GUIDELINES UNDER MCDR FOR UNITED NATIONS FRAMEWORK CLASSIFICATION OF MINERAL RESERVES / RESOURCES

(See rule 45 (1) (c) and Forms H-1 to H-8 and H-9)

I. UNFC classification of reserves :-

A. DEFINITION OF TERMS AND CODES ON RESERVES AND RESOURCES UNDER UNITED NATIONS FRAMEWORK CLASSIFICATION (UNFC) OF MINERAL RESOURCES

The UNFC consists of a three dimensional system with the following three axes: Geological Assessment, Feasibility Assessment and Economic viability. The process of geological assessment is generally conducted in stages of increasing details. The typical successive stages of geological investigation i.e. reconnaissance, prospecting, general exploration and detailed exploration, generate resource data with a clearly defined degrees of geological assurance. These four stages are therefore used as geological assessment categories in the classification. Feasibility assessment studies form an essential part of the process of assessing a mining project. The typical successive stages of feasibility assessment i.e. geological study as initial stage followed by prefeasibility study and feasibility study/mining report are well defined. The degree of economic viability (economic or subeconomic) is assessed in the course of prefeasibility and feasibility studies. A prefeasibility study provides a preliminary assessment with a lower level of accuracy than that of a feasibility study, by which economic viability is assessed in detail.

It is a three digit code based system, the economic viability axis representing the first digit, the feasibility axis the second digit and the geologic axis the third digit. The three categories of economic viability have codes 1,2 and 3 in decreasing order, similarly the three categories of feasibility study have also codes 1,2 and 3 while the four stages of geological assessment are represented by 4 codes i.e. 1 (detailed exploration), 2 (general exploration), 3 (prospecting) and 4 (reconnaissance). Thus the highest category of resources under UNFC system will have the code (111) and lowest category the code (334). The various terms used in this classification and their definitions are as follows:

1. Total Mineral Resource

- A concentration (or occurrence) of material of intrinsic economic interest.
- Reasonable prospects for eventual economic extraction.
- Location, grade, quantity, geological characteristic known, estimated or interpreted from specific geological evidence and knowledge.

(i) Measured Mineral Resource (331)

- That part of mineral resource for which tonnage, densities, shape, physical characteristics, grade and mineral content can be estimated with a high level of confidence i.e. based on detailed exploration.

(ii) Indicated Mineral Resource (332)
- Tonnage, densities, shape, physical characteristic, grade and mineral content can be estimated with reasonable level of confidence based on exploration, sampling and testing information, location of borehole, pits etc. too widely spaced.

(iii) Inferred Mineral Resource (333)
- Tonnage, grade and mineral content can be estimated with low level of confidence. Inferred from geological evidence.

2. Mineral Reserve
- Economically mineable part of measured and/or indicated mineral resource.

(i) Proved Mineral Reserves (111)
- Economically mineable part of Measured Mineral Resource.

(ii) Probable Mineral Reserves (121 & 122)
- Economically mineable part of indicated or in some cases a measured mineral resource.

3. Reconnaissance Mineral Resource (334)
- Estimates based on regional geological studies and mapping, airborne and indirect Methods, preliminary field inspections as well as geological inference and extrapolation

4. Prefeasibility Mineral Resource (221 and 222)
- That part of an indicated and in some circumstances measured mineral resource that has been shown by prefeasibility study to be not economically mineable.
- Possibly economically viable subject to changes in technological, economic, environmental and/or other relevant condition.

5. Feasibility Mineral Resource (211)
- That part of measured mineral resource, which after feasibility study has been found to be economically not mineable.
- Possibly economically viable subject to changes in technological, economic, environmental and/or other relevant condition.

<u>Definition of Uneconomic Occurrence</u>

Materials of estimated quantity, that are too low in grade or for other reasons are not considered potentially economic. Thus, Uneconomic Occurrence is not pat of a Mineral Resource. If quantity and quality are considered worthy of reporting, it should be recognized that an Uneconomic Occurrence cannot be exploited without major technological and/or economic changes, which are not currently predictable.

<u>Mineral Occurrence:</u>

A Mineral Occurrence is an indication of mineralisation, that is worthy of further investigation. The term Mineral Occurrence does not imply any measure of volume/tonnage or grade/quality and is thus not part of a Mineral Resource.

B. Definitions of Terms to be used in the United Nations International Framework Classification for Reserves/Resources

Solid Fuels and Mineral Commodities –

Definitions of Stages of Feasibility Assessment

Mining Report	A **Mining Report** is understood as the current documentation of the state of development and exploitation of a deposit during its economic life including current mining plans. It is generally made by the operator of the mine. The study takes into consideration the quantity and quality of the minerals extracted during the reporting time, changes in Economic Viability categories due to changes in prices and costs, development of relevant technology, newly imposed environmental or other regulations, and data on exploration conducted concurrently with mining. It presents the current status of the deposits, providing a detailed and accurate, up-to-date statement on the reserves and the remaining resources.
Feasibility Study	A **Feasibility Study** assesses in detail the technical soundness and Economic Viability of a mining project, and serves as the basis for the investment decision and as a bankable document for project financing. The study constitutes an audit of all geological, engineering, environmental, legal and economic information accumulated on the project. Generally, a separate environmental impact study is required. Cost data must be reasonably accurate (usually within ± 10%), and no further investigations should be necessary to make the investment decision. The information basis associated with this level of accuracy comprises the reserve figures based on the results of Detailed Exploration, technological, pilot tests and capital and operating cost calculations such as quotations of equipment suppliers. A detailed list of the important items addressed in a Feasibility Study is given below :

List of the more important items to be addressed in a Feasibility Study

Geographical conditions	**Operating**
Infrastructure Þ public utilities Þ road, railways and other Þ manpower **Geology** Þ structure, size, shape Þ Mineral content, grade, density Þ reserve/resource quantity and quality Þ other relevant geological features **Legal Matters** Þ Rights and ownership Þ Socioeconomic impact studies Þ Public acceptance Þ Land requirements Þ Government factors	Þ rock mechanics Þ mining equipment Þ mining method Þ construction plan and schedule Þ appropriate technological pilot tests Þ mill and processing plant Þ tailings disposal Þ water management Þ transportation Þ power supply Þ manpower/labour relations Þ auxiliary facilities and services Þ closure design **Environment** (if not dealt with in a separate study) **Market analysis** **Financial Analysis** Þ Capital cost Þ Cashflow forecast Þ Investment cost Þ Inflation forecast Þ Operating cost Þ Sensitivity studies Þ Closure cost Þ Rehabilitation cost **Risk Assessment**

A sensitivity study may require independent verification in certain circumstances.

Definition of Stages of Feasibility Assessment (Contd.)

Prefeasibility Study	A **Prefeasibility Study** provides a preliminary assessment of the Economic Viability of a deposit and forms the basis for justifying further investigations (Detailed Exploration and Feasibility Study). It usually follows a successful exploration campaign, and summarizes all geological, engineering, environmental, legal and economic information accumulated to date on the project. In projects that have reached a relatively advanced stage, the Prefeasibility Study should have error limits of ± 25%. In less advanced projects higher errors are to be expected. Various terms are in use internationally for Prefeasibility Studies reflecting the actual accuracy level. The data required to achieve this level of accuracy are reserves/resources figures based on Detailed and General Exploration, technological tests at laboratory scale and cost estimates e.g. from catalogues or based on comparable mining operations. The Prefeasibility Study addresses the items listed under the Feasibility Study, although not in as much details.
Geological Study	A **Geological Study** is an initial evaluation of Economic Viability. This is obtained by applying meaningful cut-off values for grade, thickness, depth and costs estimated from comparable mining operations. Economic Viability categories, however, cannot in general be defined from the Geological Study because of the lack of detail necessary for an Economic Viability evaluation. The resource quantities estimated may indicate that the deposit is of intrinsic economic interest, i.e. in the range of economic to potentially economic. A Geological Study is generally carried out in the following four main stages: Reconnaissance, Prospecting, General Exploration and Detailed Exploration (for definition of each stage see below). The purpose of the Geological Study is to identify mineralization, to establish continuity, quantity, and quality of a mineral deposit, and thereby define an investment opportunity.

