PROPOSAL FOR GENERAL EXPLORATION (G-2)

IN KELENDA BLOCK (3.975 SQ. KM) FOR GLAUCONITIC SANDSTONES AND SHALES, DISTRICT- MAHASAMUND,CHHATTISGARH

COMMODITY: GLAUCONITE

BY

MINERAL EXPLORATION AND CONSULTANCY LIMITED

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SEMINARY HILLS

NAGPUR (MH)

PLACE: NAGPUR

DATE: November, 2025

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

	Features	Details
	Block ID	**Kelenda Block**
	Exploration Agency	Mineral Exploration and Consultancy Limited (MECL)
	Commodity	**Glauconite**
	Mineral Belt	Singhora Group, Chhattisgarh Supergroup
	Budget & Time schedule to complete the project	577.64 Lakhs& 15 months
	Objectives	The present exploration program (G2) has been formulated on the basis of the outcomes of previous work to fulfill the following objectives: i. To confirm the lateral and depth continuity of glauconite-bearing horizons within the Bhalukona Formation through detailed grid-based drilling and geological mapping. ii. To validate and refine grade distribution and variability within the mineralized zones using comprehensive chemical and mineralogical analyses. iii. To carry out mineralogical, petrographic, and XRD studies to establish the quantitative presence of glauconite and associated K-bearing minerals such as illite and chlorite. iv. To assess beneficiation characteristics and recovery potential through laboratory-scale beneficiation studies. v. To generate a three-dimensional geological model integrating surface, subsurface, and analytical data for resource estimation under UNFC Category 332.
	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	
	Expected Field days (Geology, Survey)	Geologist Party days: Field -180 days & HQ-60 days
		Sampling Party days: 210 days
1.	**Location**	The proposed Kelenda Block comprises of 3.975 sq km area and lies in

<table>
<tr><td></td><td></td><td>Saraipali Tehsil of Mahasamund District (Toposheet No: 64K15 & 64K16), Chhattisgarh. Kelenda, Khairmal, Kasalba, Jognipali villages fall within the proposed area.The nearest town Saraipali is 10 km north of the block, which is also the tehsil headquarter.The district headquarter Mahasamund is 100.00 km west connected by NH-53.Basna (27 km), Bargarh (85 km) and Mahasamund (115 km) are the other township in proximity.</td></tr>
<tr><td></td><td>Latitude and Longitude</td><td>
<table>
<tr><th rowspan="2">POINTS</th><th colspan="2">UTM Zone-44N (m)</th><th colspan="2">GCS (DMS)</th></tr>
<tr><th>NORTHING</th><th>EASTING</th><th>LATITUDE</th><th>LONGITUDE</th></tr>
<tr><td>A</td><td>2354409.15</td><td>706596.14</td><td>21° 16' 47.0" N</td><td>082° 59' 28.68" E</td></tr>
<tr><td>B</td><td>2354011.98</td><td>707325.76</td><td>21° 16' 33.79" N</td><td>082° 59' 53.81" E</td></tr>
<tr><td>C</td><td>2349726.73</td><td>705057.37</td><td>21° 14' 15.42" N</td><td>082° 58' 33.27" E</td></tr>
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</td></tr>
<tr><td></td><td>Villages</td><td>Kelenda, Khairmal, Kasalba, Jognipali villages</td></tr>
<tr><td></td><td>Tehsil/Taluk</td><td>Saraipali Tehsil</td></tr>
<tr><td></td><td>District</td><td>Mahasamund</td></tr>
<tr><td></td><td>State</td><td>Chhattisgarh</td></tr>
<tr><td>2.</td><td>Area (hectares/ square kilometres)</td><td></td></tr>
<tr><td></td><td>Block Area</td><td>3.975 sq.km</td></tr>
<tr><td></td><td>Forest Area</td><td>Non forest area</td></tr>
<tr><td></td><td>Government Land Area (Bilanam)</td><td>Data not available</td></tr>
<tr><td></td><td>Charagaha</td><td>Data not available</td></tr>
<tr><td></td><td>Private Land Area</td><td>Data not available</td></tr>
<tr><td>3.</td><td>Accessibility</td><td></td></tr>
<tr><td></td><td>Nearest Rail Head</td><td>The nearest railway stations are Bargarh (60 km), Mahasamund (124 km) and Raipur (180 km).</td></tr>
<tr><td></td><td>Road</td><td>The proposed block is easily accessible by National Highway NH-53. The area is well connected by all-weather metaled road. All the villages in the area are well connected to each other by highways, motorable roads and tracks.</td></tr>
<tr><td></td><td>Airport</td><td>The nearest airport is at Raipur, which is about 150 km west of the block.</td></tr>
<tr><td>4.</td><td>Hydrography</td><td></td></tr>
<tr><td></td><td>Local Surface Drainage Pattern (Channels)</td><td>The Kelenda Block forms part of the eastern catchment of the Chhattisgarh Basin and displays a dendritic to sub-parallel drainage pattern, characteristic of gently sloping sedimentary terrains. Numerous first- and second-order ephemeral streams flow predominantly southeastward, eventually joining tributaries of the Jonk and Ong Rivers, which form part of the larger Mahanadi River system. Within the block, minor streams such as the Kelenda Nallah and its tributaries serve as the main surface water channels. Additionally, gully and stream cut exposures of glauconitic sandstone, shale, and chert along the drainage courses provide useful natural sections for geological mapping and sampling.</td></tr>
<tr><td></td><td>Rivers/ Streams</td><td>Tributaries of the Jonk and Ong Rivers</td></tr>
<tr><td>5.</td><td>Climate</td><td></td></tr>
<tr><td></td><td>Mean Annual Rainfall</td><td>The average annual rainfall in the area is 120 cm.</td></tr>
<tr><td></td><td>Temperature</td><td>Minimum temperatures: 15°C (Oct-Feb),
Maximum temperatures: up to 42°C (March-June)</td></tr>
<tr><td>6.</td><td>Topography</td><td></td></tr>
</table>

