PROPOSAL FOR RECONNAISSANCE SURVEY (G-4 STAGE) FOR REE AND RARE METAL MINERALIZATION IN KUMHARDIH-KHIJURI-PACHAMBA BLOCK, BIHAR MICA BELT, DISTRICT- GIRIDIH, JHARKHAND

COMMODITY: REE AND RARE METALS

BY

MINEREAL EXPLORATION AND CONSULTANCY LIMITED

DR. BABASAHAB AMBEDKAR BHAWAN

SEMINARY HILLS

PLACE: NAGPUR

DATE: NOVEMBER, 2023

Summary of the Block for Reconnaissance Survey (G-4 Stage)

GENERAL INFORMATION ABOUT THE BLOCK

	Features	**Details**
	Block ID	Kumhardih-Khijuri-Pachamba Block
	Exploration Agency	Mineral Exploration and Consultancy Limited (MECL)
	Commodity	REE and Rare metals
	Mineral Belt	-
	Completion Period with entire Time schedule to complete the project	09 months
	Objectives	Based on the evaluation of geological data available, the present exploration program has been formulated to fulfill the following objectives. i. To carry out Geological & Structural mapping on 1:12500 scale for identification of REE and rare metal bearing formation (host rock) with the structural features to identify the surface manifestation and lateral disposition of the mineralized zones. ii. To collect surface Bedrock and Stream Sediment samples (by heavy mineral separation) for analyses of REEs and Rare Metals to decide further course of exploration program. iii. To know the concentration of RM/ REE in the regolith within the target area, 30 cubic meters of orientation pitting will be carried out to collect 30 Soil Samples from B horizon, C horizon and by heavy mineral seperation. iv. The outcome of this exploration will decide further exploration strategy for upgradation of block to Preliminary (G-3) Exploration.
	Whether the work will be carried out by the proposed agency or through outsourcing and details thereof. Components to be outsourced and name of the outsource agency	Work will be carried out by the proposed agency.
	Name/ Number of Geoscientists	Three nos. of Geoscientist (2 Field + 1 HQ)
	Expected Field days (Geology) Geological Party Days	Geologist Party Days: 180 Days (Field) Geologist Party Days: 30 Days (HQ)
1	**Location**	

	The coordinates of corner points of proposed Kumhardih-Khijuri-Pachamba Blockare as follows:	

Sl. No.	Point	GCS- WGS 1984 (DMS)		UTM - WGS 1984 (m) Zone: 45N	
		Latitude	Longitude	Northing	Easting
1	A	24°34'07.11" N	86°00'22.54" E	2717548.29	399371.521
2	B	24°34'07.10" N	86°14'23.95" E	2717397.51	423040.038
3	C	24°30'06.55" N	86°14'25.18" E	2709998.26	423034.064
4	D	24°30'06.70" N	86°00'22.34" E	2710153.47	399312.661

	Villages	Khijuri, Tisri, Bhandari, Kenduwa, Deorivillages
	Tehsil/ Taluk	Tisri
	District	Giridih
	State	Jharkhand
2.	**Area (hectares/ square kilometers)**	
	Block Area	175.28 sq km
	Forest Area	Palmarua PF, Lahariya PF The proposed block area was checked in DSS Portal, where the result was "Not Inviolate"
	Government Land Area	Data Not Available
	Private Land Area	Data Not Available
3.	**Accessibility**	
	Nearest Rail Head	Giridih Railway station is 45km South from the proposed block.
	Road	The State Highway-13 connecting Kowar to Barmasia passes about 6 km south of the block and the GiridihJamua Road passes through the block.All the villages in the area are well connected to each other and to the highways by motorable roads and tracks.
	Airport	The nearest airport is Gaya International Airport, Bihar at 100 km North West from the proposed block.
4	**Hydrography**	
	Local Surface Drainage Pattern (Channels)	A system of streams and nalas flow from south-east to north-west, serving as feeders to the main drainage system of Sakri River and and GarhiNadi flowing towards east. Most of these tributaries are seasonal and fed by monsoon rains. They remain dry, with little amount of underflow, for greater part of the year.
	Rivers/ Streams	Bakhusi River, Kunda River, flowing towards west

		are the major tributaries contributing to the Sakri River. Garhi Nadi flowing towards east.
5	**Climate**	
	Mean Annual Rainfall	The climate of the area is generally warm and dry. It is pleasant during winter season between October and March. Summer season starting from April, with May being the hottest. The area experiences high humidity and high temperature, especially during June when pre-monsoon rain falls. The rainy season continues up to mid-October. Maximum Rainfall: 255 mm (July and August)
	Temperatures (December) (Minimum) Temperatures (June) (Maximum)	Maximum Temperature: 47ºC (May) Minimum Temperature: 10º C (January)
6	**Topography**	
	Toposheet Number	72L/02
	Morphology of the Area	The proposed area comprises mostly of gently undulating plain having gentle westernly slope with few isolated hillocks to the western part of the block. The maximum elevation in the proposed block is towards north i.e. Ghoranji (605 mRL) and the minimum elevation is 260 mRL to the north-west of the block. A WSW-ENE trending ridge with maximum elevation of 420 mRL lies to the north eastern portion of the block. The average elevation of the block ranges between 300 mRL to 360 mRL.
7	**Availability of baseline geosciences data**	
	Geological Map (1:50K/ 25K)	1:50000 (Bhukosh)
	Geochemical Map	Stream sediment sample results from NGCM, Bhukosh, GSI for TS 72L/02 have been used to compute LREE, HREE & Total REE geochemical anomaly maps presented as plates in the proposal.
	Geophysical Map	**Not Available**
8.	**Justification for taking up Reconnaissance Survey / Regional Exploration**	i NGCM Stream Sediment data from Bhukosh Portal, GSI was downloaded. Using NGCM data MECL generated total REE geochemical anomaly map. The proposed block was identified by MECL in the anomalous zone for total REE having maximum values of 1517.88 ppm for reconnaissance exploration. ii Pollucite a significant ore of cesium, in some cases rubidium and lepidolite a lithium-bearing

		mineral are reported from Phira village which is about 25 km NNW from the block. Manganocolumbite an ore of niobium is found in Dhab village which is about 30 km NW from the block. iii. The proposed Kumhardih- Khijuri- Pachamba Block lies in Bihar Mica Belt which hosts numerous economical deposits. Bedrock samples were collected by GSI during F.S. 2017-19 among which 4 samples which fall within the proposed block have analysed anomalous values for Rare Metals having maximum 308 ppm Li and 199 ppm Cs from Pegmatite. 43 nos of NGCM samples have given maximum total REE value of 1517 ppm. Hence, MECL proposes the block for reconnaissance exploration of REEs and RMs at G4 level. iv. GSI is carrying out several G-4 exploration for REE and Rare Metals in the adjoining toposheet which have encouraging total REE values in NGCM samples. The proposed block lies to the eastern extension having similar geological setup suitable for hosting REE and Rare metal mineralization. With above study, the current proposed block may be studied for REE and RM mineralization at G-4 level of exploration.

PROPOSAL FOR RECONNAISSANCE SURVEY (G-4 STAGE) FOR REE MINERALIZATION IN KUMHARDIH- KHIJURI- PACHAMBHA BLOCK, DISTRICT – GIRIDIH, STATE -JHARKHAND (AREA 175.28 SQ.KM.)

1.0.0 INTRODUCTION:

1.0.1 Rare earth elements are characterized by high density, high melting point, high conductivity and high thermal conductance with distinctive electrical, metallurgical, catalytic, nuclear, magnetic and luminescent properties make them indispensable for a variety of emerging high end and critical technology applications which are relevant to India's energy security i.e., clean energy, defense, civilian application, environment and economic areas. REE demand is expected to continue its growth, especially for their use in low carbon technology. The ever-increasing demand for these REE necessitates a concerted effort to augment the resource position of our country.