Definitions of Stages of Geological Study

Reconnaissance	A **Reconnaissance** study identifies areas of enhanced mineral potential on a regional scale based primarily on results of regional geological studies, regional geological mapping, airborne and indirect methods, preliminary field inspection, as well as geological inference and extrapolation. The objective is to identify mineralised areas worthy of further investigation towards deposit identification. Estimates of quantities should only be made if sufficient data are available and when an analogy with known deposits of similar geological character is possible, and then only within an order of magnitude.
Prospecting	**Prospecting** is the systematic process of searching for a mineral deposit by narrowing down areas of promising enhanced mineral potential. The methods utilised are outcrop identification, geological mapping, and indirect methods such as geophysical and geochemical studies. Limited trenching, drilling, and sampling may be carried out. The objective is to identify a deposit which will be the target for further exploration. Estimates of quantities are inferred, based on interpretation of geological, geophysical and geochemical results.
General Exploration	**General Exploration** involves the initial delineation of an identified deposit. Methods used include surface mapping, widely spaced sampling, trenching and drilling for preliminary evaluation of mineral quantity and quality (including mineralogical tests on laboratory scale if required), and limited interpolation based on indirect methods of investigation. The objectivce is to establish the main geological features of a deposit, giving a reasonable indication of continuity and providing an initial estimate of size, shape, structure and grade. The degree of accuracy should be sufficient for deciding whether a Prefeasibility Study and Detailed Exploration are warranted.
Detailed Exploration	**Detailed Exploration** involves the detailed three-dimensional delineation of a known deposit achieved through sampling, such as from outcrops, trenches, boreholes, shafts and tunnels. Sampling grids are closely spaced such that size, shape, structure, grade, and other relevant characteristics of the deposit are established with a high degree of accuracy. Processing tests involving bulk sampling may be required. A decision whether to conduct a Feasibility Study can be made from the information provided by Detailed Exploration.

Definition of Economic Viability Categories

Economic	Quantities, reported in tonnes/volume with grade/quality, demonstrated by means of a Prefeasibility Study, Feasibility Study or Mining Report, in order of increasing accuracy, that justify extraction under the technological, economic, environmental and other relevant conditions, realistically assumed at the time of the determination. The term economic comprises both normal economic and exceptional economic as defined below. These two subcategories are for optional use on a national level.
Normal Economic	Normal economic reserves are reserves that justify extraction under competitive market conditions. Thus, the average value of the commodity mined per year must be such as to satisfy the required return on investment.
Exceptional Economic (Conditional economic)	Exceptional (conditional) economic reserves are reserves which at present are not economic under competitive market conditions. Their exploitation is made possible through government subsidies and/or other supportive measurees.
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Potentially Economic	Quantities, reported in tonnes/volume with grade/quality, demonstrated by means of a Prefeasibility Study, Feasibility Study or Mining Report, in order of increasing accuracy, not justifying extraction under the technological economic, environmental and other relevant conditions, realistically assumed at the time of the determination, but possibly so in the future. The term potentially economic comprises both marginal and submarginal as defined below. These two subcategories are for optional use on a national level.
Marginal Economic	Marginal economic resources are resources which at the time of determination are not economic, but border on being so. They may become economic in the near future as a result of changes in technological, economic, environmental and/or other relevant conditions.
Submarginal Economic	Submarginal economic resources are resources that would require a substantially higher commodity price or a major cost-reducing advance in technology to render them economic.
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Economic to Potentially Economic (intrinsically economic)	Quantities, reported in tonnes/volume with grade/quality, estimated by means of a Geological Study to be of intrinsic economic interest. Since the Geological Study includes only a preliminary evaluation of Economic Viability, no distinction can be made between economic and potentially economic[1/]. These Resources are therefore said to lie in the range of economic to potentially economic.

1/ Except in the case of low investment mineral commodities like sand, gravel and common clay, where a distinction between economic and potential economic can be made.

C. FIELD GUIDELINES FOR ADOPTION OF UNITED NATIONS FRAMEWORK CLASSIFICATION

I . Stratiform, Stratabound and Tabular Deposits of Regular Habit

Characteristics of deposits

Of regular habit with predictable change in trend with sharp to moderate physical contrast with bounded surfaces, low dipping to moderately steep, simply folded and faulted. Also as blanket cappings and surficial tabular bodies.

Principal kinds of minerals

Coal seams, lignite beds, iron ore formation and cappings, manganese horizons in sedimentary and meta-sedimentary sequences, thick bauxite cappings, regional chromite lodes in large ultramafics; limestone, dolomite, barytes, gypsum, evaporites (including potash and salt beds), chalk and fireclay, fuller's earth.

GEOLOGICAL AXIS

G4 (Reconnaissance)	G3 (Prospecting)	G2(General Exploration)	G1(Detailed Exploration)
1.Aerial reconnaissance: Remote sensing, airborne geophysical survey etc. **2.Geological survey:** Mapping on 1: 50,000 or smaller scales. **3.Geochemical survey**: (i)Grab/chip sampling of rocks or weathered profiles (Nil for coal/lignite); (ii)Recording of broad geomorphology, drainage, etc. **4. Geophysical survey:** Ground geophysical survey. **5. Technological :** (i)Trenching - One or two to expose mineralised zone at ideal locations only; (ii)Pitting/drilling: Up to 5 test pits/boreholes per 100 sq.km. area; (iii)Scout drilling – A few to know the existence of coal/lignite; (iv)Sampling -Regional and random grab/chip sampling.	1.**Geological survey:** (i) Mapping on 1:50,000 to 1:25,000 scale (for coal, lignite exploration-mapping on 1:10,000); (ii)Linking of maps so prepared with topo-grids; (iii)Assessment of lithology, structure, surface mineralisation, analysis of old history of mining. **2.Geochemical survey**: Geochemical sampling, rock type-wise and if necessary, rock type-cum-skeletal soil-domain-wise (for all metallic mineral exploration). **3.Geophysical survey:** Detailed ground geophysical work; bore-hole geophysical logging, if possible. **4)Technological**: (a)Pitting/trenching to explore bed rock/mineralised zone; (b)Drilling:Preliminary drilling (dry drilling for bauxite and in formation vulnerable to wash). Bore-hole spacing -	**1.Geological survey :** (i)Mapping on 1:25,000 to 1:5,000 or larger scale with triangulation points, benchmarks, if any shown For coal, mapping on 1:10,000 scale (ii) Linking of maps so prepared with topogrid; (iii)Assessment of lithology, structure, surface mineralisation, analysis of old history of mining. **2. Geochemical survey:** (i)Detailed litho-geochemical channel sampling from fresh rock exposures, trenches, pits; (ii)Recording of deleterious elements, likely by-product elements (e.g. Ga in bauxite, Ni, PGE etc. in chromite, Au in Fe ore, etc. (Nil for coal/lignite exploration); (iii)In coal/ lignite exploration, geo-chemical sampling of coal and water to be done for environmental study. **3.Geophysical survey:** (i)Borehole geophysical survey;	**1.Geological survey:** (i)Mapping-For coal, mapping 1:5000;for other minerals 1:1000 (ii)Preparation of detailed topographical-cum-geological map including all surface geological features, extent of deposit, structure, location of boreholes, assay plan and sections of exploratory mine development and borehole data; (iii)Topogrid/triangu-lation stations/identified fiducials linking in the maps. **2.Geochemical survey:** Detailed grid pattern sampling and analysis. **3.Geophysical survey:** Detailed and specific borehole geophysical survey. **4.Technological:** (i)Pitting - 2 to 5 per sq. km. for simple deposits; (ii)Trenching - At spacing of 200-300m;

6. Petrographic and mineragraphic studies: Determination of principal rock types, mineral assemblage, identification of minerals of interest (especially of metallic minerals and gangues). **7.** Synthesis of all available data/concepts. **8**.The activities as above or less than that required for **G3.**	(i)Coal, gypsum, near surface potash and salt-beds- 1000 to 2000 meters; (ii) Iron and manganese ore - 200 to 400 m; (iii) Limestone and dolomite - 400 to 500 m; (iv)Bauxite of thick capping - 300 to 400 m. (v) Chromite as regional lode - 300 m; (vi) Barytes formations - 400 to 500 m. (c) Sampling: Sampling at well-defined locations at surface and also from pits/trenches, boreholes and existing mine openings. **5.Petrographic/mineragr-aphic studies:** (i)Petrographic study of rocks of the deposit and its surroundings, alterations (if any) connected with mineralisation; (ii)Determination of phase in which mineral of interest occur; (iii)Mineralogical studies including paragenesis, identification of zones of oxidation and primary zones, grain size distribution, overall characteristics of useful minerals.	(ii)Special geophysical traverses for problem solving, if required . **4**.**Technological**: (a)Pitting/trenching: systematic pitting/trenching for deciphering extent of mineralisation at surface. (b)Drilling: grid reduction needed: spacing (i) for coal, gypsum near surface potash and salt beds-400 to 1000m; (ii) Iron and manganese ore-100 to 200m. (iii) limestone and dolomite and barytes- 200 to 400m up to a depth of at least 30 m; (iv) bauxite of thick cappings and chromite as regional lode-100 to 300m. (c) Sampling: (i) Systematic pit and trench sampling, deep pitting if necessary; (ii) Core sampling: lithology and strength of mineralisation wise (check sampling -10%). (d) Laboratory scale scanning/chemical analysis, (e) Bulk sampling if necessary for testing processing technology. (f) Collection of abiotic geo-environmental parameters. **5.Petrographic:**Study of petrographic character of rocks including grain size, texture etc.	(iii)Drilling- closer spaced (with definite grid pattern) than that for G2 category; For coal, i)Density of boreholes to be 12 to 15 per sq.km. depending on the complexities for geostructural proving. ii) For opencast project grid spacing may be 100m x 50m depending on the geology, weather mantle cover , burning nature of coal seams. (iv)Exploratory mining and check drilling results if possible ; (v)Sampling- systematic pit and trench sampling, core and sludge sampling for laboratory scale and bulk sample for the pilot plant scale beneficiation studies. **5.Petrographic and mineragraphic study:** Refining of data on the petrographic character of rocks of the deposit and its surroundings, alterations (if any), including study of grain size texture gangue and its liberation characteristics for further refining of data **6)Geostatistical analysis** of borehole data thickness of ore : waste encountered in holes, assay values of samples if considered neccesarry.