	Toposheet Number	64K15 & 64K16
	Morphology of the Area	The area is characterized predominantly by plain to gently undulating lands with minimum and maximum elevation of 238m to 272m above MSL respectively. Majority of the area is plain land (private or leased for carrying out agriculture) and barren land. Physiography of the study area is mainly plain land under cultivation. The villagers grow two to three crops a year with the help of rain water, bore wells and pond water. Villages and settlements are well scattered throughout the area.
7.	**Availability of baseline geoscience data**	
	Geological Map (1:50K/25K)	Geological Map (1:50000), NGDR Portal Geological Map (1:4000), GSI (FS: 2022-23)
	Geochemical Map	NGCM data available in NGDR Portal
	Geophysical Map (Aeromagnetic, ground geophysical, Regional as well as local scale GP maps)	NGPM Gravity and Magnetic data available in NGDR Portal
8.	**Justification for taking up Exploration**	• **Confirmed Glauconite Mineralization:** G3 exploration established a laterally continuous glauconite-bearing sandstoneshale horizon with an inferred resource of 64.08 MT @ 5.45% K_2O, requiring further confirmation for upgradation to 332 categories. • **Need for Closer-Spaced Drilling:** The existing borehole spacing (400 m × 400 m) is adequate only for inferred category and maintained not all over the block; a 200 m × 200 m grid under G2 will validate grade and thickness continuity. • **Grade Consistency and Geological Simplicity:** The deposit exhibits uniform grade, consistent lithology, and simple structure, ideal for higher confidence exploration. • **Beneficiation and Recovery Studies Pending:** No beneficiation or process tests were conducted during G3; G2 will include mineral beneficiation and K_2O recovery evaluation. • **National Strategic Importance:** Glauconite represents a potash substitute mineral of national relevance, supporting Atmanirbhar Bharat and import substitution initiatives in fertilizer minerals. • **UNFC Compliance Requirement:** To upgrade from UNFC 333 to 332, data on grade reliability, density, beneficiation, and continuity are mandatory, which the G2 programme will generate. • **Alignment with NMEP & MoM Priorities:** The proposed work supports National Mineral Exploration Policy (2019) and Ministry of Mines' focus on indigenous K-mineral resource development. • **Technical Feasibility and Data Gaps:** G2 exploration will fill existing data gaps, refine geological understanding, and enable future G1 feasibility studies and techno-economic assessment.