1.0.2 The Rare earth elements (REE) are a collection of 17elements in the periodic table , namely scandium, yttrium and lanthanides (15 elements in the periodic table with atomic numbers 57 to 71 namely: lanthanum (La), cerium (Ce), praseodymium(Pr), neodymium (Nd), promethium (Pm), samarium (Sm), europium (Eu), gadolinium (Gd), terbium (Tb), dysprosium (Dy), holmium (Ho), erbium (Er), thulium (Tm), ytterbium (Yb) and lutetium (Lu). In spite of its low atomic weight Yttrium (atomic no. 39) has properties more similar to the heavy lanthanides and is included with this group. Scandium (atomic no. 21) is found in a number of minerals although it may also occur with other rare earth elements (REE).

1.0.3 Although these elements tend to occur together, the lanthanide elements are divided into two groups. The light rare earth elements (LREE) are those with atomic numbers 57 through 62(La, Ce, Pr, Nd, Pm, Sm) and the heavy rare earth elements (HREE) are those with atomicnumbers from 63 to 71 (Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb and Lu) and Y, Sc. However, because of their geochemicalproperties, rare earth elements are typically dispersed and not often found concentrated as rareearth minerals in economically exploitable ore deposits.

1.0.4 Generally the light rare earth elements (LREE) are more abundant in the earth's crustand easily extracted than heavy rare earth elements (HREE). It was the very scarcity of these minerals (previously called "earths") that led to the term "rare earth". The first such mineral discovered was gadolinite, a compound of cerium, yttrium, iron, silicon and other elements. This mineral was extracted from a mine in the village of Ytterby in Sweden; several of the rare earth elements bear names derived from this location.

1.0.5 Critical minerals are those minerals that are essential for economic development and national security. The lack of availability of these minerals or concentration of extraction or processing in a few geographical locations may lead to supply chain vulnerabilities and even disruption of supplies. The future global economy will be underpinned by technologies that depend on minerals such as lithium, graphite, cobalt, titanium, and rare earth elements. These are essential for the advancement of many sectors, including high-tech electronics, telecommunications, transport, and defence. They are also vital to power the global transition to a low carbon emissions economy, and the renewable energy technologies that will be required to meet the 'Net Zero' commitments of an increasing number of countries around the world. Hence, it has become imperative to identify and develop value chains for the minerals which are critical to our country.

1.0.6 Considering important parameters such as resource/ reserve position in the country, production, import dependency, use for future technology/ clean energy, requirement of fertilizer minerals in an agrarian economy, the Committee has identified a set of 30 critical minerals. These are Antimony, Beryllium, Bismuth, Cobalt, Copper, Gallium, Germanium, Graphite, Hafnium, Indium, Lithium, Molybdenum, Niobium, Nickel, PGE, Phosphorous, Potash, REE, Rhenium, Silicon, Strontium, Tantalum, Tellurium, Tin, Titanium, Tungsten, Vanadium, Zirconium, Selenium and Cadmium. *(Critical Minerals for India, Report of the Committee on Identification of Critical Minerals, Ministry of Mines, June 2023)*

1.2.0 BACKGROUND

1.2.1 On enactment of MMDR Amendment Act- 2015, Minerals (Evidence of Mineral Contents) Rule 2015 and Mineral Auction Rules 2015, Govt. of India directed State Government to speed up exploration work for different Mineral Commodities in the respective states. Accordingly MECL has prepared the proposal for Reconnaissance (G4) level involving identification of mineralized areas worthy of further investigation towards deposit identification.

1.2.2 The Exploration for strategic, critical, rare metals, rare earths elements, PGE and precious metals is given top priority by Govt. of India after amendment of MMDR act 2015. Keeping this in view, the present proposal is being put up for Reconnaissance Survey (G-4) for REEsand Rare Metals in Kumhardih- Khijuri- Pachamba Block, Bihar Mica Belt, Giridih District, Jharkhand.

1.2.3 MECL has prepared the proposal for G4 level exploration for REE & RM in Kumhardih-Khijuri-Pachamba Block, Giridih district, Jharkhand to put up for approval in the forthcoming meeting of Technical cum Cost Committee (TCC) of NMET.

1.3.0 LOCATION AND ACCESSIBILITY

1.3.1 The proposed Kumhardih- Khijuri- Pachamba Block comprises of 175.28 sq km area and lies in Tisri Tehsil of Giridih District (Toposheet No. 72L/02), Jharkhand. Khijuri, Tisri, Bhandari, Kenduwa, Deori villages are falling within the proposed area. The State Highway-13 connecting Kowar to Barmasia passes about 6 km south of the block and the Giridih Jamua Road passes through the block. The district headquarter Giridih is 45 km south of the block. All the villages in the area are well connected to each other and to the highways by motorable roads and tracks. The nearest Railway Stations are Giridih and New Giridih which are at about 45 km south east from the proposed block. The nearest airport is Gaya International Airport, Bihar at 100km North Westfrom the proposed block.

1.4.0 PHYSIOGRAPHY

1.4.1 The proposed area comprises mostly of gently undulating plain having gentle westernly slope with few isolated hillocks to the western part of the block. Major River is Bakhusi River, Kunda River, flowing towards west and Garhi Nadi flowing towards east. The maximum elevation in the proposed block is towards north i.e. Ghoranji (605mRL) and the minimum elevation is 260 mRL to the north-west of the block. A WSW-ENE trending ridge with maximum elevation of 420 mRL lies to the north eastern portion of the block. The average elevation of the block ranges between 300 mRL to 360 mRL.

1.5.0 DRAINAGE

1.5.1 A system of streams and nalas flow from south-east to north-west, serving as feeders to the main drainage system of Sakri River and and Garhi Nadi flowing towards east. Most of these tributaries are seasonal and fed by monsoon rains. They remain dry, with little amount of underflow, for greater part of the year. Bakhusi River, Kunda River, flowing towards west are the major tributaries contributing to the Sakri River.

1.6.0 CLIMATE

1.6.1 The climate of the area is generally warm and dry. It is pleasant during winter season between October and March. Summer season starts from April, with May being the

hottest.The area experiences high humidity and high temperature, especially during June when pre-monsoon rain falls. The rainy season continues up to mid-October.

Maximum Temperature: 47ºC (May)

Minimum Temperature: 10º C (January)

Maximum Rainfall: 255mm (July and August)

1.7.0 FLORA AND FAUNA

1.7.1 The hill ranges of the area support fairly thick jungles, consisting essentially Sal, Acacia, etc. in addition to thorny bushes. Around the villages, banyan, mango (*Mangifera indica*), banana, bamboo (*Dendrocalamus calostachyus*), jackfruit etc., have been planted by the local people. The other important plants maintained by forest department under the social forestry scheme are eucalyptus, acacia and rose wood. Deforestation is active in the area and only shrubs and bushes have been left out with the fast development of agricultural land

1.7.2 The wild animals reported in the area include beer, leopard and fox, besides, the rodents.

REGIONAL GEOLOGY

2.0.0 Regionally, the area exibits a wide variety of rocks, where the older rock units encountered are unclassified metamorphics of Archean age overlain by Proterozoic Chotanagpur Gneissic Complex and Paleo-Proterozoic to Meso-Proterozoic Bihar Mica Belt follower by Permo-Carboniferous Lower Gondowana formations. The proposed area falls in Bihar Mica Belt (BMB) i.e. the long linear East-West trending belt comprising of thick pile of psammo-pelitic metasedimentary sequences. The BMB is profusely intruded by granite plutons, mica pegmatite and quartz veins. The stratigraphic succession of the BMB supracrustal as proposed by Singh (2001) is as follow.

