mining, mineral processing and metallurgical recoveries are also presented

In situations where estimates for both Mineral Resources and Mineral Reserves are reported, a clarifying statement must be included in the report that clearly indicates whether Mineral Reserves are part of the Mineral Resource or if they have been removed from the Mineral Resources. Mineral Resources and Mineral Reserves must be reported on a site by site basis.

*The CIM Standards recognize that there are legitimate reasons, in some situations, for reporting Mineral Resources inclusive of Mineral Reserves (the Australian approach) and, in other situations, for reporting Mineral Resources additional to Mineral Reserves (the South African and United States approach). The CIM Standards do not express a preference but do require*

*that reporting companies make it clear which form of reporting has been adopted. A single form of reporting should be used in a report. Appropriate forms of clarifying statements may be:*

*‘The Measured and Indicated Mineral Resources are inclusive of those Mineral Resources modified to produce the Mineral Reserves.’*

*or*

*‘The Measured and Indicated Mineral Resources are additional to the Mineral Reserves.’*

*Inferred Mineral Resources are, by definition, always additional to Mineral Reserves.*

*Mineral Reserves may incorporate material (dilution) which is not part of the original Mineral Resource or exclude material (mining losses) that is included in the original Mineral Resource. It is essential that these fundamental differences between Mineral Resources and Mineral Reserves be noted and caution exercised when attempting to draw conclusions from a comparison of the two.*

*In preparing a Mineral Reserve report, the relevant Mineral Resource report on which it is based should first be developed. This can be reconciled with the Mineral Resource report estimated for the previous comparable period and differences (due, for example, to mine production, exploration, etc.) identified. The application of mining and other criteria to the Mineral Resource can then be made to develop the Mineral Reserve statement that can also be reconciled with the previous comparable report. A detailed account of differences between estimates is not essential, but sufficient comment should be made to enable significant variances to be understood by the reader. Reconciliation of estimates with production whenever possible is required.*

*Where Mineral Reserve estimates are reported, information on assumed metal or mineral prices, operating costs and mineral processing/metallurgical recovery factors is very important, and should always be included in Technical Reports.*

Reports must continue to refer to the appropriate category or categories of Mineral Resources until technical feasibility and economic viability have been established. If re-evaluation indicates that the Mineral Reserves are no longer viable, the Mineral Reserves may be reclassified as Mineral Resources, if appropriate, or removed from Mineral Resource and Mineral Reserve statements.

The Committee is generally opposed to the reporting of metal equivalence. However, if reporting is carried out in this way, the appropriate correlation formulae including assumed metal prices, metallurgical recovery, comparative smelter charges, likely losses, payable metals, etc. must be included.

*Mineralized stope fill and stockpiles of mineralized material should be considered to be similar to in situ mineralization when reporting Mineral Resources and Mineral Reserves. Consequently the Qualified Person assessing the fill or stockpiles must use the basis of classification outlined in the CIM Standards. In most cases, the opinion of a mining engineer should be sought when making judgements about the mineability of fill, remnants and pillars. If there are not reasonable prospects for the eventual economic extraction of a particular portion of the fill or stockpile, this material cannot be classified as either Mineral Resources or Mineral Reserves. If some portion is currently sub-economic but there is a reasonable expectation that it will become economic, then this material may be classified as a Mineral Resource. Such stockpile material may include old dumps and tailings material. If technical and economic studies of at least a Preliminary Feasibility Study standard have demonstrated that economic extraction could reasonably be justified under realistically assumed conditions, the material may be classified as a Mineral Reserve.*

*The above guidelines apply equally to low grade in situ mineralization, sometimes referred to as ‘mineralized waste’ or ‘marginal grade material’, and often intended for stockpiling and treatment towards the end of mine life. For clarity of understanding, it is recommended that tonnage and grade estimates of such material be itemized separately in Technical Reports, although they may be aggregated with total Mineral Resource and Mineral Reserve figures.*

*Stockpiles are defined to include both surface and underground stockpiles, including broken ore in stopes, and can include ore currently in the ore storage system. Mineralized material being processed (including leaching), if reported, should be reported separately.*

*Mineralized remnants, shaft pillars and mining pillars which are potentially mineable are in situ mineralization and consequently are included in the CIM Standards definitions of Mineral Resources and Mineral Reserves. Mineralized remnants, shaft pillars and mining pillars which are not potentially mineable must not be included in Mineral Resource and Mineral Reserve statements.*

## **REPORTING OF COAL RESERVES**

Coal resource and reserve estimates should conform to the definitions and guidelines on Paper 88-21 of the Geological Survey of Canada: “A Standardized Coal Resource/Reserve Reporting System for Canada”.