FEASIBILITY AXIS

F3 (Geological Study)	F2 (Pre-feasibility Study)	F1 (Feasibility Study)
1.Geological and related study: (i) Geological, mineralogical and chemical analysis data; (ii) Topographical setting and nature of land; (iii) Infrastructure; (iv) Meteorological and preliminary ecology data if possible. **2**. The activities as above or less than that required for **F 2.**	**1. Geology:** Local geology, mineralogy, identification of ore types and geometry. **2. Mining:** Methods, pre-production plan, development plan, manpower (rough estimate). **3. Environment:** Base line data on environment. **4. Processing:** Proven laboratory scale/pilot scale beneficiation, investigation data,likely establishment, **5.Infrastructure and services, construction activities**: Brief details **6. Costing**: Capital and operating cost - rough estimates based on comparable mining operations. **7.Marketing**: Overview like industrial structure, demand supply relation, pricing, etc. **8. Economic viability:**Preliminary study of cash flow forecasts. **9. Other factors**: Statutory provisions relating to labour, land, mining, taxation, etc.	**1. Geology:** Geology of area and project, detailed exploration, closed spaced drilling, ore body modelling, bulk samples for beneficiation, geotechnical and ground water &surface waters studies.However for coal, beneficiation studies to be carried out depending upon coal qualities. **2. Mining:** Mining plan, mine recoveries and efficiencies, equipment selection, manpower requirement. **3.Environment:** EIA studies and EMP including socio-economic impact, rehabilitation of project affected persons, waste disposal/reclamation.,detailed land use data. **4. Processing**: Pilot scale/industrial scale investigation data, list of equipment, manpower and environmental considerations like waste disposal of tailing, etc. **5. Infrastructure and services, construction activities:** Full details **6. Costing:** Detailed break-up of capital cost, operating cost, details of working capital. **7.Marketing:** Overview, specific market aspects. **8. Economic viability**: Cash flow forecast, inflation effects, sensitivity studies. **9. Other factors:** Statutory provisions relating to labour, land, mining, taxation etc.

ECONOMIC AXIS

E3(Intrinsically Economic)	E2 (Potentially Economic)	E1(Economic)
1.Reconnaissance to detailed geological study, rough estimates of grades (may be below economic cut-off), general idea about forest /non –forest and land use status. 2. The activities as above or less than that required for **E 2.**	1.General and detailed exploration 2 .Specific end-use grades of reserves (above /marginally below economic cut-off grade). 3. General knowledge of forest/non-forest and other land use data.	1.Detailed exploration. 2.Mining report /mining plan / working mines. 3.Specific end-use grades of reserves (above economic cut-off grade). 4. Specific knowledge of forest/non-forest and other land use data.

II.Stratiform, Stratabound and Tabular Deposits of Irregular Habit

Characteristics of deposits

Of irregular habit and /or with faults of large measures, shear zones, solution cavities, irregular erosion and weathering (oxidation) features, partings and bifurcations, igneous intrusives, facies changes, etc.

Principal kinds of minerals

Coal seams, lignite belt, iron ore formations and cappings, manganese horizons in sedimentary and meta-sedimentary sequences, thick bauxite cappings, regional chromite lodes in large ultramafics, limestone, dolomite, barytes, gypsum, evaporites including potash and saltbelts, chalk and fireclay, fullers earth, gold in banded iron formation, platinum group of elements in chromite or in chromite bearing rocks and molybdenum in shear - controlled zones.

GEOLOGICAL AXIS

G4 (Reconnaissance)	G3 (Prospecting)	G2 (General Exploration)	G1(Detailed Exploration)
1.Aerial reconnaissance: Remote sensing, airborne geophysical survey, etc. **2.Geological survey:** Mapping on 1:50,000 or smaller scales. **3. Geochemical survey:** (i) Grab/chip sampling of rocks or weathered profiles (Nil for coal/lignite exploration); (ii)Recording of broad geomorphology, drainage etc. **4.Geophysical survey :** Ground geophysical survey. **5.Technological :** (i)Trenching - One or two to expose mineralised zones at ideal locations only; (ii)Pitting /drilling- Upto 5 test pits / boreholes per 100 sq.km area; (iii)Scout drilling - a few to know existence of coal /lignite; (iv)Sampling – Regional and random grab/chip sampling. **6. Petrographic and mineragraphic studies**: (i)Determination of principal rock types,	**1.Geological survey**: (i) Mapping on 1:50,000 to 1:25,000 scale (for coal, lignite exploration-mapping on 1:10,000); (ii) Linking of maps so prepared with topogrids; (iii) Assessment of detailed statigraphy, lithology, structure, surface mineralisation, analysis of old history of mining. **2.Geochemical survey:** Grid geochemical sampling- rock type wise and if necessary, soil-domain-wise (for all metallic mineral exploration). **3.Geophysical survey:** Detailed ground geophysical work. **4.Technological:** (i)Pitting/trenching/ drilling depending on variability; (ii) Selection of drilling sites best suited to unravel the lithological/ structural complexities. **5.Petrographic/miner-agraphic studies:** (i)Petrographic study of rocks of the deposit and	**1.Geological survey:** (i) Mapping on 1:25000 to 1:1000 or larger scale with triangulation points, benchmarks, if any;For coal, mapping on1:10,000 scale (ii) Linking of maps so prepared with topo- grids. **2.Geochemical survey:** (i)Detailed litho-chemical channel samplling from fresh rock exposures, trenches, pits; (ii)Recording of deleterious elements,likely by-product elements (e.g. Ga in bauxite, Ni, PGE etc. in chromite, Au in Fe ore, etc. (Nil for coal/ lignite exploration). **3. Geophysical survey:** (i)Borehole geophysical survey; (ii)Special geophysical traverses for problem solving if required; (iii)Concurrent synthesis of multi-disciplinary data, Bore-hole geophysical logging, if possible. **4. Technological:** (i)Pitting/trenching-pitting/trenching for helping surface and subsurface correlation of mineralised zones; (ii)Drilling - Close spaced at 200 x 200m grid to decipher the ore -shoot behaviour	**1.Geological survey:** (i)Mapping a)Coal –1:5000 b) For other minerals-1:1000 or larger scale; (ii)Preparation of detailed topographical -cum-geological map including all surface geological features, extent of deposit, structure, location of boreholes, assay plan and sections of exploratory mine development and borehole data. **2.Geochemical survey:** Detailed lithogeochemical analysis **3.Geophysical survey:** Detailed borehole geogphysical survey **4. Technological:** (i)Pitting: 3 to5 nos. for every mass body or at 100-200 meter grid interval; (ii)Trenching- At spacing of 50 to 200 meters; (iii)Drilling- Closer spaced than that for G-2 at 3-4 levels down to a workable depth;(iv)Sampling- Core and sludge, pits samples for grade analysis or beneficiation, bulk samples for laboratory scale / pilot plant investigation; (v)Collection of abiotic geo-

mineral assemblage; (ii)Identification of minerals of interest (especially of metallic minerals and gangues); **7**. Synthesis of all available data / concepts. **8.**The activities as above or less than that required for **G-3**.	its surroundings, alterations (if any), connected with mineralisation; (ii)Determination of phase in which mineral of interest occur; (iii)Mineralogical studies including paragenesis, identification of zones of oxidation and primary zones, grain size distribution, overall characteristics of useful minerals.	atleast at two level. In general, spacing of probe points along strike may be 100m but in specific cases depending on the necessity it may be brought down to 50 m. especially for precious metals. A few probe points for deeper intersections; (iii)Detailed core sampling, bulk sampling for testing of processing technology ; (iv)Collection of abiotic geo-environmental parameters. **5. Petrographic**: Refining of data on the petrographic character of rocks including study of grain size,texture and liberation characteristics.	environmental data - its further refining and analysis. **5.Petrographi**c: Study of petrographic characters of rock and study of useful minerals. **6)Geostatistical analysis** of borehole data, thickness of ore : waste encountered in holes, assay values of samples if considered neccesarry.