Table No. 2.1
Sratigraphic succession of the BMB (After Singh, 2001, GSI)

	Group	Formation	Lithology
	Rajgir Group		Upper Phyllite Formation Quartzite Formation Lower Phyllite Formation
Unconformity			
Bihar Mica Belt	**Intrusive Suite**		Rare metal bearing pegmatite, and pegmatoid granite and quartz veins. Mica bearing plagioclase-pegmatites; Trondhjemite; Mathurapur Gabbro: Amphibolite-metadolerite-gabbro-anorthosite; Porphyritic and non-

	Group	Formation	Lithology
			porphyritic granites and augen gneiss (ca 1600 Ma); Migmatites and gneisses.
	Kodarma Group	**Kakolat Formation**	Massive quartzite with thin layers of quartz-schist and quartz-mica schist.
		Dhab Formation	Mica schist, mica gneiss and carbonaceous schist with thin bands of calc-silicate rock, calcareous quartzite and acid tuff.
		Phulwaria Formation	Quartzite, quartz-schist, quartz-mica schist, banded hematite Jaspar, banded hematite quartzite, amphibolite, hornblende schist, calc-silicate gneiss, crystalline limestone, conglomerate, conglomeratic and pebbly quartz-schist
Unconformity			
Chotanagpur Gneissic Complex			

2.1.1 The regional geological setting of of the proposed block within Bihar Mica Belt is depicted in Plate-II. The metasedimentary sequence of the Kodarma Group of BMB is classified into two formations, the lower Phulwaria Formation, composed of quartzite, quartz-schist, quartz mica schist, amphibolite/ hornblende schist and the upper Dhab Formation predominantly composed of mica schist, mica gneiss, carbonaceous mica schist. The pegmatoid granites and pegmatites contain pods of milky white quartz with which the lepidolite and other rare minerals are associated.

2.2.0 GEOLOGY OF THE BLOCK

2.2.1 The proposed area is mainly covered by Paleoproterozoic to Mesoproterozoic Phyllites and Mica schists of Koderma Group and Neoproterozoic Gangpur Granites with enclaves of quartzites and gritty quartzites. All these suite of rocks are intruded by younger intrusives suite like amphibolites and pegmatites. The generalized stratigraphy of the proposed area is given in Table No 2.2

Table- 2.2
The generalized stratigraphic succession of the proposed block. (After GSI)

Era	Group	Rock types	Description
PROTEROZOIC	Intrusives	Pegmatites and Quartz Vein Granites Amphibolite and Gabbro	
	Koderma	Quartzite	Buff coloured medium to fine grained ripple marked quartzite
		Mica schist	Biotite muscovite schists, garnetiferous mica and staurolite bearing mica schist,

			sillimanite bearing quartz mica schists
		Quartzite	Massive and foliated sericite quartzite and quartz mica schist

2.2.2 **Quartzite:** The quartzite is generally grayish to yellowish brown in colour. Primary bedding is discernible as prominent colour bandings which trend east-west with 55^{o} to 70^{o} northerly or southerly dips.

2.2.3 **Mica Schist:** Mica schists are grayish brown to yellowish brown in colour, characterised by widely developed schistose planes in varying degree from place to place and shows porphyroblastic nature with development of andalusite and / or garnet porphyroblasts. This is a medium grained schistose rock which is found to be mineralogical composed of muscovite, andalusite, garnet, staurolite, quartz, biotite, magnetite and occasionally sillimanite. The other minerals contained in this rock type are fine flakes of muscovite, garnet, staurolite, quartz, biotite, occasional sillimanite and magnetite.

2.2.4 **Amphibolite:**Amphibolites/ Hornblende Schists occurs as thin-long foliated interlayered banding. They are at places found to be along the contact between granite and quartzite or mica-schist. The rock is medium grained massive dark greenish black in colour. The amphibolites are found to be composed of hornblende, plagioclase, quartz and opaques.

2.2.5 **Pegmatite:**Pegmatites are randomly distributed within the metasediments and granites. Bhattachary and Banerjee (1985) recognized three types of pegmatites in Bihar Mica Belt, viz. Tourmaline bearing, Mica bearing and Lepidolite bearing. The lepidolite-bearing pegmatites occur within the andalusite-bearing mica schists. Beryl is found at few places. Pegmatite of this area is mainly composed of alkali feldspar, quartz and muscovite.

2.3.0 PREVIOUS WORK - OBSERVATION AND RECOMMENDATIONS

2.3.1 Bhattacharyya B.P. and Banerjee A. S. during F.S.1981-82, GSI carried out detailed Mineralogical and Geochemical studies of the Mica Pegmatites and associated rocks in Bihar Mica Belt. The objective of the investigation was to find out the geological, geochemical and geophysical parameters suitable for mica exploration. During the course of the investigation, 0.785 sq km of area was mapped on 1:1000 scale. 874 Nos. of geochemical samples were collected in grid pattern, 56 cu.m. of pitting and geophysical survey of 2.8 line km were carried out. They observed that the Mica pegmatiteswere preferably associated with migmatitic mica gneiss, biotite-rich mica gneiss and sillimanite.rich mica schist, while the metabasics and the graphite-bearing schists are devoid of mica pegmatites. The mica-rich pegmatites are characterised by dominant oligoclase, while the mica-

poor and mica-barren pegmatites contain dominant microcline perthite. Trace element geochemistry of the residual soil is characterised by low Ba (less than 200 ppm) coupled with high Rb+Li+Cs (more than 400 ppm), over the mica-rich pegmatites. Resistivity anomaly peaks with values ranging upto1300 ohm-m are recorded over the pegmatite bodies. Test drilling in Tisri Block was recommended to examine the anticipations regarding pegmatite incidence on the basis of geophysical and geochemical anomalies.

2.3.2 Sarkar B., Mukherjee A.K., Maity S.K.during F.S.1982-83, GSI carried out Geophysical investigation for locating Mica bearing Pegmatite in Tisri and Lachhmipur areas, Giridih District, Bihar. Electrical resistivity techniques were employed with a view to locate hidden mica-pegmatite bodies embedded in the metapelites. Anomalous values of 600 ohm.m to 1000 ohm.m. were picked up from Tisri area which had established the extension of the pegmatite zones identified earlier. In Lachhmipur area an isolated anomaly was picked up which probably indicate the presence of soil covered pegmatite vein.

2.3.3 Sharan R.R. during F.S. 1985-86, GSI carried out Geological Mapping and Geochemical Prospecting for Mica in Charkapathal area, Munger District, Bihar with an objective to establish guide-line to locate mica-bearing-pegmatites. 1.20 sq. km area was mapped on 1:2,000 scales and thereafter 261 No. of geochemical samples were collected on grid pattern. Individual mineral from pegmatites were sampled to know the behavior of any significant trace element in the mineral samples. Number of mica pits, incline and shaft were located in the area, indicating mica workings. Mica was being worked out by local people in the study area and much emphasis was given by them for prospecting of gem stones in the Charkapathal area. The results of the geochemical samples were awaitedthus geophysical survey was recommended to decipher mica-pegmatites, on the basis of available geological investigation findings.

2.3.4 Hansda C., Jaiswal N. during F.S. 2007-2007, GSI carried out ground evaluation of Radiometric Anomalies generated from Multisensor Airborne Surveys under “Operation Hard Rock” in parts of Giridih, Hazaribag and Koderma Districts, Jharkhand. A total of 100 radiometric peaks were ground checked and correlated. A total area of 1700 sq km was ground evaluated 0.5 sq km was mapped in detail and 303 nos of bed rocks samples, 200 nos of channel samples and 47 nos of petrographic samples was collected. A part of these geochemical samples were analysed by ICP-AES, Flame AAS and ICP-MS methods for RM and REE mineralization. The analytical results (ICP-AES) shows average assay values of La ranging from 30 to 140 ppm, Y 62 -138 ppm, Cs 12 to 200ppm, Li 28 to 100ppm,

Ce75- 170 ppm and Sr 450 – 730 ppm. The cesium abundance was reported from south and north of Phira (72H/14)in Giridih District. The occurrences of pollucite and lepidolite are reported from Phira and traces of Manganocolumbite and Clinochlore are found in Dhab area (72H/14).It was recommended that detail work showing occurrences of REE and RM minerals may be carried out in the area.