## **REPORTING OF INDUSTRIAL MINERALS**

When reporting Mineral Resource and Mineral Reserve estimates relating to an industrial mineral site, the Qualified Person(s) must make the reader aware of certain special properties of these commodities. **An Industrial Mineral is any rock, mineral or other naturally occurring substance of economic value, exclusive of metallic ores, mineral fuels and gemstones; that is one of the non-metallic minerals.** To assist Qualified Persons, the following guidelines are presented.

*The quality of industrial mineral deposits is typically measured by physical and/or chemical properties. The properties may be defined by standard industry specifications that must be considered in the classification of Mineral Resources and/or Mineral Reserves.*

*Before a tonnage and quality and/or value per tonne estimate of an industrial mineral deposit can be classified as a Mineral Resource, there must be recognition by the Qualified Person preparing the tonnage and quality estimate that there is a viable market for the product or that a market can be reasonably developed.*

*Before any part of an industrial mineral deposit can be classified as a Mineral Reserve the Qualified Person preparing the tonnage and quality and/or value per tonne estimate must assure himself or herself that the mineral can be sold at a profit through review of specific and identifiable markets for the product.*

*When the quality of any industrial minerals is defined by standard industry specifications and these specifications are used to estimate the value of a tonne of product or products, the industry standard used must be identified. The methods for estimating the value must be explained.*

## **REPORTING OF DIAMONDS AND GEMSTONES**

Mineral Resource and Reserves estimates of diamonds or gemstones must conform to the definitions and guidelines found in “Reporting of Diamond Exploration Results, Identified Mineral Resources and Ore Reserves” published by the Association of Professional Engineers, Geologists and Geophysicists of the Northwest Territories.

*Reports of diamonds or gemstones recovered from sampling programs must specify the number and total weight of stones (in carats for diamonds) recovered. Details of the type and size of samples which produced the diamonds must also be specified including the lower cut-off sieve size and type of sieve used in the recovery. Of equal or greater importance to the total weight of diamonds is diamond value which depends on the colour, size, and proportion of gem and near*

*gem quality of stones recovered. The weight of diamonds recovered may only be omitted from the report when the diamonds are less than 0.5 mm in size (i.e. when the diamonds recovered are microdiamonds).*

*For Technical Reports dealing with diamond or other gemstone mineralization, it is also a requirement of the CIM Standards that, if a valuation(s) of a parcel of diamonds or gemstones is reported, the person(s) or organization valuing the parcel must be named in the report and their professional valuation experience, competency and independence must be stated. If a valuation of a parcel of diamonds is reported, the weight in carats and size range of the contained diamonds must be stated and the value of the diamonds must be estimated in US dollars per carat. If the valuation(s) is not independent, this must be clearly stated.*

*Diamond valuation is a highly specialized process and value can only be reliably estimated for large parcels (at least 2,000 carats) of diamonds from a single deposit. The reliability of valuations of parcels smaller than 2,000 carats decreases as the size of the parcels decreases to the point where valuations placed on a small number of diamonds from exploration samples are likely to be misleading.*

**TABLE 1**

Table 1 is a checklist that may be used by Qualified Persons may use when estimating Mineral Resources and Mineral Reserves. Relevance and materiality are overriding principles that determine what information should be presented with the estimates. It is important to report any matters that might materially affect a reader's understanding or interpretation of the results or estimates being reported