PROPOSAL FOR GENERAL EXPLORATION (G-2)

OF GLAUCONITIC SANDSTONE AND SHALEIN KELENDA BLOCK

(3.975 SQ. KM AREA)

DISTRICT- MAHASAMUND, CHHATTISGARH

1.0.0 INTRODUCTION

1.1.1 Glauconite is a green, hydrous, potassium iron silicate mineral (K,Na) (Fe^{3+}, Al,Mg) $_2(Si,Al)_4O_{10}(OH)_2 \cdot nH_2O$], generally occurring as peloids or aggregates within marine sedimentary rocks, especially sandstones and shales. It forms under low sedimentation rates in shallow marine shelf environments and represents slow chemical precipitation in mildly reducing conditions. Glauconite typically contains 4–7% K_2O and serves as a potential indigenous source of potash for agricultural fertilizers and allied industries.

1.1.2 The occurrence of glauconitic sandstone and shale within the Singhora Group of the Chhattisgarh Supergroup was first reported by GSI workers as early as Medlicott (1867) and Ball (1877), and later described by Das et al. (1992). Subsequent reconnaissance and preliminary investigations by the Geological Survey of India, Central Region, Raipur, in the Bhalukona–Khairmal–Kelenda sector of Mahasamund District, delineated glauconite-bearing horizons within the Bhalukona Formation. The latest G3 stage exploration (Field Season 2022–23; FSP Item No. M2ASMIF-MEP/NC/CR/SU-CG/2022/42962) established a well-defined glauconitic shale and sandstone zone in Kelenda Block with encouraging K_2O values ranging between 4.25% and 5.97%.

1.1.3 Glauconite has wide industrial applications, the most significant being its use as a natural, slow-release potassium fertilizer. It improves soil structure, provides steady nutrient release, and supports sustainable and organic farming practices. In addition, it finds limited applications in water filtration, ceramics, and catalysis. Its potential as an indigenous substitute for imported potash minerals such as Muriate of Potash (KCl) gives it a strategic economic importance for India.

1.1.4 At present, India imports nearly its entire potash requirement, with annual demand estimated at 4.5 to 5 million tonnes K_2O equivalent, costing the exchequer over ₹10,000 crore annually (Department of Fertilizers, 2023). Indigenous production remains negligible, highlighting the strategic need to develop domestic K-bearing resources such as glauconite. Recognizing this, the Ministry of Mines, Geological Survey of India (GSI), Mineral Exploration and Consultancy Limited (MECL), and Indian Bureau of Mines (IBM) have prioritized glauconite exploration under the National Non-Fuel Mineral Exploration Policy (NMEP) to achieve self-reliance in fertilizer minerals under the *Atmanirbhar Bharat* initiative.

1.1.5 The market demand for potash is expected to increase year - on - year globally. The domestic demand met almost entirely by imports require a turnaround, initiatives to promote indigenous mining of potash in India must be encouraged. Prospects of potash mining in India could mitigate the issue of import of the mineral and consequently will have

positive impact in the investment opportunities in the sector which in turn could be utilized for the development of mineral wealth (IMY, 2020).

1.2.0 BACKGROUND

1.2.1 The preliminary exploration (G3 stage) carried out by GSI in the Kelenda Block successfully delineated glauconite-bearing horizons with average grades above 4% K_2O and an inferred mineral resource of 64.08 million tonnes (UNFC 333 category). However, further work is required to confirm the lateral and depth continuity of the mineralized zone, assess grade variability, determine bulk density and specific gravity, and carry out beneficiation studies to evaluate its fertilizer-grade suitability.

1.2.2 Considering the confirmed presence of glauconitic mineralization, consistent grade, favorable infrastructure, and its strategic importance in reducing potash import dependency, the Kelenda Block warrants detailed exploration at the G2 stage. The proposed G2-level work aims to upgrade the deposit from UNFC Category 333 to 332 through systematic drilling, detailed sampling, petrographic and chemical characterization, and beneficiation evaluation. This will not only enhance geological confidence in the deposit but also contribute towards developing indigenous fertilizer-grade potash resources in line with national mineral policy objectives.