2.3.5 Mohammad A., Verma S. carried out Specialised Thematic Mapping along the southern contact margin of Bihar Mica Belt and Chhotanagpur Gneissic Complex around Chakai Chandramandih-Kewal area in parts of Jamui district, Bihar and Giridih district, Jharkhand to study contact relationship and locate zones of gold, base metal and REE mineralisation. The objectives were to examine the contact-relationship between Bihar Mica Belt and Chhotanagpur Gneissic Complex, search for Conglomerate horizon if any, which is already reported along northern contact margin and identification of zones of mineralization Gold, Rare Earth Elements (REE) & Rare Metals (RM), Mica, if any. Two generations of pegmatite were observed in the study area (i) Majority of the veins were emplaced along the general gneissosity planes (ii) Few were across it. Pegmatites were differentiated based on the mineralogical composition, in which along the foliation plane pegmatite having K-feldspar (microcline) variety being one of the most dominant in the mapped area. The pegmatites which occurred across the foliation plane were composed dominantly of K-feldspar (orthoclase) variety. The Petrochemical analysis of Intrusive granite from north of Baku yielded 853.72ppm of total REE, sediment and rubble from Latto Pahar yielded 1410.16ppm of total REE and garnetiferous sillimanite mica schist from Nawadih area yielded 507.97ppm of total REE.

In the pegmatite near contact between BMB and CGC at Kundelwa village bedrock sample yielded 308.53 ppm Li and 199.92 ppm of Cs value. A stream sediment sample near Dotna yielded 1407.14ppm of Ce, 739.46ppm La 616.65ppm of Nd and total REE 3191.21ppm. Discontinuous mafic unit of metagabbro having 7 Km strike length was observed from Karijhal to Jogia to South of Harni. Petrochemical sample from this unit yielded 1878ppm of Cr, and 651ppm of Ni. Amphibolite of Dhakipahari yielded 62.53 ppm, Pegmatite from Bamdah yielded 67.57ppm and intrusive granite from NW of Barmasiya yielded 82.56 ppm of Sn. Garnetiferous amphibolite from Machhli yielded Cr (388ppm), Ni (128ppm), Zn (95ppm) and V(246ppm) and intrusive granite from north of Jogia yielded Co(96ppm), Cr(1878ppm),Ni (651ppm)and Zn(115ppm). Thus itwas recommended that further

exploration for Li and its related elements, REE, base metals Cr, Ni and PGE, Sn might be carried out from the areas having anomalous values.

The entire sequence of the gneisses and the metasedimentary units has been intruded by younger granitoids and later quartz and pegmatitic veins, specially the middle and contact (BMB & CGC) part of study area. It was recommended that further study may be taken up from mineralisation of REE & RM.

2.3.6 MECL has downloaded NGCM data from Bhukosh portal of GSI for Stream Sediments, Soil and Regolith falling in Toposheet No. 72L/02 andcalculated LREE, HREE and TREE values, whose range are given in below table and also anomaly maps are prepared for the same. Due to the potentiality of the area MECL put up this exploration proposal for NMET approval.

Table-2.3

Data showing NGCM Stream Sediment results for Proposed Kumhardih-Khijuri-Pachamba Block (43 numbers of samples) (Source: Bhukosh portal GSI)

Crustal abundance (ppm) of rare earth elements (After Mason and Moore 1982)			**Summary of Stream sediment sample data falling in Proposed Block**	
Group	**Element**	**Crustal abundance (ppm)**	**Minimum (ppm)**	**Maximum (ppm)**
LREE	Lanthanum (La)	30	42.6	332.56
	Cerium (Ce)	60	84.4	620.91
	Praseodymium (Pr)	8.2	9.78	72.45
	Neodymium (Nd)	28	38.75	271.56
	Samarium (Sm)	06	7.32	42.55
HREE	Europium (Eu)	1.2	1.24	3.56
	Gadolinium (Gd)	5.4	6.35	31.38
	Terbium (Tb)	0.9	1.21	5.43
	Dysprosium (Dy)	03	7.24	32.95
	Holmium (Ho)	1.2	1.49	6.5
	Erbium (Er)	2.8	4.67	20.13
	Thulium (Tm)	0.5	0.71	3.3
	Ytterbium (Yb)	3.4	4.52	21.62
	Lutetium (Lu)	0.5	0.67	3.36
	Scandium (Sc)	22	8	14
	Ytrium (Y)	33	37	166
LREE			**182.85**	**1340.03**
HREE			**75.57**	**300.09**
TREE			**258.42**	**1517.88**

2.4.0 JUSTIFICATION

2.4.1 NGCM Stream Sediment data from Bhukosh Portal, GSI was downloaded. Using NGCM data MECL generated total REE geochemical anomaly map. The proposed block was identified by MECL in the anomalous zone for total REE having maximum values of 1517.88 ppm for reconnaissance exploration.

2.4.2 Pollucite a significant ore of cesium, in some cases rubidium and lepidolite a lithium-bearing mineral are reported from Phira village which is about 25 km NNW from the block. Manganocolumbite an ore of niobium is found in Dhab village which is about 30 km NW from the block.

2.4.3 The proposed Kumhardih- Khijuri- Pachamba Block lies in Bihar Mica Belt which hosts numerous economical deposits. Bedrock samples were collected by GSI during F.S. 2017-19 among which 4 samples which fall within the proposed block have analysed anomalous values for Rare Metals having maximum 308 ppm Li and 199 ppm Cs from Pegmatite. 43 nos of NGCM samples have given maximum total REE value of 1517 ppm. Hence, MECL proposes the block for reconnaissance exploration of REE and RMs at G4 level.

2.4.4 GSI is carrying out several G-4 exploration for REE and Rare Metals in the adjoining toposheet which have encouraging total REE values in NGCM samples. The proposed block lies to the eastern extension having similar geological setup suitable for hosting REE and Rare metal mineralization.

With above study, the current proposed block may be studied for REE and RM mineralization at G-4 level of exploration.

3.0.0 BLOCK DESCRIPTION

3.1.0 The proposed Kumhardih- Khijuri- Pachambha Block area falls in Survey of India Toposheet No 72L/02 and covers an area of about 175.28 sq km in and around villages of, Khijuri, Tisri, Bhandari, Kenduwa, Deori villages, Giridih District, Jharkhand. Location plan marked in topo-sheet is enclosed as **Plate-I.** The Co-ordinates of the corner points of the block area both in Geodetic and UTM are given in **Table No.-3.1.**

Table- 3.1

Co-ordinates of the Corner points of the Proposed Kumhardih-Khijuri-PachambhaBlock

Sl. No	Point	GCS- WGS 1984 (DMS)		UTM - WGS 1984 (m) Zone: 45N	
		Latitude	Longitude	Northing	Easting
1	A	24°34'07.11" N	86°00'22.54" E	2717548.29	399371.521
2	B	24°34'07.10" N	86°14'23.95" E	2717397.51	423040.038
3	C	24°30'06.55" N	86°14'25.18" E	2709998.26	423034.064
4	D	24°30'06.70" N	86°00'22.34" E	2710153.47	399312.661

4.0.0 PLANNED METHODOLOGY

4.0.1 The exploration program is proposed in accordance to the objective set for reconnaissance survey (G-4) of the block. The Exploration shall be carried out as per Minerals (Evidence of Mineral Contents) Amendment Rules, 2021. Accordingly, the following scheme of exploration is formulated in order to achieve the objectives.

i. To carry out Geological & Structural mapping on 1:12500 scale for identification of REE and rare metal bearing formation (host rock) with the structural features to identify the surface manifestation and lateral disposition of the mineralized zones.

ii. To collect surface Bedrock and Stream Sediment (by heavy mineral separation) samples for analyses of REEs and Rare Metals to decide further course of exploration program.

iii. To know the concentration of RM/ REE in the regolith within the target area, 30 cubic meters of orientation pitting will be carried out to collect 30 nos of Soil Samples separately from B and C horizon by heavy mineral seperation.

iv. The outcome of this exploration will decide further exploration strategy for upgradation of block to Preliminary (G-3) Exploration.

4.0.2 The details of different activities to be carried out are presented in subsequent paragraphs.

4.1.0 GEOLOGICAL MAPPING

4.1.1 Geological mapping will be carried out in the entire 175.28 sq.km area on 1:12,500 scale. Rock types, their contact, structural features will be mapped. Surface manifestations of the mineralisation available along with their surface disposition will be marked on map. 10 nos. of surface samples of various lithounits will be studied for petrology and minerography. Classification of pegmatites would be taken up depending upon their mineralogical-geochemical characteristics and depth of

emplacement according to Cerny (1991) based on the Mineragraphic Studies carried out.