<b>CHECKLIST FOR THE ESTIMATION OF MINERAL RESOURCES</b>	
<i>Database integrity</i>	<i>Measures taken to ensure that data has not been corrupted by, for example, transcription or keying errors, between its initial collection and its use for Mineral Resource estimation purposes. Data validation and due diligence procedures used.</i>
<i>Geological interpretation</i>	<i>Nature of the data used and of any assumptions made. The effect, if any, of alternative interpretations on Mineral Resource estimation. The use of geology in guiding and controlling Mineral Resource estimation. The factors affecting continuity both of grade and geology.</i>
<i>Estimation and modelling techniques</i>	<i>The estimation technique(s) and key assumptions, including treatment of extreme grade values, interpolation parameters, maximum distance of extrapolation from data points, must be appropriate and consistent with best mineral industry practice.. The availability of check estimates, previous estimates and/or mine production records and whether the Mineral Resource estimate must take appropriate account of such data. The assumptions made regarding recovery of by-products. In the case of block model interpolation, the block size in relation to the average sample spacing and the search employed. Any assumptions behind modelling of selective mining units (eg. non-linear kriging). The process of validation, the checking process used, the comparison of model data to drillhole data, and use of reconciliation data if available. The software and version used for computer generated estimates should be identified. When computer techniques are used in Mineral Resource or Mineral Reserve estimation, verification by other techniques is required..</i>
<i>Cut-off grades or parameters, and cutting of high assays</i>	<i>The basis of the cut-off grade(s) or quality parameters applied. If high values have been cut, the level of cutting must be explained and justified. The effect of cutting high grades on the Mineral Resource estimate must be discussed.</i>
<i>Mining factors or assumptions</i>	<i>Assumptions made regarding possible mining methods, minimum mining dimensions and internal (or, if applicable, external) mining dilution.</i>
<i>Metallurgical factors or assumptions</i>	<i>The basis for assumptions or predictions regarding metallurgical amenability.</i>
<i>Tonnage factors (in situ bulk densities)</i>	<i>The determination method used, the frequency of the measurements, the nature, size and representativeness of the samples must be stated.</i>
<i>Classification</i>	<i>The basis for the classification of the Mineral Resources into varying confidence categories. Appropriate account must be taken of all relevant factors. i.e. relative confidence in tonnage/grade estimations, confidence in continuity of geology and recoverable mineral and metal values, quality, quantity and distribution of the data. All Qualified Persons involved in a Mineral Resource estimate must sign off.</i>
<i>Audits or reviews</i>	<i>The results of any audits or reviews of Mineral Resource estimates.</i>

**Table 1 cont'd**

<b>ESTIMATION OF MINERAL RESERVES</b>	
<i>Mineral Resource estimate for conversion to Mineral Reserves</i>	<i>Description of the Mineral Resource estimate used as a basis for the conversion to an Mineral Reserve. Clear statement as to whether the Mineral Resources are reported additional to, or inclusive of, the Mineral Reserves.</i>
<i>Cut-off grades or parameters</i>	<i>The basis of the cut-off grade(s) or quality parameters applied, including the basis, if appropriate, of equivalent metal formulae. The cut-off grade parameter may be economic value per block rather than mineral or metal grade.</i>
<i>Mining factors or assumptions</i>	<i>The method and assumptions used to convert the Mineral Resource to an Mineral Reserve. The choice of, the nature and the appropriateness of the selected mining method(s) and other mining parameters including associated design issues such as pre-strip, access, etc. The assumptions made regarding geotechnical parameters (eg. pit slopes, stope sizes, etc.), grade control and pre-production drilling. The major assumptions made and Mineral Resource model used for pit optimisation (if appropriate). The mining dilution factors, mining recovery factors, and minimum mining widths used and the infrastructure requirements of the selected mining methods. Results of bulk sampling and/or test mining must be reported.</i>
<i>Metallurgical and processing factors or assumptions</i>	<i>The metallurgical process proposed and the confirmation of the applicability of that process to the style of mineralization. Whether the metallurgical process is well-tested and "commercialized" technology. The nature, amount and representativeness of metallurgical testwork undertaken and the metallurgical recovery factors applied. Any assumptions or allowances made for deleterious elements. The existence of any bulk sample or pilot scale testwork and the degree to which such samples are representative of the Mineral Reserve as a whole.</i>
<i>Cost and revenue factors</i>	<i>The derivation of, or assumptions made, regarding projected capital and operating costs. The assumptions made regarding revenue including head grade, metal or commodity price(s), exchange rates, transportation and treatment charges, penalties, etc.. The allowances made for royalties payable, both Government and private and, if material, taxes or sales restrictions. Comparisons of operating and capital costs with other similar operations should be made if appropriate.</i>
<i>Market assessment</i>	<i>The demand, supply and stock situation for the particular commodity, consumption trends and factors likely to affect supply and demand into the future. A customer and competitor analysis along with the identification of likely market windows for the product. Price and volume forecasts and the basis for these forecasts. For industrial minerals the customer specification, testing and acceptance requirements prior to a supply contract.</i>
<i>Others</i>	<i>The effect, if any, of natural risk, infrastructure, environmental, legal, marketing, social or governmental factors on the likely viability of a project and/or on the estimation and classification of the Mineral Reserves. The status of titles and approvals critical to the viability of the project, such as mining leases, discharge permits, government and statutory approvals.</i>
<i>Classification</i>	<i>The basis for the classification of the Mineral Reserves into varying confidence categories. The proportion of Probable Mineral Reserves which have been derived from Measured Mineral Resources (if any). Appropriate sign-off by all Qualified Persons involved in a Mineral Reserve estimate is required.</i>
<i>Audits or reviews</i>	<i>The results of any audits or reviews of Mineral Reserve estimates.</i>