FEASIBILITY AXIS

F3 (Geological Study)	F2 (Pre-feasibility Study)	F1 (Feasibility Study)
1.Geological and related study: (i) Geological study encompassing reconnaissance to prospecting, general/ detailed exploration; (ii) Geological map depicting extent of mineralisation lithology/host rocks, mineralogical and chemical data and its interpretions, studies on amenability to beneficiation, recoveries and their estimates; (iii)Infrastructure; (iv)Environmental: Meteorological and preliminary ecological data of area if possible. **2**.The activities as above or less than that required for F-2.	**1.Geology**:General/ detailed exploration ,moderate to close spaced drilling, trench/pit/ bore hole sampling to delineate complexity of ore body/ mineralisation, bulk sampling for processing/ beneficiation (bench scale/pilot scale). **2. Mining:** Methods with geotechnical considerations,preproduction plan, likely mine recoveries. **3. Environmental**: Base line data on environment of the area. **4. Processing:** Proven laboratory scale/pilot plant scale ore dressing investigations on bulk samples, likely establishment of plant and cost estimates thereof. **5. Infrastructure and services and constructions activities:** Brief details. **6. Costing:** Capital cost with estimates based on comparable mining operations **7. Marketing:** Over view on demand supply relations, industry structure, pricing etc. **8**. **Economic viability**: Preliminary study of cash flow forecast. **9. Other factors:** Statutory provisions relating to labour , land , mining, taxation etc.	**1.Geology**: Geology of area and project, detailed exploration, closed spaced drilling,ore body modelling, bulk samples for beneficiation, geotechnical and ground water&surface water studies. **2.Mining:** Methods with special emphasis on detailed geotechnical test work/ site characterisation studies, safety measures; mining plan, mine recoveries and efficiency with variability due to structural complexeties like close folds and faults; detailed estimates of manpower. **3. Environmental**: (i)Environmental impact assessment (EIA) studies/environmental management plan (EMP) including socio-economic impacts; (ii)Rehabilitation of project affected persons, and waste disposal/ reclaimation ; detailed land use data. **4. Processing** : Details of proven pilot plant scale/ industrial scale investigations appended with layout design ,equipment list fuel/power consumption, specification for product/ by-product, disposal of tailings, effluent and future remedial measures. **5. Infrastructure and services and constructions activities:** Full details. **6. Costing**: Detailed breakup of capital and operating costs and details of working capital . **7. Marketing:** Marketing overview, specific market aspects. **8. Economic viability** : Cash flow forecast inflation effects and sensitivity studies **9. Other factors :** Statutory provisions (labour , land , mining, taxation, etc.)

ECONOMIC AXIS

E3(Intrinsically Economic)	**E2** (**Potentially Economic)**	**E1**(**Economic)**
1.Reconnaissance to detailed geological study, rough estimates of grades (may be below economic cutoff), general idea about forest/ non- forest and land use status. **2.** The activities as above or less than that required for **E 2.**	**1**.General and detailed exploration. **2**.Specific end-use grades of reserves (above economic cut-off grade). **3**. General knowledge of forest/non-forest and other land use data	**1**.Detailed exploration. **2.** Mining report/mining plan/ working mine. **3**. Specific end-use grades of reserves (above economic cut-off grade). **4**. Specific knowledge of forest/non-forest and other land use data.

III. Lenticular Bodies of All Dimensions Including Bodies Occurring en echelon, Silicified Linear Zones of Composite Veins

Characteristics of Deposits

Gradual and abrupt change in thickness and grade along strike and dip direction; bounding surfaces of mineralized bodies often, but in sulphides mostly, defined by assay contacts:

(a) massive bodies with irregular shape and grade-homogeneous to inhomogeneous distribution of metal values as in replacement and disseminated type bodies - shapes interpretative;
(b) steeply dipping narrow bodies with or without pitch, pinch and swell type, with or with out bi-furcations, partings etc.

Principal kinds of minerals

Base metal sulphides, supergene iron and manganese ore bodies in lateritoid country, pockety bauxite and nickel-cobalt lateritoids,auriferous quartz reefs, PGM in association with sulphides , graphite lenses, porphyry deposits of copper, molybdenum, and tin, pyrite, pyrrhotite bodies .

GEOLOGICAL AXIS

G4 (Reconnaissance)	**G3 (Prospecting)**	**G2 (General Exploration)**	**G1 (Detailed Exploration)**
1. Aerial Recconnaissance: Remote sensing, airborne geophysical survey etc. **2. Geological survey:** Mapping on 1:50,000 or smaller scales. **3.Geochemical survey:** (i)Stream sediment, soil overburden, rocks, chips, grabs, groundwater and any other soluble media (decided on the basis of orientation survey) sampling, identification of ore significant zones; (ii)Delineation of predominently forest area, geomorphology, landforms and vegetable developments etc. **4.Geophysical survey :** Ground geophysical survey. **5.Technological :** (i)Widely spaced pitting/trenching to expose mineralised zones; (ii)Sampling - a)Regional and random	**1.Geological survey:** : (i)Mapping on 1:50,000 to 1:5000 scale depending on geology of area; (ii)Linking of maps so prepared with topogrids; (iii)Assessment of lithology, structure, surface mineralisation and analysis of old history of mining. **2.Geochemical survey:** (i)Study of detailed and primary and secondary geochemical parameters(close grid sampling) of prospects and their processing rock type-wise and rock type-cum-overburden wise for identification of ore significant anomaly zones; (ii)Recording of deleterious elements, likely by-product elements. **3.Geophysical survey:** (i)Detailed ground geophysical work; (ii)Bore-hole geophysical survey.	**1.Geological survey:** (i)Mapping on 1:5,000 to 1:1,000 or larger scale with triangulation stations, benchmarks, if any; (ii)Linking of maps so prepared with topo- grids, (iii)Assessment of lithology, structure, surface mineralisation, analysis of old history of mining. **2. Geochemical survey:** (i)Detailed litho-geo-chemical channel sampling from fresh rock exposures, trenches, pits for further refinement of data; (ii)Recording of deleterious elements and likely by-product elements. **3.Geophysical survey**: (i) Borehole geophysical survey ; (ii)Special geophysical traverses for problem solving if required. **4. Technological** (i) Pitting/trenching for helping surface and subsurface, correlation of mineralised zones;	**1. Geological survey:** (i)Mapping-1:1000 or larger scale; (ii)Preparation of detailed topographical -cum-geological map including all surface geological features, extent of deposit, structure, location of pits/trenches/boreholes, assay plan and sections of exploratory mine development and borehole data. **2. Geochemical survey:** (i)Detailed litho-geo-chemical channel sampling from fresh rock exposures/ trenches, pits; (ii)Analysis of geo-chemical data for potential utilisation. **3. Geophysical survey:** (i) Borehole geophysical survey ; (ii)Special geophysical traverses for problem solving , if required. **4. Technological:** (i)Pitting/trenching for helping surface and subsurface correlation of

grab/chip sampling, b)Channel sampling for exposures in trenches. **6.Petrographic and mineragraphic studies**: (i)Determination of principal rock types, mineral assemblages; (ii) Identification of minerals of interest (especially of metallic minerals and gangues). **7.**Synthesis of all available data/concepts **8**. The activities as above or less than that required for G-3.	**4**.**Technological**: (i)Pitting/trenching to explore mineralised zones to decipher surface manifestation of mineralisation - moderately spaced preferably at 500 - 400m interval; (ii)Preliminary drilling - (a) Spacing will be guided by the structural complexity or nature of discontinuity, (b)Spacing of probe points along strike generally between 100and 200m; (iii)Further drilling to be planned to intersect ore-shoot,ore body at least at two levels with only few deeper level intersections; (iv)Exploration planning to be guided by the result of ground geochemical and geophysical studies, pit sampling/ trench/core sampling (5% check sampling). **5.Petrographic/minera graphic studies:** (i)Petrographic study of rocks of the deposit and its surroundings, alterations (if any), connected with mineralisation; (ii)Determination of phase in which mineral of interest occurs; (iii)Mineralogical studies including paragenesis, identification of zones of oxidation and primary zones, grain size distribution, overall characteristics of useful minerals.	(ii)Drilling- close –spaced drilling to decipher the ore -shoot behaviour atleast upto two levels; in general, spacing of probe points along strike may be 100m but in specific cases, depending on the necessity, it may be brought down to 50 m. especially for precious metals; a few probe points for deeper intersections; (iii)Detailed core sampling, bulk sampling for testing of processing technology; (iv)Collection of abiotic geo-environmental parameters. (10% check sampling). **5. Petrographic**; Detailed study of data on the petrographic character of rocks including study of grain size ,texture, liberation characteristics.	mineralised zones; (ii)Drilling: closer–spaced than that for G-2 and upto the depth of 100-50 m. below the oxidation zone - depending on the necessity it may be brought down to 50 m. or less especially for precious metals; a few probe points for deeper intersections; (iii)Sampling- detailed core sampling, bulk sampling for testing of processing technology on laboratory/pilot plant scale; (iv)Collection of abiotic geo-environmental parameters. **5. Petrographic:** Detailed study of data on the petrographic character of rocks including study of grain size ,texture, liberation characteristics and further refining of data. **6)Geostatistical analysis** of borehole data (thickness of ore :waste encountered in holes, assay values) if considered necesarry.