4.2.0 GEOCHEMICAL SAMPLING

4.2.1 Bed Rock Sampling and Stream Sediment Sampling:

4.2.1.1 During the course of Geological mapping bed rock and stream sediment samples shall be collected. The stream sediment samples will be subjected to heavy mineral separation, following which the heavies will be crushed and sieved to 120 mesh size. The final sample will be sent to laboratory for ICPMS analysis of REE and Rare Metals.

4.2.1.2 A total no of 150 Bedrock and 50 Stream Sediment Samples from 1st order streams will be collected during Geological Mapping. Total 20 nos. external check samples [10% External] will be analyzed for assay of 34 elemental analysis includes Nb, Sr, Ta, W, Mo, Sn, Rb, Be, Ba, Cs, Li & REE.

4.3.0 EXPLORATORY MINING (PITTING):

4.3.1 Shallow pitting (Excavation) shall be carried out in the potential zones identified based on the results of geological mapping and stream sediment sampling. A provision of 10 nos of shallow pitting on the identified anomalous zone (1.5 m wide X 2.0 m deep) with 30 cubic meters is kept. Pitting will be carried out on surface up to a depth of 2 m (maximum 2 m depth from surface) after removal of soil/ weathered column in the area. Locations of pits on ground will be decided by field geologist based on field observations and positive outcome of the geochemical sampling.

4.3.2 30 orientation soil samples will be collected from 10 pits marked by the field geologist. Separate samples would be collected from B horizon, C horizon and bedrock of each pit. The collected soil samples will be subjected to heavy mineral separation, following which the heavies will be crushed and sieved to 120 mesh size. The orientation soil samples would help to decide the target soil horizon best suitable for REEs and Rare Metals. All the samples generated would be analysed for 34 elemental analysis including Nb, Sr, Ta, W, Mo, Sn, Rb, Be, Cs, Li & REE by ICP-AES / ICPMS (sequential technique). Total 03 nos. of check samples [10% External] will be analyzed for assay of 34 elemental analysis includes Nb, Sr, Ta, W, Mo, Sn, Rb, Be, Cs, LI & REE.

4.4.0 CHEMICAL ANALYSIS

4.4.1 PETROLOGICAL & MINERAGRAPHIC STUDIES:

During the course of Geological mapping and sampling 10 nos. of samples from outcrops of various lithounits will be collected to carry out Petrography and Minerography.

5.0.0 PROPOSED QUANTUM OF WORK

5.1.0 Details of the particular, Quantum and the targets are tabulated in **Table No.-5.1.**

Table No- 5.1

Envisaged Quantum of proposed work in Kumhardih- Khijuri- PachambaBlock

Sl. No.	Item of Work	Unit	Target
1	**Geological Mapping** (on 1:12,500 Scale)	Sq km	175.28
2	**Geochemical Sampling**		
	a) Bedrock samples for 34 elemental analysis includes Nb, Sr, Ta, W, Mo, Sn, Rb, Be, Cs, Li& REE	Nos	150
	b) Stream Sediment samples for 34 elemental analysis includes Nb, Sr, Ta, W, Mo, Sn, Rb, Be, Cs, Li& REE	Nos	50
3	**Exploratory Mining**		
	Excavation (Pitting)	Cu.m	30
	a) Pit samples for 34 elemental analysis includes Nb, Sr, Ta, W, Mo, Sn, Rb, Be, Cs, LI & REE	Nos	30
4	**Laboratory Studies**		
	i) Heavy Mineral Seperation (50 Stream Sediment Sampoles + 30 Pit Samples)	Nos	80
	ii) Surface Sampling: bedrock samples (Primary samples + 10% External Check Samples)	Nos	165
	iii) Surface Sampling: stream sediment samples (Primary samples + 10% External Check Samples)	Nos	55
	iv) Pit samples (Primary samples+10% External Check Samples samples)	Nos	33
7	**Petrological Samples (Surface Samples)**	Nos	10
8	**Mineragraphic Studies (Surface Samples)**	Nos	10
9	**XRD Mineral phase analysis**	Nos	5
10	**Report Preparation (5 Hard copies with a soft copy)**	Nos.	1
11	**Preparation of Exploration Proposal (5 Hard copies with a soft copy)**	Nos.	1

5.2.0 BREAK-UP OF EXPENDITURE

5.2.1 Tentative Cost has been estimated based on Schedule of Charges (SoC) of projects funded by National Mineral Exploration Trust (NMET) w.e.f. 01/04/2020. The total estimated cost is **Rs. 78.10 Lakhs.** The summary of cost estimates for Reconnaissance Survey (G-4 Level) is given in **Table No. - 5.2** and details of cost estimates is given in **Table No. – 5.3.**

Table No. 5.2

Summary of cost estimates for Reconnaissance survey (G-4) in Kumhardih- Khijuri-Pachamba Block, District- Giridih, Jharkhand.

Sl. No.	Item	Total Estimated Cost (Rs.)
1	Geological Mapping (LSM), Other Geological Work	26,44,920
2	Trenching	1,14,000
3	Laboratory Studies	33,98,403
	Sub Total (1 to 6)	**61,57,323**
5	Exploration Report Preparation	3,07,866
6	Proposal Preparation	1,23,146
7	Peer review charges	30,000
8	Sub Total (1 to 7)	66,18,336
9	GST 18%	11,91,300
	Total:	**78,09,636**
	Say Rs. In Lakh	**78.10**

5.3.0 TIMELINE

5.3.1 The entire project is planned tentatively for 09 months. Initially, geological mapping and surface bedrock sampling along with soil sampling shall be carried out followed by trenching provided positive results are obtained in the first phase of sampling.

Table No. 5.4

Tentative Time schedule / Action plan of Reconnaissance Survey (G-4) for REE In Kumhardih- Khijuri- PachambaBlock, District- Giridih, Jharkhand, Total block area- 175.28 sq km; Completion Time- 09 Months

Sl. No.	Activities	Months									
		1	2	3	4	5		6	7	8	9
1	Camp setting										
2	Geological mapping & Sampling										
3	Exploratory Trenching & Sampling										
3	Sample preparation										
4	Analytical work										
10	Camp winding										
12	Geologist at HQ										
13	Geological report										
14	Peer Review										
* Commencement of project will be reckoned from the day the exploration acreage is available along with all statutory clearances											
*Time loss on account of monsoon/agricultural activity/forest clearance/ local law & order problems will be addition to above time line.											