**Table 1a**

<b>ADDITIONAL GUIDANCE FOR THE REPORTING OF SAMPLING TECHNIQUES AND DATA</b>	
<b>CRITERIA</b>	<b>EXPLANATION</b>
<i>Drilling techniques</i>	<i>Drill type (eg. core, reverse circulation, cable tool rotary air blast, auger, etc.) and details (eg. core diameter, triple or standard tube, face-sampling bit or other type, etc.). Measures taken to maximize sample recovery and establish representative nature of the samples.</i>
<i>Logging</i>	<i>Core and chip samples must be logged to a level of detail to support appropriate Mineral Resource estimation, mining studies and processing/metallurgical studies. Logging must be quantitative in nature. Core (or trenching, channel etc.) photography. Logging must include where possible the collection of structural data (core samples, rock quality and description).</i>
<i>Drill sample recovery</i>	<i>Core and chip sample recoveries must be properly recorded and results assessed. Establish whether a relationship exists between sample recovery and grade and whether sample bias may have occurred due to preferential loss/gain of fine/coarse material.</i>
<i>Other sampling techniques</i>	<i>Nature and quality of sampling (eg. channel, random, chips etc.) and measures taken to establish sample representivity.</i>
<i>Sub-sampling techniques and sample preparation</i>	<i>If core, whether cut or sawn and whether quarter, half or all core taken. If non-core, whether riffled, tube sampled, rotary split etc. and whether sampled wet or dry. For all sample types, the nature, quality and appropriateness of the sample preparation technique. Quality control procedures adopted for all sub-sampling stages to maximise representivity of samples. Measures taken to establish that the sampling is representative of the in situ material collected. Confirmation that sample sizes are appropriate to the grain size of the material being sampled.</i>
<i>Quality of assay data and laboratory tests</i>	<i>The nature, quality and appropriateness of the assaying and laboratory procedures used and whether the technique is considered partial or total. Nature of quality assurance procedures adopted (eg. Standards, blanks, duplicates, external laboratory checks) and whether acceptable levels of accuracy (i.e. lack of bias) and precision have been established.</i>
<i>Verification of sampling and assaying</i>	<i>The verification of significant intersections by either independent or alternative company personnel. The use of twinned holes.</i>
<i>Location of data points</i>	<i>Accuracy and quality of surveys used to locate drill holes (collar and down-hole surveys), trenches, mine workings and other locations used in Mineral Resource estimation. Quality and adequacy of topographic control.</i>
<i>Data density and distribution</i>	<i>The data density and distribution must be sufficient to establish the degree of geological and grade continuity appropriate for the Mineral Resource and Mineral Reserve estimation procedure(s) and classifications applied. Whether sample compositing has been applied.</i>

