

**Form 43-101F1**  
***Technical Report***

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**Form 43-101F1**  
**Technical Report**

**INSTRUCTIONS:**

- (1) *The objective of the technical report is to provide a summary of material scientific and technical information concerning mineral exploration, development, and production activities on a mineral property that is material to an issuer. This Form sets out the requirements for the preparation and content of a technical report.*
- (2) *Terms used in this Form that are defined or interpreted in National Instrument 43-101 Standards of Disclosure for Mineral Projects (the “Instrument”) will have that definition or interpretation. In addition, a general definition instrument has been adopted as National Instrument 14-101 Definitions that contains definitions of certain terms used in more than one national instrument. Readers of this Form should review both these national instruments for defined terms.*
- (3) *The qualified person preparing the technical report should keep in mind that the intended audience is the investing public and their advisors who, in most cases, will not be mining experts. Therefore, to the extent possible, technical reports should be simplified, summarized, and written in plain language. However, the technical report should include sufficient context and cautionary language to allow a reasonable investor to understand the nature, importance, and limitations of the data, interpretations, and conclusions summarized in the technical report.*
- (4) *The qualified person preparing the technical report must use all of the headings of Items 1 to 14 and 23 to 27 in this Form and provide the information specified under each heading. For advanced properties, the qualified person must also use the headings of Items 15 to 22 and include the information required under each of these headings. The qualified person may create sub-headings. Disclosure included under one heading is not required to be repeated under another heading.*
- (5) *The qualified person preparing the technical report may refer to information in a technical report previously filed by the issuer for the subject property if the information is still current and the technical report identifies the title, date and author of the previously filed technical report. However, the qualified person must still summarize or quote the referenced information in the current technical report and may not disclaim responsibility for the referenced information. Except as permitted by subsection 4.2(3) of the Instrument, an issuer may not update or revise a previously filed technical report by filing an addendum.*
- (6) *While the Form mandates the headings and general format of the technical report, the qualified person preparing the technical report is responsible for determining the level of detail required under each Item based on the qualified person’s assessment of the relevance and significance of the information.*

- (7) *The technical report may only contain disclaimers that are in accordance with section 6.4 of the Instrument and Item 3 of this Form.*
- (8) *Since a technical report is a summary document the inclusion and filing of comprehensive appendices is not generally necessary to comply with the requirements of the Form.*
- (9) *The Instrument requires certificates and consents of qualified persons, prepared in accordance with sections 8.1 and 8.3 respectively, to be filed at the same time as the technical report. The Instrument does not specifically require the issuer to file the certificate of qualified person as a separate document. It is generally acceptable for the qualified person to include the certificate in the technical report and to use the certificate as the date and signature page.*

## **CONTENTS OF THE TECHNICAL REPORT**

**Title Page** - Include a title page setting out the title of the technical report, the general location of the mineral project, the name and professional designation of each qualified person, and the effective date of the technical report.

**Date and Signature Page** – The technical report must have a signature page, at either the beginning or end of the technical report, signed in accordance with section 5.2 of the Instrument. The effective date of the technical report and date of signing must be on the signature page.

**Table of Contents** - Provide a table of contents listing the contents of the technical report, including figures and tables.

**Illustrations** – Technical reports must be illustrated by legible maps, plans and sections, all prepared at an appropriate scale to distinguish important features. Maps must be dated and include a legend, author or information source, a scale in bar or grid form, and an arrow indicating north. All technical reports must be accompanied by a location or index map and a compilation map outlining the general geology of the property. In addition, all technical reports must include more detailed maps showing all important features described in the text, relative to the property boundaries, including but not limited to

- (a) for exploration projects, areas of previous or historical exploration, and the location of known mineralization, geochemical or geophysical anomalies, drilling, and mineral deposits;
- (b) for advanced properties other than development and production properties, the location and surficial outline of mineral resources, mineral reserves, and, to the extent known, areas for potential access and infrastructure; and
- (c) for development and production properties, the location of pit limits or underground development, plant sites, tailings storage areas, waste disposal areas, and all other significant infrastructure features.

If information is used from other sources in preparing maps, drawings, or diagrams, disclose the source of the information. If adjacent or nearby properties have an important bearing on the potential of the subject property, the location of the properties and any relevant mineralized structures discussed in the report must be shown in relationship to the subject property.

***INSTRUCTION:** Summarize and simplify the illustrations so that they are legible and suitable for electronic filing. For ease of reference, consider inserting the illustration in the text of the report in relative proximity to the text they illustrate.*

### **Requirements for All Technical Reports**

**Item 1: Summary** – Briefly summarize important information in the technical report, including property description and ownership, geology and mineralization, the status of exploration, development and operations, mineral resource and mineral reserve estimates, and the qualified person’s conclusions and recommendations.