FEASIBILITY AXIS

F3 (Geological Study)	F2 (Pre-feasibility Study)	F1 (Feasibility Study)
1. Geological and related study: Geology of area, reconnaissance and prospecting by geo-chemical and geo-physical surveys/general exploration/detailed exploration, core and sludge samples, for beneficiation; geological maps depicting extent and dimension of mineralisation lithology of host rocks, controls and guides for mineralisation, amenability to beneficiation; infrastructure; environmental base line data. **2.** The activities as above or less than that required for F-2.	**1. Geology**: Geology of area, detailed exploration/general exploration guided by geo-chemical and geo-physical surveys, moderate to close - spaced drilling, different mineralised zones at viable cut off grades, core and sludge sampling for exploratory stage beneficiation studies/laboratory scale investigations. **2.Mining** : Methods, pre-production plan, development plan, manpower requirements. **3.Environment :** EIA/EMP with details of waste disposal and likely unavoidable effects of projects. **4.Processing**: Proven laboratory scale/pilot plant scale ore dressing investigations on bulk samples and likely establishment, cost estimates for processing plant. **5.Infrastructure and services and construction activities**: Brief details. **6. Costing** :Capital and operating costs-rough estimates based on comparable mining operations. **7. Marketing**: An overview, demand supply relations, industry structure. **8. Economic viability**: Preliminary study of cash flow forecasts. **9. Other factors:** Statutory provisions relating to land, labour, mining, taxation, etc.	**1.Geology:** Geology of area and project, detailed exploration, closed spaced drilling, exploratory mining upto 2^{nd} level and undeground boreholes, channel/groove sampling (50-100 cm), ore body modelling, bulk samples for beneficiation, geotechnical and ground & surface waters studies. However for coal beneficiation studies to be carried out depending upon coal qualities. **2.Mining:** Mining plan, mine recoveries and efficiencies, man power requirements. **3.Environment:** EIA/EMP including socio economic impact, rehabilitation of project affected persons, waste disposal/ reclamation;.detailed land use data. **4.Processing:** Details of proven pilot plant /industrial scale investigations, appended with plant layout, design, equipment list, manpower, fuel/power consumption, environmental considerations, disposal of tailings, effluents and future/present remedial measures. **5. Infrastructure and services and construction activities**: Full details. **6. Costing:** Details of break up of capital and operating costs and working capital. **7.Marketing:** Overview, specific marketing aspects. **8. Economic viability**: Cash flow forecasts, inflation effects, sensitivity studies. **9. Other factors:** Statutory provisions relating to land, labour, mining, taxation, etc.

ECONOMIC AXIS

E3(Intrinsically Economic)	**E2 (Potentially Economic)**	**E1(Economic)**
1.Reconnaissance to detailed geological study, rough estimates of grades (may be below economic cut -off), general idea about forest / non - forest and land use status. **2.**The activities as above or less than that required for E-2.	**1.**General and detailed exploration. **2.** Specific end-use grades of reserves (above/ marginally below economic cut-off grade). **3.** General knowledge of forest/non-forest and other land use data .	**1**.Detailed exploration. **2.** Mining report/mining plan/ working mines. **3**. Specific end-use grades of reserves (above economic cut-off grade). **4.** Specific knowledge of forest/non-forest and other land use data.

IV. Lenses, Veins and Pockets; Stock-works, Irregular Shaped, Modest to Small size Bodies

Characteristics of deposits

Bodies distributed in space lacking estimable regular patterns; structural control less than lithologic, if any; small cluster of multi-shaped bodies, of volcanic origin pipes and chimneys, of magmatic origin, plugs and pots, clots and seggregations of hydrothermal origin – vein and replacement. Bodies in stockwork, metaporphic and meta-somatic in skarn and tektites, in griesens and in thermal aureole around intrusives.

Principal kinds of minerals

Small multimetal complex sulphide bodies of Cu-Pb-Zn-Sb-Hg, podiform chromite, Sn-Ag chimneys and pipes; tektite mineral bodies, skarn bodies of scheelite, powellite, wollastonite, fluorite etc. and semi-precious minerals, network of apatite, baryte, asbestos veins, vermiculite bodies, magnesite lenses and mica in pegmatites, pyrophyllite lenses and veins, high grade bauxite in clay pockets, clay, ochre and bentonite lenses, diamond pipes.

GEOLOGICAL AXIS

G4 (Reconnaissance)	G3 (Prospecting)	G2(General Exploration)	G1(Detailed Exploration)
1.Aerial reconnaissance:Remote sensing, airborne geophysical survey etc. **2.Geological survey:** Mapping on 1:50,000 scale or smaller scales. **3.Geochemical survey:** (i)Sampling of stream, sediment, soil over burden, rock chips, grabs, ground water or any other soluble media; (ii)Delineation of predominantly forest areas, geomorphology, landforms and vegetable development. **4. Geophysical survey:**Ground geophysical work. **5.Technological:** (i)Pitting and drilling: Upto 5 test pits/bore boles per 100 sq. km. area; (ii)Sampling : Regional and random sampling;	**1.Geological survey:** (i) Mapping on 1:5,000 scale and larger scale; (ii) Linking of the geological maps with topo-grids; (iii)Assessment of stratigraphy, lithology, structure surface shows of mineralisation and analysis of metallogeny. **2.Geochemical survey:** (i)Study of detailed primary and secondary geochemical parameters based on closed grid sampling, identification of ore significant anomaly zones; (ii)Recording of deleterious and byproduct elements. **3.Geophysical survey:** (i)Detailed ground geophysical work; (ii)Borehole geophysical survey.	**1.Geological survey:** Mapping on 1:5,000 to 1:1,000 scales with triangular stations, bench marks if any and fiducials plotted. **2.Geochemical survey:** Detailed lithogeochemical sampling for further refining of data. **3.Geophysical survey:** Borehole geophysical surveys, special geophysical surveys for problems solving if required. **4.Technological:** (i)Closed spaced trenching and extensive sampling for exploring irregularly shaped zones of mineralization; (ii)Close space drilling (50m-30m); (iii)Bore hole deviation surveys; (iv)Beneficiation tests; (v)Exploration preferably with exploratory mining, systematic core sampling, check analysis 10%, deep piting.	**1. Geological survey:** (i)Mapping on 1:1000 scale; (ii)Preparation of topographical-cum-geological map including all surface geological features,extent of deposit, trenches,pits,borehole locations, level-wise assay plan and exploratory mine development. **2. Geochemical survey**: Detailed litho-geochemical channel sampling from fresh rock exposures, pits /trenches. **3.Geophysical survey:** Wherever necessary. **4**.**Technological:** (i)Pitting /trenching- as necessary; (ii)Drilling - 30 to 15 m or less strike interval upto a depth of 100m; (iii)Exploratory mining: 2-3 levels at 20-30m interval wherever necessary; (iv)Core sludge, channel, bulk samples for beneficiation studies on bench/ pilot scale. **5. Petrographic:** Further refining of data.

(iii)Collection of sample for deciphering the mineralised zones. **6.Petrographic and mineragraphic study**: (i)Determination of principal rock types and mineral assembleges; (ii)Identification of minerals of interest and gangues and determination of useful minerals. **7**. Synthesis of all available data/concepts. **8.** The activities as above or less than that required for G-3.	**4.Technological :** (i) Sampling at well defined locations, extensive pit, trench and surface sampling to decipher the extent and grade of mineralisation at surface; (ii)Core sampling; (iii)Laboratory studies of samples; (iv)Check samples-10%; (v)Deep pitting to decipher grade variation of irregularly shape mineralisation; (vi)Drilling - 100m to 50 m. interval; borehole deviation survey. **5.Petrographic and mineragraphic** : (i)Petrographic studies of rocks of deposits and its surrounding, alteration connected with mineralisation; (ii)Mineralogical studies including identification of zones of oxidation and primary zones, grain size analysis, overall chracteristics of useful and deleterious minerals.	**5.Petrographic:** Further refining of data.	**6)Geostatistical analysis** of borehole data (thickness of ore :waste encountered in holes, assay values), if considered neccesarry.