1.2.3 In light of the aboveproposal for General Explorationfor glauconitic sandstone in Kelenda Block over an extent of 3.975 sq km is prepared and submitted for discussion. The details of the proposal are described in the following paragraphs.

2.1.0 LOCATION AND ACCESSIBILITY

2.1.1 The proposed Kelenda Block comprises of 3.975 sq km area and lies in Saraipali Tehsilof MahasamundDistrict (Toposheet No: 64K15 & 64K16), Chhattisgarh.Kelenda, Khairmal, Kasalba, Jognipalivillages fall within the proposed area.The proposed block is easily accessible by National Highway NH-53. The area is well connected by all-weather metaled road. The district headquarter Mahasamund is 100.00 km westconnected by NH-53. The nearest town Saraipali is 10 km north of the block, which is also the tehsil headquarter.Basna (27 km), Bargarh (85 km) and Mahasamund (115 km) are the other township in proximity. All the villages in the area are well connected to each other by highways, motorable roads and tracks. The nearest airport is at Raipur, which is about 150km west of the block. The nearest railway stations are Bargarh (60 km), Mahasamund (124 km) and Raipur (180 km).The Location Map of proposed Kelenda Block is given in Plate No I.

Table 2.1
Coordinates of Corner Points of Proposed Kelenda Block, Saraipali Tehsil, Mahasamund District, Chhattisgarh

SL. NO.	POINTS	UTM Zone-44N (m)		GCS (DMS)	
		NORTHING	EASTING	LATITUDE	LONGITUDE
1	A	2354409.15	706596.14	21° 16' 47.0" N	082° 59' 28.68" E
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2.2.0 PHYSIOGRAPHY AND DRAINAGE

2.2.1 The area is characterized predominantly by plain to gently undulating lands with minimum and maximum elevation of 238m to 272m above MSL respectively. Majority of the area is plain land (private or leased for carrying out agriculture) and barren land. Physiography of the study area is mainly plain land under cultivation. The villagers grow two to three crops a year with the help of rain water, bore wells and pond water.Villages and settlements are well scattered throughout the area.

2.2.2 The area has thin to moderate forest cover developed over the hilly areas exposing Singhora Group of rocks and it falls under Palasapali Reserved Forests. The remaining majority of the area forms fertile plain lands. During dry season, agriculture is supported by irrigation through the reservoirs. There are no environmental issues reported in the area as such. Both glauconitic and non-glauconitic sandstones are being used by the locals as building stones and as road construction materials.

2.2.3 Chhattisgarh State Power Distribution Company Limited (CSPDCL) supplies electric power through Saraipali sub-station to all villages.

2.2.4 The Kelenda Block forms part of the eastern catchment of the Chhattisgarh Basin and displays a dendritic to sub-parallel drainage pattern, characteristic of gently sloping sedimentary terrains. The drainage is primarily influenced by subtle topographic variations and lithological contrasts within the Singhora Group. Numerous first- and second-order ephemeral streams flow predominantly southeastward, eventually joining tributaries of the Jonk and Ong Rivers, which form part of the larger Mahanadi River system. The drainage network consists mainly of seasonal nallahs and surface runoffs active during the monsoon months (June to September), while the stream density and gradient remain moderate, consistent with the subdued relief and gentle regional slope from northwest to southeast.

2.2.5 Within the block, minor streams such as the Kelenda Nallah and its tributaries serve as the main surface water channels. Several village tanks, ponds, and check dams have been constructed along these courses to store rainwater for agricultural and domestic use, which can also supply water for exploration and drilling operations. The absence of major rivers, flood-prone zones, or steep gradients ensures safe and stable ground conditions for field activities throughout the year. The moderate drainage density facilitates surface access, reduces erosion risk, and allows efficient site maintenance. Additionally, gully and stream cut

exposures of glauconitic sandstone, shale, and chert along the drainage courses provide useful natural sections for geological mapping and sampling. Overall, the drainage characteristics of the Kelenda Block are favorable for detailed G2 exploration, offering both operational convenience and geological advantage.