**Table 1b**

<b>ADDITIONAL GUIDANCE FOR THE REPORTING OF EXPLORATION RESULTS</b>	
<i>Mineral title and land tenure status</i>	<i>Type, reference name/number, location and ownership including agreements or material issues with third parties such as joint ventures, partnerships, overriding royalties, native title interests, historical sites, wilderness or national park and environmental settings. In particular the security of the tenure held at the time of reporting along with any known impediments to obtaining a licence to operate in the area.</i>
<i>Exploration work done by other parties</i>	<b>Acknowledgment and appraisal of previous exploration by other parties, previous audits, reviews and valuation reports.</b>
<i>Geology</i>	<i>Deposit type, geological setting and style of mineralization.</i>
<i>Data aggregation methods</i>	<i>Weighting averaging techniques, maximum and minimum grade truncations (ie. cutting of high grades) and cut-off grades are material and must be stated. Where aggregate intercepts incorporate short lengths of high grade results and longer lengths of low grade results, the procedure used for such aggregation must be stated and some typical examples of such aggregations should be shown in detail. Assumptions used for any use of metal equivalency and the date of the metal equivalency calculation must be clearly stated.</i>
<i>Diagrams</i>	<i>Where possible, maps and sections (with scales) and tabulations of intercepts should be included for any material discovery.</i>
<i>Other substantive exploration data</i>	<i>Other data, if meaningful and material, should be reported including (but not limited to): geological observations; geophysical survey results; geochemical survey results; bulk samples – size and method of treatment; metallurgical test results; bulk density, groundwater, geotechnical and rock characteristics; potential deleterious or contaminating substances.</i>

**Table 2**

<b>Exploration Best Practices Guidelines</b>	
<p><b>Preamble:</b> <i>These guidelines have been prepared to assist the Qualified Person(s) in the planning and supervision of exploration programs which will be reported under National Instrument 43-101. Such exploration programs must be under the supervision of the Qualified Person who will be responsible and accountable for the planning, execution and interpretation of all exploration activity as well as the implementation of quality assurance programs and reporting. These guidelines are also recommended for use in the planning and execution of exploration programs which will not be reported under NI 43-101. This set of broad guidelines or "best practices" has been drawn up to ensure a consistently high quality of work that will maintain public confidence and assist securities regulators. The guidelines are not intended to inhibit the original thinking or application of new approaches, that are fundamental to successful mineral exploration.</i></p> <p><i>Results should be summarized and reported in a Technical Report of good professional quality in accordance with the National Instrument 43-101 and Form 1 contained in that instrument.</i></p> <p><i>All exploration work from which public reporting will ensue must be designed and carried out under the supervision of a Qualified Person ("QP"). A QP is defined in National Instrument 43-101 as an individual who is an engineer or geoscientist with at least five (5) years' experience in mineral exploration, mine development, mine operation or project assessment, has experience relevant to the subject matter of the project or report and is a member in good standing of a recognized professional association.</i></p>	
1. Qualified Person	The Qualified Person may base the exploration program on such geological premises and interpretation of existing information as the QP(s) may decide and select such exploration methods and tools as the QP(s) may judge to be appropriate. In planning, implementing and supervising any exploration work, the Qualified Person should ensure that the practices followed are based on criteria that are generally accepted in the industry or that can reasonably be justified on scientific or technical grounds.
2. Geological Concept	The geological premise on which the exploration work is conducted including the deposit type, geological setting and style of mineralization sought, should be supported by relevant field data and a reasoned scientific approach.
3. Quality Assurance and Control	Throughout the process of mineral exploration, the QP(s) should ensure that a quality assurance program is in place and that any required quality control measures are implemented. Quality assurance programs should be systematic and apply to all types of data acquisition, across the full range of values measured and not only high or unusual results.
4. Exploration Methods & Data Collection	Field work is to be planned and implemented under the direct supervision of a QP(s). Data should be properly recorded and documented at appropriate scales. All data points should be accurately located with respect to known reference points. The QP(s) supervising this work should ensure that any work by employees, contractors or consultants is done by competent personnel and that appropriate quality assurance programs and security procedures are practised. Whenever several persons carry out similar duties or when the data has been collected over a period of time, care should be taken to ensure the quality and consistency of the data being used.
5. Records and Data Verification	The exploration process including planning, mapping, sampling, sample preparation, sample security and analysis or testing should be accompanied by detailed record keeping setting out the procedures followed, the results obtained and the abbreviations used. In addition to paper records, digital storage is encouraged in a standard format on a reliable medium. A program of data verification should be in place to confirm the validity of exploration data that are entered into the database. A summary of records should be included in a periodic technical report produced and signed by the QP(s). Practices used should be well documented and justified.