REVIEW

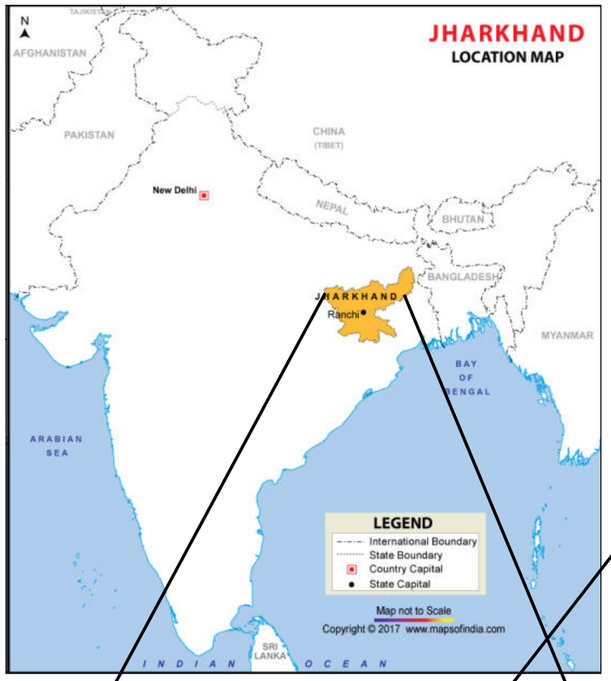
References

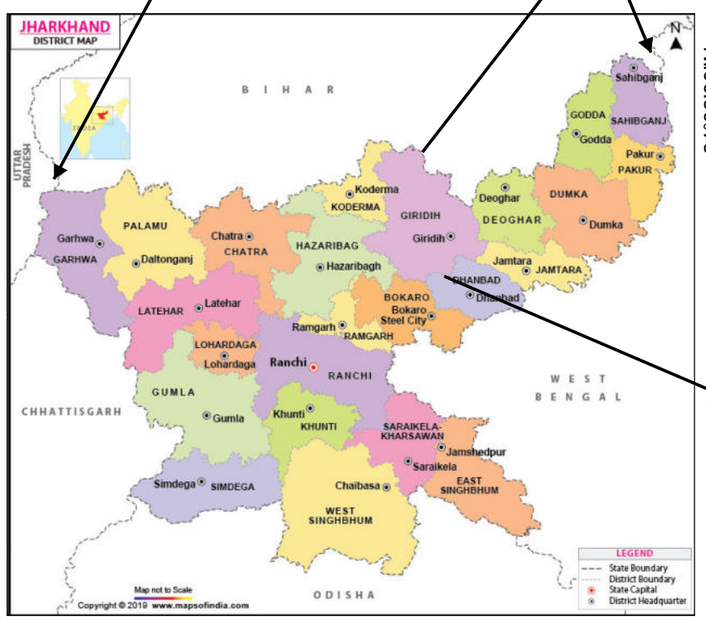
1. Bhattacharyya B.P. and Banerjee A. S., F.S.1981-82, GSI, Detailed Mineralogical and Geochemical studies of the Mica Pegmatites and associated rocks in Bihar Mica Belt.
2. B., Mukherjee A.K., Maity S.K., F.S. 1982-83, GSI, Geophysical investigation for locating Mica bearing Pegmatite in Tisri and Lachhmipur areas, Giridih District, Bihar.
3. Sharan R.R., F.S. 1985-86, GSI, Geological Mapping and Geochemical Prospecting for Mica in Charkapathal area, Munger District, Bihar.
4. Hansda C., Jaiswal N., F.S. 2007-2007, GSI,Final Report on ground evaluation of Radiometric Anomalies generated from Multisensor Airborne Surveys under "Operation Hard Rock" in parts of Giridih ,Hazaribag and Koderma Districts, Jharkhand.
5. GSI's online data portal – Bhukosh (for NGCM raw data source, Block Geology and Regional Geology)

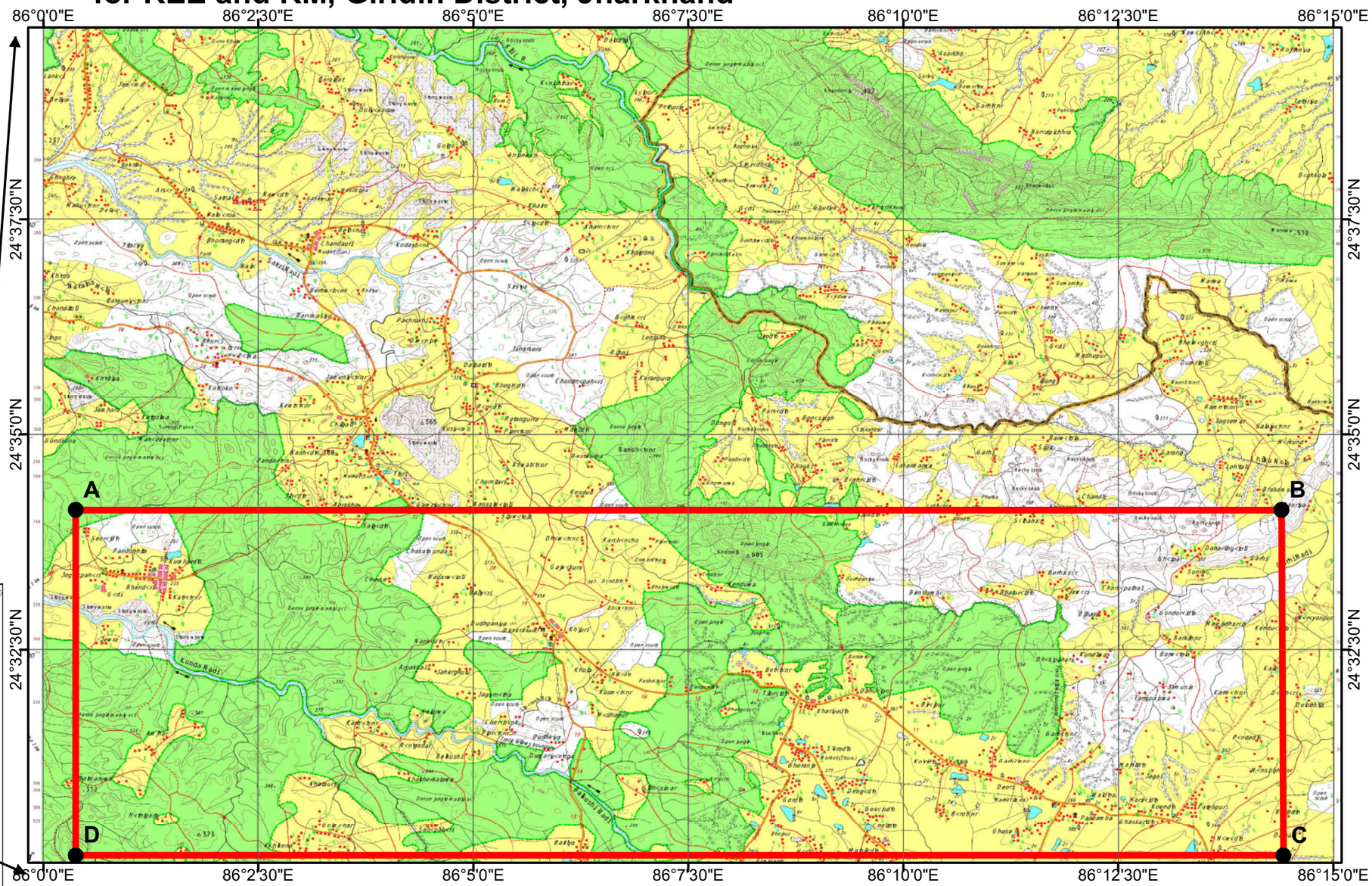
List of Plates

1. Plate –I: Location Map of Proposed Kumhardih- Khijuri- Pachamba Block (155.51sq km), District: Giridih, State: Jharkhand.
2. Plate–II: Regional Geological Map showing Proposed Kumhardih- Khijuri- Pachamba Block, District: Giridih, State: Jharkhand (Source: Bhukosh, GSI).
3. Plate–III: Geological Map of Proposed Kumhardih- Khijuri- Pachamba Block, District: Giridih, State: Jharkhand (Source: Bhukosh, GSI).
4. Plate–IV: Geology Map with total REE values in Kumhardih- Khijuri- Pachamba Block, District: Giridih, State: Jharkhand (Source: Bhukosh, GSI).

Location Map of Proposed Kumhardih- Khijuri- Pachambha Block at Reconnaissance Survey Level (G-4) for REE and RM, Giridih District, Jharkhand







Sl. No	Point Name	GCS- WGS 1984 (DMS)		Area (sq km)
		Latitude	Longitude	
1	A	24°34'07.11" N	86°00'22.54" E	175.28
2	B	24°34'07.10" N	86°14'23.95" E	
3	C	24°30'06.55" N	86°14'25.18" E	
4	D	24°30'06.70" N	86°00'22.34" E	

1:100,000

0 1 2 4 6 8 Kilometers

Source: Survey of India Toposheet No 72L/02

Legend

- Proposed Block Corner Points
- Proposed Kumhardih Khijuri Pachamba Block

Regional Geology Map showing Proposed Kumhardih Khijuri Pachamba Block, Giridih District, Jharkhand