FEASIBILITY AXIS

F3 (Geological Study)	F2 (Pre-feasibility Study)	F1 (Feasibility Study)
1.Geological and related study: (i)Reconnaissance prospecting by geochemical, geophysical, scout drilling to understand controls of mineralisations/ general and detailed exploration; (ii)Geological maps showing extent and persistence of mineralisations, guides, controls, hostrock, lithology etc; (iii)Infrastructure; (iv)Preliminary ecological and meteorological data, if possible. **2.** The activities as above or less than that required for **F-2.**	**1. Geology:** (i)Geology of area; (ii)General and detailed exploration guided by surface and sub-surface geochemical and geophysical data, exploratory mining details. **2. Mining:** mine recoveries estimates, man power details, pre-production plan . **3. Environment:** Baseline data, potential constraints on project. **4. Processing:** Proven laboratory scale /pilot scale investigations on bulk samples; likely establishment of plant; possibilities of cost estimates. **5.Infrastructure, construction, services etc:**Brief details . **6. Costing**: Capital and operating cost estimates based on comparable mining operations . **7. Marketing**:An overview, demand and supply relations, industry structure, pricing. **8.Economic viability:** Preliminary studies of cash flow forecasts. **9. Other factors:** Statutory provisions relating to land, labour, mining, taxation, etc.	**1.Geology**: Geology of project, detailed exploration with larger inputs of exploratory mining, deep pitting, trenching /benching, underground boreholes, closed spaced drilling. **2.Mining:** Mining plan, meticulous methods with special emphasis on geotechnical, production aspects; safety measures, mine recoveries, efficiency variability due to various controls. **3. Environment:** EIA/EMP including socio- economic impact rehabilitation of project affected persons and waste disposal/ reclamation ;detailed land use data. **4.Processing:** Proven details of pilot plant scale investigation, appended with layout, plant design, manpower requirements, fuel/power consumption, disposal of effulents and present/future remedial measures. **5. Infrastructure, constructions and service:** Full details. **6. Costing:** Detailed break up of capital and operating cost and details of working capitals. **7. Marketing:** An overview, specific market aspects. **8. Economic viability:** Cash flow forecast, inflation effects, sensitivity studies. **9. Other factors**: Statutory provisions relating to land, labour, mining, taxation, etc.

ECONOMIC AXIS

E3(Intrinsically Economic)	E2 (Potentially Economic)	E1(Economic)
1.Reconnaissance to detailed geological study, rough estimates of grades (may be below economic cutoff), general idea about forest / non - forest and land use status. **2.**The activities as above or less than that required for E-2.	**1**. General and detailed exploration. **2** . Specific end-use grades of reserves (above/marginally below economic cut-off grade). **3.** General knowledge of forest/non-forest and other land use data.	**1**. Detailed exploration. **2**. Mining report/mining plan/working mines. **3.** Specific end-use grades of reserves (above economic cut-off grade). **4**. Specific knowledge of forest/non-forest and other land use data.

V. Gem- Stones and Rare Metal Pegmatites, Reefs and Veins

Characteristics of Deposit
Highly erratic distribution of minerals and metals. No trend in grade and thickness, no assured continuity, cluster of high values in barren zones, structural and lithologic controls undeterminate.

Principal kinds of Minerals
Tin-tungstun-tantalum-molybdenum veins and pegmatites, beryl, topaz, emerald, cesium deposits, mineralisation associated with alkaline rocks, complexes and veins and plugs of carbonatites.

GEOLOGICAL AXIS

G4 (Reconnaissance)	G3 (Prospecting)	G2(General Exploration)	G1(Detailed Exploration)
1.Aerial reconnaissance: Remote sensing, airborne geophysical survey etc. **2.Geological survey:** Mapping on 1:50,000 scale or smaller scales. **3.Geochemical survey**: (i)Grab/chip sampling of rocks or weathered profiles; (ii)Recording of broad geomorphology, drainage etc. **4. Geophysical survey:** Ground geophysical work. **5.Technological:** (i)Trenching- One or two random pits or trenches; (ii)Pitting/drilling: Upto 5 test pits per100sq. km area; (iii)Sampling- Regional and random grab sampling, stream sediment sampling after orientation survey for narrowing down target areas. **6. Petrography and minerography:** (i)Determination of main rock types and mineral assemblages; (ii)Identification of minerals of interest and gangues. **7.** Synthesis of all available data/concepts.	**1.Geological survey:** (i)Mapping: 1:50,000 to 1:25000 scale; (ii)Linking of geological maps with topogrids; (iii)Assessment of stratigraphy, lithology, structure, surface shows of mineralisation, analysis of old history of mining. **2.Geochemical survey:** (i)Closed -grid geoche-mical sampling , rocktype wise and if necessary rock type-cum –skeletal soil - domain-wise; (ii)Geochemical specialization with respect to element of interest of pegmatite rock to be deciphered and identification of path finder and trace elements. **3.Geophysical survey:** Detailed ground geophysical work to delimit the potential host rock. **4.Technological:** (i)Pitting and trenching in colluvial zones, residual overburden and on primary host rocks; randomly distributed; (ii)Drilling-only to broadly test the continuity of host rock at 100 m to 200m strike spacing; (iii)Sampling- At surface across zones of	**1.Geological survey:** (i)Mapping on 1:5000 or larger scales with triangulation stations, bench marks, if any and fiducials shown; (ii)Linking of geological maps with topogrids. **2. Geochemical survey:** (i)Detailed litho-geochemical channel sampling from fresh rock exposures, trenches, pits etc; (ii)Recording of deleterious and likely by -product elements. **3. Geophysical:** Detailed and specialised geophysical studies (e.g. missalamasse, borehole geophysical study etc.) to unravel the three dimensional configuration of host rock. **4.Technological**: (i)Pitting/trenching- pits on regular grid pattern (preferably at 50 m. sq.grid) in colluvial zones and residual overburdens; trenches across host rocks of mineralisation; (ii)Drilling-testing at two levels; Strike spacing of boreholes to be 50-100m up to depth of 100-150m; (iii)Sampling- systematic pits sampling (over burden horizon wise) and trench	**1.Geological survey:** (i)Mapping on 1:2000 scale or larger scale; (ii)Preparation of detailed topographical cum geological map, including all surface geological features ,extent of deposit,location of trenches, pits, boreholes, geological plan andsections of exploratory mining. **2.Geochemical:** Detailed litho-geochemical analysis. **3.Geophysical** : Detailed survey if necessary and specific borehole geophysical studies. **4.Technological :** (i) Drilling-surface drilling at 50-10m section intervals in3 -4 levels, 30-60m x 90m vertically apart to trace and intersect mineralised zones; under ground drilling as and when necessary; (ii)Sampling - core and sludge ,bulk and channel samples for processing technology bulk samples for pilot plant/bench scale investigation; (iii)Exploratory mining - 3 or more levels over the entire or part strike length of ore body at 30m level interval and along dip at suitable intervals.

8. The activities as above or less than that required for **G-3.**	mineralisation; also from pits and trenches on the basis of lithological homogenity; closer spaced stream sediments sampling (2-3 samples per sq. km) for further narrowing down target areas; (iv)Core sampling. **5. Petrographic and mineragraphic:** (i)Petrographic study of rocks of the deposit and its surrounding, alterations (if any) associated with mineralisation; (ii)Determination of phase in which the mineral of interest occurs; (iii)Mineralogical studies including paragenesis, identification of zones of oxidation if any, and primary zones, grain size distribution, over all characteristics of useful minerals.	sampling (lithological domain wise), core sampling. **5. Petrographic**: (i)Refining of data on the petrographic characters of rocks, including study of grain size, texture, gangues etc; (ii)Further refining of data.	**5. Petrographic:** (i)Refining of data on the petrographic characters of rocks, including study of grain size, texture, gangues and its liberation etc; (ii)Further refining of data.