**Item 2: Introduction** - Include a description of

- (a) the issuer for whom the technical report is prepared;
- (b) the terms of reference and purpose for which the technical report was prepared;
- (c) the sources of information and data contained in the technical report or used in its preparation, with citations if applicable; and
- (d) the details of the personal inspection on the property by each qualified person or, if applicable, the reason why a personal inspection has not been completed.

**Item 3: Reliance on Other Experts** - A qualified person who prepares or supervises the preparation of all or part of a technical report may include a limited disclaimer of responsibility if:

- (a) The qualified person is relying on a report, opinion, or statement of another expert who is not a qualified person, or on information provided by the issuer, concerning legal, political, environmental, or tax matters relevant to the technical report, and the qualified person identifies
  - (i) the source of the information relied upon, including the date, title, and author of any report, opinion, or statement;
  - (ii) the extent of reliance; and
  - (iii) the portions of the technical report to which the disclaimer applies.
- (b) The qualified person is relying on a report, opinion, or statement of another expert who is not a qualified person, concerning diamond or other gemstone valuations, or the pricing of commodities for which pricing is not publicly available, and the qualified person discloses

- (i) the date, title, and author of the report, opinion, or statement;
- (ii) the qualifications of the other expert and why it is reasonable for the qualified person to rely on the other expert;
- (iii) any significant risks associated with the valuation or pricing; and
- (iv) any steps the qualified person took to verify the information provided.

**Item 4: Property Description and Location** - To the extent applicable, describe

- (a) the area of the property in hectares or other appropriate units;
- (b) the location, reported by an easily recognizable geographic and grid location system;
- (c) the type of mineral tenure (claim, license, lease, etc.) and the identifying name or number of each;
- (d) the nature and extent of the issuer's title to, or interest in, the property including surface rights, legal access, the obligations that must be met to retain the property, and the expiration date of claims, licences, or other property tenure rights;
- (e) to the extent known, the terms of any royalties, back-in rights, payments, or other agreements and encumbrances to which the property is subject;
- (f) to the extent known, all environmental liabilities to which the property is subject;
- (g) to the extent known, the permits that must be acquired to conduct the work proposed for the property, and if the permits have been obtained; and
- (h) to the extent known, any other significant factors and risks that may affect access, title, or the right or ability to perform work on the property.

**Item 5: Accessibility, Climate, Local Resources, Infrastructure and Physiography** - Describe

- (a) topography, elevation, and vegetation;
- (b) the means of access to the property;
- (c) the proximity of the property to a population centre, and the nature of transport;
- (d) to the extent relevant to the mineral project, the climate and the length of the operating season; and
- (e) to the extent relevant to the mineral project, the sufficiency of surface rights for mining operations, the availability and sources of power, water, mining personnel,

potential tailings storage areas, potential waste disposal areas, heap leach pad areas, and potential processing plant sites.

**Item 6: History** - To the extent known, describe

- (a) the prior ownership of the property and ownership changes;
- (b) the type, amount, quantity, and general results of exploration and development work undertaken by any previous owners or operators;
- (c) historical mineral resource and mineral reserve estimates in accordance with section 2.4 of the Instrument; and
- (d) any production from the property.

**Item 7: Geological Setting and Mineralization** - Describe

- (a) the regional, local, and property geology; and
- (b) the significant mineralized zones encountered on the property, including a summary of the surrounding rock types, relevant geological controls, and the length, width, depth, and continuity of the mineralization, together with a description of the type, character, and distribution of the mineralization.

**Item 8: Deposit Types** - Describe the mineral deposit type(s) being investigated or being explored for and the geological model or concepts being applied in the investigation and on the basis of which the exploration program is planned.

**Item 9: Exploration** – Briefly describe the nature and extent of all relevant exploration work other than drilling, conducted by or on behalf of, the issuer, including

- (a) the procedures and parameters relating to the surveys and investigations;
- (b) the sampling methods and sample quality, including whether the samples are representative, and any factors that may have resulted in sample biases;
- (c) relevant information of location, number, type, nature, and spacing or density of samples collected, and the size of the area covered; and
- (d) the significant results and interpretation of the exploration information.

**INSTRUCTION:** *If exploration results from previous operators are included, clearly identify the work conducted by or on behalf of the issuer.*

**Item 10: Drilling** - Describe

- (a) the type and extent of drilling including the procedures followed and a summary and interpretation of all relevant results;

- (b) any drilling, sampling, or recovery factors that could materially impact the accuracy and reliability of the results;
- (c) for a property other than an advanced property
  - (i) the location, azimuth, and dip of any drill hole, and the depth of the relevant sample intervals;
  - (ii) the relationship between the sample length and the true thickness of the mineralization, if known, and if the orientation of the mineralization is unknown, state this; and
  - (iii) the results of any significantly higher grade intervals within a lower grade intersection.