86°0'0"E

86°15'0"E

24°30'0"N

N

1:200,000

0 2.75 5.5 11 16.5 22

Kilometers

Source: Bhukosh, GSI

Legend

- Proposed Kumhardih Khijuri Pachamba Block

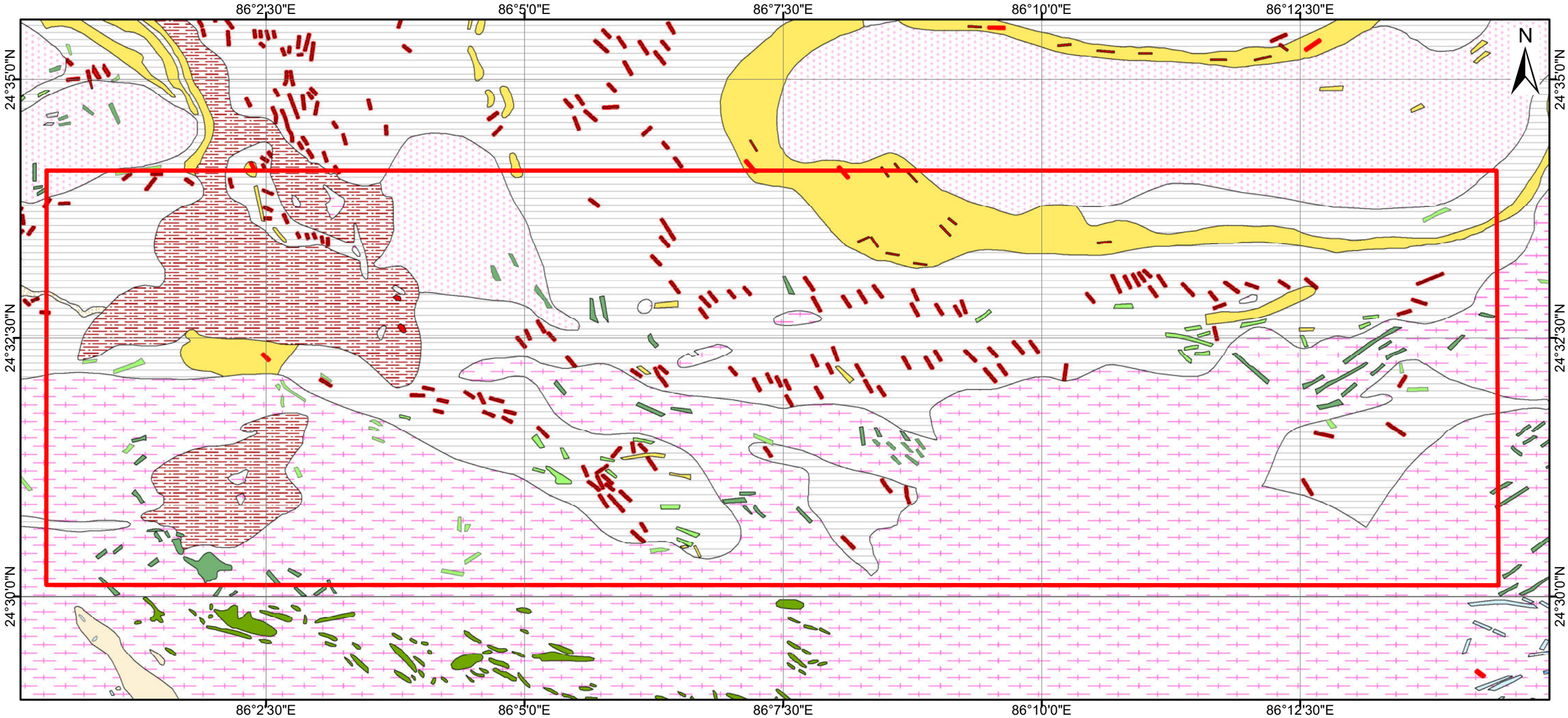
LITHOLOGY

- NEWER ALLUVIUM
- OLDER ALLUVIUM
- LOWER GONDWANA
- YOUNGER INTRUSIVES
- BIHAR MICA BELT
- CHHOTANAGPUR GNEISSIC COMPLEX
- UNCLASSIFIED METAMORPHICS

ORIENTED STRUCTURAL PLANE

- BEDDING
- CLEAVAGE/FOLIATION/SCHISTOSITY (S1)
- JOINT

Block Geology of Proposed Kumhardih- Khijuri- Pachambha Block, Giridih District, Jharkhand



1:70,000

0 0.75 1.5 3 4.5 6 Kilometers

Source: Bhukosh, GSI

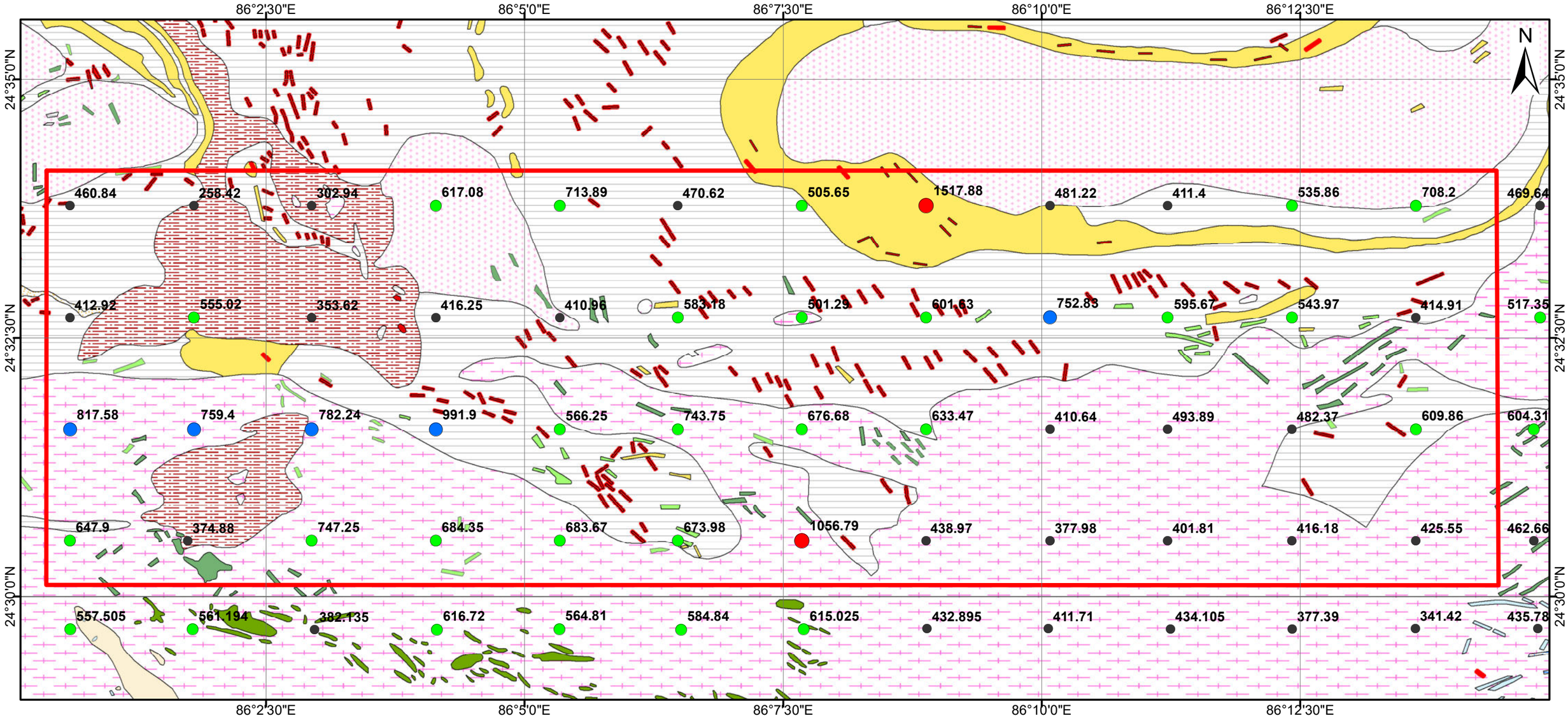
Legend

- Proposed Kumhardih Khijuri Pachamba Block

Lithology

- DOLERITE
- DOLERITE / BASIC INTRUSIVES
- GRANITE GNEISS
- HAZARIBAG GRANITE
- HORNBLENDE SCHIST, AMPHIBOLITE
- HORNBLENDE SCHIST,AMPHIBOLITE,META ULTRABASITE
- LIMESTONE, IMPURE MARBLE, CALC SILICATE ROCKS
- MICA SCHIST / SCHIST
- PEGMATITE
- PHYLLITE, MICA SCHIST
- QUARTZITE, GRITTY QUARTZITE
- SAND, SILT AND CLAY
- SHALE, SANDSTONE, CONGLOMERATE