FEASIBILITY AXIS

F 3(Geological Study)	F 2(Prefeasibility Study)	F1(Feasibility Study)
1.Geological and related study: (i)Geology of area, reconnaissance phase to detailed phase exploration guided by geochemical, geophysical survey; geological maps dealineating mineralised zones and its extent, lithology, controls, guides, mineralogical, chemical analytical data; (ii)Studies on amenability to beneficiation; (iii)Infrastructure; (iv)Environmental- meteorological and preliminary ecological data, if possible. **2.** The activities as above or less than that required for **F 2.**	**1.Geology:** Geology of area, detailed exploration, closed spaced drilling in prospect in 2-3 levels for delineation of host rock body ; boreholes, channel, bulk samples for beneficiation test. **2. Mining**- Viable methods-details of exploratory mining data, recoveries estimates, manpower details. **3. Environment**- Baseline data, potential constraints and analysis of possible impacts /hazards. **4. Processing**- Proven pilot plant investigations, further follow up for viability.	**1.Geology:** Geology of area, detailed exploration, closed space drilling in prospect in 2-3 levels for delineation of host rock body, ore body modelling; boreholes channel bulk samples for beneficiation, geotechnical and ground water &surface water studies. **2.Mining**- methods of mining, mine plan, mine recoveries and its milling characteristics; exploitation plan preferably with exploratory mining scheme, manpower details. **3.Environmental**- EIA/EMP, including socio-economic impact, rehabilitation of project affected persons ,waste disposal/reclamation.

	5.Infrastructure, services and construction activities: Brief details. **6.Costing**- Capital and operating cost estimates with likely break-up. **7.Marketing-** An overview, demand supply relations, industry structure. **8. Economic viability:** Preliminary study of cash flow forecast. **9. Other factors**: Statutory provisions relating to labour , land , mining ,taxation, etc.	**4.Processing-** a) For tin- tungsten, molybdenum -details of proven pilot plant scale investigations on bulk samples, choosing of suitable processing treatment by industrial scale testing, tailings and effluent disposal plans, plant layout, equipment list; b) For gemstones- studies on amenability to cutting, polishing etc **5.Infrastructure, utilities and construction activities**: Full details. **6. Costing**- Detailed capital and operating cost, along with break up. **7. Marketing**- An overview , specific market aspects. **8. Economic viability**- Cash flow forecast, inflation effects, sensitivity studies. **9. Other factors**: : Statutory provisions relating to labour, land , mining , taxation, etc.

ECONOMIC AXIS

E3(Intrinsically Economic)	**E2 (Potentially Economic)**	**E1(Economic)**
1.Reconnaissance to detailed geological study, rough estimates of grades (may be below economic cut-off), general idea about forest /non - forest and land use status. **2.**The activities as above or less than that required for E-2.	**1**.General and detailed exploration. **2**. Specific end-use grades of reserves (above/marginally below economic cut-off grade). **3**. General knowledge of forest/non-forest and other land use data.	**1**.Detailed exploration. **2**.Mining report/mining plan/working mines. **3.** Specific end-use grades of reserves (above economic cut-off grade). **4**. Specific knowledge of forest/non-forest and other land use data.

VI. Placer and Residual Mineral Deposits of Hill and Valley Wash

Characteristics of Deposit
Eluvial, colluvial and alluvial placer concentration of heavy metals and minerals, pebble and cobble, boulder beds, gravel beds in alluvium and colluvium, conglomerates, foothills fan deposits, grain size from extremely fine striated material to rough to polished boulders.

Principal kinds of Minerals
Placer tin and gold deposits, monazite, garnet, ilmenite, rutile, diamonds in conglomerate, floats and gravel beds of corundum, kyanite, sillimanite, floats and talus deposits of magnetite.

GEOLOGICAL AXIS

G4 (Reconnaissance)	G3 (Prospecting)	G2(General Exploration)	G1(Detailed Exploration)
1.Aerial reconnaissance: Remote sensing, airborne geophysical survey, etc. **2.Geological survey:** Mapping on 1: 25,000 or smaller scales. **3.Geo-chemical survey:** (i)Stream sediment or over burden sampling after selection of sites and media of sampling; (ii)Recording of geomor-phology, land form etc. in a broad way. **4.Geophysical survey:** Ground geophysical survey . **5. Technological**- (i)Trenching - not essential; (ii)Pitting/drilling-upto 5 test pits /boreholes per 100 sq. km area; (iii)Sampling – stream sediment or placer sediment sampling and analysis; panning at random /heavy mineral studies. **6. Petrographic and mineragraphic studies:** Preliminary identification of economic minerals**.** **7**. Synthesis of all	**1.Geological survey:** (i)Mapping on 1:25,000 to 1:5,000 scale depending on the extent of potential zone; (ii)Tracing of coarse sediments (e.g.boulders etc.) exposures in eluvial and colluvial terrains; (iii)Geomorphic analysis of terrain; (iv)Analysis of history of mining, etc. **2.Geo-chemical survey:** Representative pit sampling, horizon or layer wise, large diameter bore holes (or auger sampling) one or two sets of samples for each demarcated potential zone. **3.Geo-physical survey:** Geo- physical survey in identified mineralised areas. **4. Technological** : (i)Pitting/trenching - one or two per prospect; (ii)Drilling - large diameter or auger drilling one or two per prospect if necessary; (iii)Sampling and analysis-systematic stream sediments/placer sampling (two to three samples per sq.km) and analysis.	**1. Geological survey**: (i)Mapping on 1:5,000 to 1: 1,000 or larger scales with triangulation stations, bench marks, if any, and fiducials shown; (ii)Tracing of favourable sediment horizons in detail; (iii)Detailed analysis of geo-morphology and land use; (iv)Linking of map so prepared with topo grids; (v)Synthesis and regional correlation and analogy. **2. Geo-chemical:** Representative layer wise sampling from pits, bore holes and auger drills. **3. Geo-physical:** Geo-physical survey for bringing out the depth of weathering or thickness of over burden if required. **4**.**Technological :** (i)Pitting: On grid pattern of 400 m. x 400 m. to 50 m. x 50 m.; occasional deep pits (upto 6 m.); (ii)Trenching- as per requirement; (iii)Drilling : systematic large diameter drilling at 400 m. x 400 m. grid or augering at 200 m. x 200 m. to 50 m. x 50 m. grid.	**1. Geological survey:** (i)Mapping on 1:1000 scale; (ii)Preparation of geological base map including all geological features, extent of deposit, structure and location of pits and trenches and of auger-drill-holes, assay plan. **2**.**Geo-chemical:** Systematic grid pattern sampling and analysis. **3**.**Geo-physical survey:** if necessary. **4.Technological :** (i)Pitting at smaller than 50 m grid; (ii)Trenching - as necessary; (iii)Drilling - (a) auger drilling at 50 m grid, (b) for buried placer deposits deep drilling necessary; (iv)Sampling - closed grid pattern placer sampling in identified prospects at 50x50 m or smaller grid;However for beach sand minerals, sampling by auger or improvised version of drilling equipment at 200m x50m to 100m x25m in grid pattern. (v)Collection of abiotic geo-environmental parameters.

available data/concepts. **8**. The activities as above or less than that required for G-3.	**5) Petrographic and minerographic studies:** Mineral phases and deleterious constituents identification, grain size analysis.	However for beach sand minerals, augering at 400mx100m grid and sampling along grid profile over total width . Depthwise sampling of boreholes at 1m interval. (iv)Sampling and analysis: Placer sampling in identified prospects, hydraulicking , sluicing, panning and follow-up laboratory scale separation and testing and analysis of concentrates from bulk samples. **5.Petrographic and mineragraphic studies**: Further refinement of petrographic and mineragraphic data, laboratory scale studies on recoverability.	**5. Petrogrpahic and mine-ragraphic studies**: Refining of data on petrographic character of rocks including study of grain size textures, associated gangues and concentrate recoveries.