**INSTRUCTION:** *For properties with mineral resource estimates, the qualified person may meet the requirements under Item 10 (c) by providing a drill plan and representative examples of drill sections through the mineral deposit.*

**Item 11: Sample Preparation, Analyses, and Security** – Describe

- (a) sample preparation methods and quality control measures employed before dispatch of samples to an analytical or testing laboratory, the method or process of sample splitting and reduction, and the security measures taken to ensure the validity and integrity of samples taken;
- (b) relevant information regarding sample preparation, assaying and analytical procedures used, the name and location of the analytical or testing laboratories, the relationship of the laboratory to the issuer, and whether the laboratories are certified by any standards association and the particulars of any certification;
- (c) a summary of the nature, extent, and results of quality control procedures employed and quality assurance actions taken or recommended to provide adequate confidence in the data collection and estimation process; and
- (d) the author's opinion on the adequacy of sample preparation, security, and analytical procedures.

**Item 12: Data Verification** – Describe the steps taken by the qualified person to verify the data being reported on, including

- (a) the data verification procedures applied by the qualified person;
- (b) any limitations on or failure to conduct such verification, and the reasons for any such limitations or failure; and
- (c) the qualified person's opinion on the adequacy of the data for the purposes used in the technical report.

**Item 13: Mineral Processing and Metallurgical Testing** - If mineral processing or metallurgical testing analyses have been carried out, discuss

- (a) the nature and extent of the testing and analytical procedures, and provide a summary of the relevant results;
- (b) the basis for any assumptions or predictions regarding recovery estimates;
- (c) to the extent known, the degree to which the test samples are representative of the various types and styles of mineralization and the mineral deposit as a whole; and
- (d) to the extent known, any processing factors or deleterious elements that could have a significant effect on potential economic extraction.

**Item 14: Mineral Resource Estimates** – A technical report disclosing mineral resources must

- (a) provide sufficient discussion of the key assumptions, parameters, and methods used to estimate the mineral resources, for a reasonably informed reader to understand the basis for the estimate and how it was generated;
- (b) comply with all disclosure requirements for mineral resources set out in the Instrument, including sections 2.2, 2.3, and 3.4;
- (c) when the grade for a multiple commodity mineral resource is reported as metal or mineral equivalent, report the individual grade of each metal or mineral and the metal prices, recoveries, and any other relevant conversion factors used to estimate the metal or mineral equivalent grade; and
- (d) include a general discussion on the extent to which the mineral resource estimates could be materially affected by any known environmental, permitting, legal, title, taxation, socio-economic, marketing, political, or other relevant factors.

***INSTRUCTIONS:***

- (1) *A statement of quantity and grade or quality is an estimate and should be rounded to reflect the fact that it is an approximation.*
- (2) *Where multiple cut-off grade scenarios are presented, the qualified person must identify and highlight the base case, or preferred scenario. All mineral resources reported under the cut-off grade scenarios must meet the test of reasonable prospect of economic extraction.*

**Additional Requirements for Advanced Property Technical Reports**

**Item 15: Mineral Reserve Estimates** - A technical report disclosing mineral reserves must

- (a) provide sufficient discussion and detail of the key assumptions, parameters, and methods used in the preliminary feasibility or feasibility study, for a reasonably



informed reader to understand how the qualified person converted the mineral resources to mineral reserves;

- (b) comply with all disclosure requirements for mineral reserves set out in the Instrument, including sections 2.2, 2.3, and 3.4;
- (c) when the grade for a multiple commodity mineral reserve is reported as metal or mineral equivalent, report the individual grade of each metal or mineral and the metal prices, recoveries, and any other relevant conversion factors used to estimate the metal or mineral equivalent grade; and
- (d) discuss the extent to which the mineral reserve estimates could be materially affected by mining, metallurgical, infrastructure, permitting, and other relevant factors.

**Item 16: Mining Methods** – Discuss the current or proposed mining methods and provide a summary of the relevant information used to establish the amenability or potential amenability of the mineral resources or mineral reserves to the proposed mining methods. Consider and, where relevant, include

- (a) geotechnical, hydrological, and other parameters relevant to mine or pit designs and plans;
- (b) production rates, expected mine life, mining unit dimensions, and mining dilution factors used;
- (c) requirements for stripping, underground development, and backfilling; and
- (d) required mining fleet and machinery.

***INSTRUCTION:** Preliminary economic assessments, pre-feasibility studies, and feasibility studies generally analyse and assess the same geological, engineering, and economic factors with increasing detail and precision. Therefore, the criteria for Items 16 to 22 can be used as a framework for reporting the results of all three studies.*

**Item 17: Recovery Methods** – Discuss reasonably available information on test or operating results relating to the recoverability of the valuable component or commodity and amenability of the mineralization to the proposed processing methods. Consider and, where relevant, include

- (a) a description or flow sheet of any current or proposed process plant;
- (b) plant design, equipment characteristics and specifications, as applicable; and
- (c) current or projected requirements for energy, water, and process materials.