6. Sampling	The practices and procedures used in each sampling program should be appropriate for the objectives of the program. All sampling programs should be carried out in a careful and diligent manner using scientifically established sampling practices designed and tested to ensure that the results are representative and reliable. Samples should be collected under the supervision of a QP(s). Quality control programs appropriate to the type of sample and the mineralization should be planned and implemented. These programs should include such measures as external blanks, standards and duplicate samples. Where the volume of individual samples is reduced prior to shipping to a laboratory for analysis, appropriate reduction procedures to obtain representative subsamples should be applied and verified.
7. Drilling	The drilling method will be selected by a QP(s) and should be appropriate to the material being investigated, the objective of the program and local drilling conditions. The drill hole size selected should provide sufficient representative sample material for analysis and reference. Surface and downhole locational surveys should be undertaken using techniques appropriate for the hole size, angle and length of holes. A representative fraction of the drill sample material should be retained, however if material is not retained, the QP(s) should report and explain the reason for this decision. Drill logs, forms or software specifically suited to the type of drilling, the particular geological situation, and the minerals being sought, should be used for detailed geological logging of core or cuttings. Logs should be appropriately detailed for the type of drilling being conducted, the geological setting, type of mineralization, and geotechnical conditions. Core or sample recoveries should be noted on the logs. Cross sections depicting basic geology and hole data, including correlation with surface geology and any nearby holes should be developed and updated as drilling proceeds. Any downhole geophysical information or other such surveys should also be kept with the drill log. A photographic record of the core is recommended, where appropriate.
8. Sample Security	The security of samples from sample acquisition to analysis is a vital component of the sampling process. Procedures should include the use of secure core logging, sampling, storage and preparation facilities, as appropriate, and the prompt, secure and direct shipping of samples to the laboratories. The QP(s) should endeavour to put in place the best security procedures practical, given the geographic and topographic conditions and the logistics created by the site location.
9. Sample Preparation	The selection of sample preparation procedures should be approved by the QP and should be appropriate to the material being tested, the elements being analyzed and should be subject to the security measures as stated above. All samples that are reduced or split should be processed in a manner such that the fraction analyzed or tested is as representative of the whole sample as possible. Representative fractions of the material to be analyzed or tested should be retained for an appropriate period of time, as decided by the QP. Quality control checks should be undertaken as determined by the QP.
10. Analysis and Testing	Analysis and testing of samples should be done by a reputable and preferably accredited laboratory qualified for the particular material to be analyzed or tested. The selection of a laboratory, testing or mineral processing facility and the analytical methods used will be the responsibility of the QP. The analytical methods chosen must be documented and justified. All analytical or test results should be supported by duly signed certificates or technical reports issued by the laboratory or testing facility and should be accompanied by a statement of the methods used. The reliability of the analytical and testing results should be measured using the results of the quality control samples inserted in the process by the QP. Duplicate analyses at other laboratories should be undertaken.
11. Interpretation	A comprehensive and ongoing interpretation of all the exploration data is an essential activity at all stages of the project and should be undertaken to assess the results of the work. This interpretation should be based on all of the information collected to date, be systematic and thorough, describe and document the interpretation and discuss any information that appears at variance with the selected interpretation. The density of the exploration data should be critically assessed as to its ability to support the qualitative and quantitative conclusions.

12. Mineral Resource and Reserve Estimation	Estimation of a mineral resource and a mineral reserve are both fundamental steps in project development. The classification and categorization of these estimates must be done in accordance with National Instrument 43-101 and be prepared by a QP(s). The methods and parameters used in making these estimates should be in accordance with the principles generally accepted in Canada and should be presented and justified with the estimate.. A mineral resource can be estimated for material where the geological characteristics and the continuity are known or reasonably assumed and where there is the potential for production at a profit. Reserves can be estimated when a positive pre-feasibility or feasibility study as defined by NI 43-101 has established the technical, economic and other relevant factors that indicate that these resources can be produced at a profit. Reserve estimates should be based on input and information from a multidisciplinary team under the direction of QP(s).
13. Environment, Safety and Community Relations	All field work should be conducted in a safe, professional manner with due regard for the environment, the concerns of local communities and with regulatory requirements. An environmental program, including baseline studies, appropriate to the stage of the project should be carried out.
14. Recommendations	The interpretation and assessment of the program results at the end of each phase should determine if the program objectives have been met and if further work is justified. Any plan for further work should identify exploration targets, recommend an exploration program and present a budget and schedule. Any changes in working hypotheses and objectives should be recorded.
15. Technical Reporting	A comprehensive technical report signed by the QP(s) should be prepared on completion of a particular phase or stage of work following the format presented in Form 1 of the National Instrument 43-101.