Block Geology of Proposed Kumhardih- Khijuri- Pachambha Block with total REE values in NGCM Stream Sediment Samples, Giridih District, Jharkhand



1:70,000

0 0.75 1.5 3 4.5 6 Kilometers

Source: Bhukosh, GSI

Legend

Proposed Kumhardih Khijuri Pachamba Block

Total REE

- 174.116009 - 250.000000
- 250.000001 - 500.000000
- 500.000001 - 750.000000
- 750.000001 - 1000.000000
- 1000.000001 - 5500.000000

Lithology

- DOLERITE
- DOLERITE / BASIC INTRUSIVES
- GRANITE GNEISS
- HAZARIBAG GRANITE
- HORNBLENDE SCHIST, AMPHIBOLITE
- HORNBLENDE SCHIST,AMPHIBOLITE,META ULTRABASITE
- LIMESTONE, IMPURE MARBLE, CALC SILICATE ROCKS
- MICA SCHIST / SCHIST
- PEGMATITE
- PHYLLITE, MICA SCHIST
- QUARTZITE, GRITTY QUARTZITE
- SAND, SILT AND CLAY
- SHALE, SANDSTONE, CONGLOMERATE

Estimated cost for Reconnaissance Survey (G-4) for REE in Kumhardih-Khijuri-Pachambha Block, District- Giridih, Jharkhand Total block area- 175.28 sq km; Completion Time- 09 Months, Review: after 05 months							
Sl. No.	**Item of Work**	**Unit**	**Rates as per NMET SoC**		**Estimated Cost of the**		**Remarks**
			SoC- Item- S. No.	**Rates as per SoC**	**Qty.**	**Total Amount (Rs)**	
1.0	**Large scale (LSM) Geological mapping (1:12500)/ Trenching/ Drilling**						
1.1	Large scale (LSM) Geological mapping/ Trenching/ Drilling						
	Geologist man days (1 No.) for Geological map & Report (HQ)	days	1.1b	9,000	30	2,70,000	
	a) Geologist man days (2 No) for Large scale (LSM) Geological mapping/ Trenching/ Drilling	days	1.2	11,000	180	19,80,000	
	b) Labour (field)	per worker	5.7	504	360	1,81,440	Amount will be reimburse as per the notified rates by the Central Labour Commissioner or respective State Govt. whichever is higher
	c) Sampler for Suface Samples/ Trench Samples / Core Samples Labour charge not included (1 sampler)	day	1.5.2	5100	30	1,53,000	
	d) 4 labours/ party (As per rates of Central Labour Commissioner)	day	5.7	504	120	60,480	Amount will be reimburse as per the notified rates by the Central Labour Commissioner or respective State Govt. whichever is higher
	Sub-Total 1.0					**2644920**	
2	**Mineral Investigation**						
2.1	**Pitting**						
	a) Excavation of pits	per cu m	2.1.1	3800	30	114000	
	Sub-Total 2.0					**114000**	
3	**Laboratory Studies**						
3.1	**Chemical Analysis**						
	i) Heavy Mineral Seperation	per sample	4.3.6a, 4.3.6b	16200	80	1296000	
	ii) Surface sampling (Bed Rock Samples/Stream Sediment & Pit Samples)						
	a. For 34 elemental analysis includes Nb, Sr, Ta, W, Mo, Sn, Rb, Be, Cs, LI & REE analysis by ICP-AES / ICPMS (sequential technique)	per sample	4.1.14	7731	150	1159650	150 Bedrock Samples
	b. For 34 elemental analysis includes Nb, Sr, Ta, W, Mo, Sn, Rb, Be, Cs, LI & REE analysis by ICP-AES / ICPMS (sequential technique)	per sample	4.1.14	7731	80	618480	30 Soil samples from Pits and 50 Stream Sediment Samples
	iii) Check Samples (Bed Rock/Soil/Stream Sediment Samples & Pit) -10% External						
	a. For 34 elemental analysis includes Nb, Sr, Ta, W, Mo, Sn, Rb, Be, Cs, LI & REE analysis by ICP-AES / ICPMS (sequential technique)	per sample	4.1.14	7731	23	177813	
3.2	**Petrological / Mineralographic studies**					-	
	a) Preparation of thin section	per sample	4.3.1	2,353	10	23,530	
	b) Study of thin section for petrography	per sample	4.3.4	4,232	10	42,320	
	c) Preparation of polished section	per sample	4.3.2	1,549	10	15,490	
	d) Study of polished section for mineragraphy	per sample	4.3.4	4,232	10	42,320	
	e) Digital photomicrograph of thin polished section	per sample	4.3.7	280	10	2,800	
	f) XRD Mineral Phase Analysis	per sample	4.5.1	4,000	5	20,000	
	Sub-Total 3.0					**33,98,403**	
4.0	**Total (1.0 to 3.0)**					**61,57,323**	
5.0	**Geological Report Preparation**	**Nos**	**5.2**	A Minimum of Rs. 2.5 lakhs or 5% of the work whichever is more	**1**	**3,07,866**	For the projects having cost up to exceeding Rs. 50 Lakhs but less than 150 Lakhs: A Minimum of Rs. 2.5 lakhs or 5% of the work whichever is more and Rs. 3000/- per each additional copy.
8.0	**Preparation of Exploration Proposal**	**Nos**	**5.1**	2% or Rs. 500000 whichever is less	**1**	**1,23,146**	EA has to submit the Hard Copies and the soft copy of the final proposal along with Maps and Plan as suggested by the TCC-NMET in its meeting while clearing the proposal.
9.0	**Report Peer Review Charges**	**lumpsum**	**As per EC decision**	**30000**	**1**	**30,000**	
10.0	**Total Estimated Cost without GST (7+8+9+10)**					**66,18,336**	
11.0	**Provision for GST (18%)**					**11,91,300**	GST will be reimburse as per actual and as per notified prescribed rate
12.0	**Total Estimated Cost with GST**					**78,09,636**	
					Say, in Lakhs	**78.10**	
Note:							
*	Marked items not indicated in SoC and required to be taken up during the course of exploration shall be charged separately (as peractuals)						
$	Trenching/Pitting dimensions are tentative may vary depending upon the geology and field conditions						
i	Satellite imageries shall be procured from website/NRSA as the case may be and procurement charges if any shall be charged at actuals.						
#	2nd level of work shall be carried out after review of 1st level work i.e. Geological mapping, geochemical sampling and analysis						

Sl. No.	Item	Total Estimated Cost (Rs.)
1	Geological Mapping (LSM), Other Geological Work	26,44,920
2	Trenching	1,14,000
3	Laboratory Studies	33,98,403
	Sub Total (1 to 6)	**61,57,323**
5	Exploration Report Preparation	3,07,866
6	Proposal Preparation	1,23,146
7	Peer review charges	30,000
8	Sub Total (1 to 7)	66,18,336
9	GST 18%	11,91,300
	Total:	**78,09,636**
	Say Rs. In Lakh	**78.10**

Tentative Time schedule / Action plan of Reconnaissance Survey (G-4) for REE in Kumhardih-Khijuri- Pachamba Block, District- Giridih, Jharkhand
Total block area- 175.28 sq km; Completion Time- 09 Months

Sl. No.	Activities	Months									
		1	2	3	4	5	REVIEW	6	7	8	9
1	Camp setting										
2	Geological mapping & Sampling										
3	Exploratory Trenching & Sampling										
3	Sample preparation										
4	Analytical work										
10	Camp winding										
12	Geologist at HQ										
13	Geological report										
14	Peer Review										

* Commencement of project will be reckoned from the day the exploration acreage is available along with all statutory clearances

*Time loss on account of monsoon/agricultural activity/forest clearance/ local law & order problems will be addition to above time line.