FEASIBILITY AXIS

F 3 (Geological Study)	F2 (Pre-feasiblity Study)	F1(Feasiblity Study)
1. Geological and related study: (i)Geological map delineating boulder zones,eluvial/ colluvial terrain placers and recognition of geo-morphological structure and its analysis; (ii)Surface soil testing; (iii)Pit and trench sampling at various grid intervals; (iv)Delineation of pay zones through pit/auger sampling and its analytical data; concentrate recoveries through panning, other physical separation methods; (v)Infrastructure; (vi)Environmental :Meteorological and preliminary ecological data of the area, if possible. **2**.The activities as above or less than that required for **F-2.**	**1. Geology:** Geology of area, general to detailed exploration by pitting in grids in moderate to close spaced intervals; recoveries through physical separation e.g. panning and its analytical data on concentrate recoveries. **2.Mining** : Methods of mining, pre-production plan, manpower requirements through rough estimates. **3.Environmenta**l : EMP with special emphasis on geo-hydrology and hydrology. **4. Processing** - Pilot plant/laboratory scale investigations, possibilities of setting up of plant. **5. Infrastructure, construction** etc - Brief details. **6.Costing** – Capital and operating costs-rough estimates based on	**1.Geology:** Geology of area; detailed/general exploration by pitting and auger drilling in grid pattern at closed intervals; panning ,concentrate recoveries from the beneficiation test on pilot plant scale/laboratory scale of bulk samples, geotechnical and ground &surface waters studies. **2.Mining -** Methods of mining, mining plan,detail of manpower,equipment list. **3.Environmenta**l: EIA/EMP including socio- econmic impact,rehabilitation of project affected persons with details of waste disposal/reclamation, detailed land use data. **4.Processing** - Proven, pilot plant/industrial scale level investigations, plant layout, enviromental considerations - disposal of placer material/handling

	comparable mining operations. **7. Marketing** - An overview on marketing aspects, demand supply relations, and industry structure. **8.Economic viability** -Preliminary study of cash flow forecast. **9. Other factors**: Statutory provisions relating to labour, land , mining, taxation, etc.	plan, effluent treatment etc; details of equipment required. **5.Infrastructure, construction, etc:** Full details **6. Costing** - Capital costs with break up details of capital and operating costs, working capital. **7. Marketing** - An overview, industry structure and specific market studies. **8. Economic viability** - Cash flow forecasts, inflation effects and sensitivity studies. **9. Other factors**- Statutory provisions relating to labour, land , mining, taxation etc.

ECONOMIC AXIS

E3(Intrinsically Economic)	**E2 (Potentially Economic)**	**E1(Economic)**
1.Reconnaissance to detailed geological study, rough estimates of grades (may be below economic cut –off), general idea about forest /non – forest and land use status. **2**. The activities as above or less than that required for **E2.**	**1**.General and detailed exploration. **9.** Specific end-use grades of reserves (above marginally below economic cut-off grade). **3.** General knowledge of forest/non-forest and other land use data.	**9.** Detailed exploration. **9.** Mining report/ mining plan/working mines. **9.** Specific end-use grades of reserves (above economic cut-off grade). **4**. Specific knowledge of forest/non-forest and other land use data.

VII. Dimension Stones

Characteristics of Deposit
Surficial, occasionally bouldery or tabular, partly weathered, jointed/fractured, recoverability dependant on block size chosen vis-à-vis joint spacing etc, marketable at buyer's choice, amenable to good polish with aesthetic colour or colour combination.

Principal kinds of minerals
Coloured varieties, including granites, syenites, schists, marbles, slates and sandstone, migmatities, etc; black varieties including dyke rocks, e.g; diorite, dolerite, gabbro, etc.; sills, plugs, batholiths etc. e.g., anorthosites, gabbro, etc.

GEOLOGICAL AXIS

G4 (Reconnaissance)	G3 (Prospecting)	G2 (General Exploration)	G1(Detailed Exploration)
1.Aerial reconnaissance: Remote sensing, airborne geophysical survey etc. **9. Geological survey:** Mapping on 1:50,000 or smaller scales. **3.Geo-chemical survey:** Not required. **4. Geophysical survey:**Ground geophysical survey. **9. Technological :** (i)Pitting and trenching: not required; (ii)Sampling –Random grabs of fresh rock, one or two samples per 5 sq. km; (iii)Geo-technical work – joints/fractures density and preliminary assessment of blockability. **6.Petrographic and other studies** : (i)Petrographic studies - not required; (ii)Meausrement of ground water table – not required; (iii)Measurement of geo-environmental parameters – not required. **9.** Synthesis of all available data/concepts.	**1.Geological survey:** **9.** Mapping on 1:50,000 to 1:25,000 scale; (ii)Photogeology on 1:25,000 or equivalent scale. **2.Geo-chemical survey:** Identification of deleterious constituents of one or two samples drawn from each prospect. **3.Geophysical survey:** Not required. **4.Technological:-** (i)Pitting /trenching/drilling –not required. (ii)Sampling – One grab of fresh rock per prospect of premium variety; (iii)Geo-technical – measurement of at least one sample per prospect for determination of specific gravity, porosity, water absorption, compressive strength and tensile strength. **9. Petrographic and other studies** : (i)Petrographic studies- mineralogical composition, texture and micro	**1.Geological survey:** Mapping on 1:25,000 to 1:10,000 scale. **2.Geo-chemical :** Identification of deleterious constituents of one or two samples drawn from each prospect; measurement of abiotic geoenvironmental parameters. **3.Geophysical survey :** not required. **4.Technological:** (i)Pitting/trenching :one or two per prospect; (ii)Drilling – One or two per prospect (scout drilling); (iii)Sampling – Sample density two to three grabs per prospect; (iv)Geo-technical – further refinement of blockability data and polishing index measurement. **5.Petrographic and other studies** : (i)Petrographic studies- mineralogical composition, texture and micro structure study of each variant in a prospect; (ii)Ground water table: measurement at each prospect.	**1.Geological survey:** **9.** Mapping on 1:10000 or larger scale; (ii)Preperation of detailed topographical- cum – geological map, including all surface geological features, joint patterns, fracture density etc.; (iii)Delineation of blockable dimension stone zones/ areas. **2.Geochemical :** Identification of deleterious constituents; measurement of abiotic geoenvironmental parameters. **3.Geophysical :** Not required **4.Technological:** (i)Pitting/trenching – not required; (ii)Drilling- One or two per prospect; (iii)Geo-technical – measurement of compressive strength, tensile strength, traverse strength, abrasion test, specific gravity,density, porosity, absorption, polishing index. **5.Petrographic and other studies** : (i)Colour, granularity, inclusions, texture and microstructure study. (ii)Ground water table: measurement at each prospect.

8.The activities as above or less than that required for **G3.**	–texture study of each variety; (ii)Measurement of ground water table: not required.		

FEASIBILITY AXIS

F3 (Geological Study)	F2 (Pre-feasibility Study)	F1 (Feasibility Study)
9. Geological and related study: (i)Geological mapping, delineating weathered and boulder zone, blockable areas and recognition of geomorphological structure and its analysis,prospectwise grab sampling at grid intervals; (ii)Delineation of probable productive zones through grab sampling and its analytical data; (iii)Infrastructure; (iv)Environmental: meteorological and preliminary ecological data, if possible. **9.** The activities as above or less than that required for **F 2**.	**1.Geology** : Geology of area; detailed / general exploration; geological map delineating blockable areas and identification of productive zones with recovery factors based on gotechnical studies conducted. **2.Mining** : Methods of mining, pre-production plan, manpower requirements through rough estimates**.** **9. Environmental:** EMP with particular reference to geo-hydrology and hydrological aspects, bulk material handling management plan. **4. Processing:** Physical characteristics data,detailsof petro-fabric studies generated through laboratory investigations, possibilities of setting up of cutting,polishing plant. **9. Infrastructure, construction etc.:** Brief details. **9. Costing :**Capital and operating costs – rough estimates based on comparable mining operations. **9. Marketing:** An overview on marketing aspects, demand supply relations and industry structure. **8. Economic viability:** Preliminary study of cash flow forecast. **9. Other Factors:** Statutory provisions relating to labour, land , mining, taxation, etc.	**9. Geology:** Detailed exploration; geological map delineating blockable areas and identification of productive zones with recovery factors based on gotechnical studies conducted. **2.Mining:** Mining plan, block recoveries and efficiencies, heavy machineries,equipment selection, manpower requirement. **3.Environment:** EIA studies with particular refernce to geo-hydrology and hydrological aspects, bulk material, and EMP including socio-economic impact, rehabilitation of project affected persons, waste disposal,detailed land use data. **4.Processing**: Industrial scale investigation data on physical haracteristics data,details of petrofabric studies, setting up of cutting,polishing plant (optional), list of equipments, manpower details. **9. Infrastructure and services, construction activities:** Full details. **6.Costing:**Detailed break-up of capital cost, operating cost, details of working capital. **9. Marketing:** Overview, specific market aspects. **8. Economic viability**: Cash flow forecast, inflation effects, sensitivity studies. **9.Other factors:** Statutory provisions relating to labour, land, mining, taxation, etc.

ECONOMIC AXIS

E3(IntrinsicallyEconomic)	E2 (Potentially Economic)	E1 (Economic)
1.Reconnaissance to detailed geological study, rough estimates of coloured and non coloured varieties, general idea about forest /non - forest and land use status. **2**. The activities as above or less than that required for **E2.**	**1.**General and detailed exploration. **2.**Rough identification of marketable varieties. **3**. General knowledge of forest/non-forest and other land use data.	**1**.Detailed exploration. **2**.Mining report/mining plan/working mines. **3.** Specific identification of marketable varieties. **4.**Specific knowledge of forest/non-forest and other land use data.

CONTROLLER GENERAL
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