**Item 18: Infrastructure** – Provide a summary of infrastructure and logistic requirements for the project, which could include roads, rail, port facilities, dams, dumps and leach pads, tailings disposal, power and pipelines, as applicable.

**Item 19: Market Studies and Contracts**

- (a) Provide a summary of reasonably available information concerning markets for the issuer's production, including the nature and material terms of any agency relationships and the results of any relevant market studies, commodity price projections, product valuation, market entry strategies, and product specification requirements.
- (b) Identify any contracts material to the issuer that are required for property development, including mining, concentrating, smelting, refining, transportation, handling, sales and hedging, and forward sales contracts or arrangements. State which contracts are in place and which are still under negotiation. For contracts that are in place, discuss whether the terms, rates or charges are within industry norms.

**Item 20: Environmental Studies, Permitting, and Social or Community Impact** - Discuss reasonably available information on environmental, permitting, and social or community factors related to the project. Consider and, where relevant, include

- (a) a summary of the results of any environmental studies and a discussion of any known environmental issues that could materially impact the issuer's ability to extract the mineral resources or mineral reserves;
- (b) requirements and plans for waste and tailings disposal, site monitoring, and water management both during operations and post mine closure;
- (c) project permitting requirements, the status of any permit applications, and any known requirements to post performance or reclamation bonds;
- (d) a discussion of any potential social or community related requirements and plans for the project and the status of any negotiations or agreements with local communities; and
- (e) a discussion of mine closure (remediation and reclamation) requirements and costs.

**Item 21: Capital and Operating Costs** – Provide a summary of capital and operating cost estimates, with the major components set out in tabular form. Explain and justify the basis for the cost estimates.

**Item 22: Economic Analysis** – Provide an economic analysis for the project that includes

- (a) a clear statement of and justification for the principal assumptions;

- (b) cash flow forecasts on an annual basis using mineral reserves or mineral resources and an annual production schedule for the life of project;
- (c) a discussion of net present value (NPV), internal rate of return (IRR), and payback period of capital with imputed or actual interest;
- (d) a summary of the taxes, royalties, and other government levies or interests applicable to the mineral project or to production, and to revenues or income from the mineral project; and
- (e) sensitivity or other analysis using variants in commodity price, grade, capital and operating costs, or other significant parameters, as appropriate, and discuss the impact of the results.

**INSTRUCTIONS:**

- (1) *Producing issuers may exclude the information required under Item 22 for technical reports on properties currently in production unless the technical report includes a material expansion of current production.*
- (2) *The economic analysis in technical reports must comply with paragraphs 2.3(1)(b) and (c), subsections 2.3(3) and (4), and paragraph 3.4(e), of the Instrument, including any required cautionary language.*

**Requirements for All Technical Reports**

**Item 23: Adjacent Properties** - A technical report may include relevant information concerning an adjacent property if

- (a) such information was publicly disclosed by the owner or operator of the adjacent property;
- (b) the source of the information is identified;
- (c) the technical report states that its qualified person has been unable to verify the information and that the information is not necessarily indicative of the mineralization on the property that is the subject of the technical report;
- (d) the technical report clearly distinguishes between the information from the adjacent property and the information from the property that is the subject of the technical report; and
- (e) any historical estimates of mineral resources or mineral reserves are disclosed in accordance with section 2.4 of the Instrument.

**Item 24: Other Relevant Data and Information** - Include any additional information or explanation necessary to make the technical report understandable and not misleading.

**Item 25: Interpretation and Conclusions** - Summarize the relevant results and interpretations of the information and analysis being reported on. Discuss any significant risks and uncertainties that could reasonably be expected to affect the reliability or confidence in the exploration information, mineral resource or mineral reserve estimates, or projected economic outcomes. Discuss any reasonably foreseeable impacts of these risks and uncertainties to the project's potential economic viability or continued viability. A technical report concerning exploration information must include the conclusions of the qualified person.

**Item 26: Recommendations** - Provide particulars of recommended work programs and a breakdown of costs for each phase. If successive phases of work are recommended, each phase must culminate in a decision point. The recommendations must not apply to more than two phases of work. The recommendations must state whether advancing to a subsequent phase is contingent on positive results in the previous phase.

***INSTRUCTION:** In some specific cases, the qualified person may not be in a position to make meaningful recommendations for further work. Generally, these situations will be limited to producing or development properties where material exploration activities and engineering studies have largely concluded. In such cases, the qualified person should explain why they are not making further recommendations.*

**Item 27: References** - Include a detailed list of all references cited in the technical report.