2.3.0 CLIMATE

2.3.1 The investigated area experiences tropical climate. Summer season begins from middle of March till early June. Summer is characterized by stretches of humid to very hot dry months with maximum temperature up to 42°C. Winter prevails from Late October to mid-February, temperature fluctuates between 15°C to 21°C during winter.

2.3.2 The area receives heavy rainfall through the southwest monsoon, prevailing from early June to September. The average annual rainfall in the area is 120 cm.

2.4.0 FLORA AND FAUNA

2.4.1 The area is poorly inhabited in the hilly/ridges area. The plain land and villages are characterized by intensive cultivation producing seasonal crops like paddy, wheat etc. The floral assemblages reported in the area are Tendu (Diospyros melanoxylon), Mahua (Bila latifolia), Teak (Tectona qrandis), Jamun (Eugenia cumini), Babul (Acacia arabica), Mango (Mangifera indica) and bamboo (Bambusa bambos). In cultivated plains Babul (Acacia arabica) is the predominant tree.

2.4.2 The main wild animals reported are Jackal (Canis aureus), fox (Vulpes bengalensis), rabbit (Oryctolagus cuniculus), bear (Meluvsus ursinus), Monitor Lizard (Varanus varius) and snakes.

3.1.0 REGIONAL GEOLOGY

3.1.1 The Mesoproterozoic Chhattisgarh Supergroup represents a classic example of silici-carbonate sequence of ~2300m thickness in Central India. Chhattisgarh basin is a major 'Purana Basin' situated in Bastar Craton. Chhattisgarh Supergroup of rocks unconformably overlies the granite/gneiss basement of Archean/Paleoproterozoic Sonakhan Group of rocks (Chakraborty et al., 2012). The Chhattisgarh succession includes three major unconformity bound sequences, viz. the Singhora Group, Chandarpur-Raipur Group and Kharsiya Group. Singhora, the early embryonic basin (Proto-basin) is situated along the SE margin of the Chhattisgarh basin. It is bounded by the Sonakhan Greenstone Belt on the west, Sambalpur Granitoids on the east and Eastern Ghat Mobile Belt on the southeast. The Singhora proto-basin covers around 1000 sq km area and has a NE-SW long axis. The study area forms a part of Singhora Group of sediments which overlies the granitic basement in the south and is in turn overlain by Chandarpur Group of rocks on the north.

3.1.2 Regionally the basement mainly comprises of granitoids and its variants. The basement is overlain by the Singhora Group, which comprises the four litho facies. The present study area is occupied by rocks of Saraipali and Bhalukona formations. The basal Rehatikhol Formation consists of coarse-grained arenaceous sequence depicting typical of a pre-vegetation alluvial fan and braided delta setting, while the Saraipali and Chhuipali formations

are mainly argillaceous and they are deposited in Palaeogeographic setting ranging from storm-infested inner shelf to distal outer shelf extending beneath the storm wave base (Chakraborty et al., 2012). The Saraipali Formation is mainly argilitic and consists of purple and green shale with banded chert. It is overlain by Bhalukona Formation comprising quartz arenite, arkose to subarkose, shale and siltstone. Glauconite in these areas is associated with quartz arenite and arkosic-subarkosic sandstone of Bhalukona Formation of Singhora Group. The glauconite bearing Bhalukona Sandstone in the area underlain by Saraipali Formation and is overlain by the Chhuipali Formation. It comprises of five major facies associations viz: fluvial, foreshore-beach, upper shore face, lower shore face and wave influenced delta front deposits (Banerjee et. al., 2015). The sandstone of Bhalukona Formation has maximum thickness of ~23m in the Bhaludongar section (Banerjee et. al., 2015), and it wedges out in the extreme east and north-eastern part of the basin. Regional stratigraphy of the area after GSI is as follows: -

Table: 3.1: Regional stratigraphy of the area (Das et al., 1992, GSI).

Group	Formation	Lithology
	Intrusives	Basic Dykes
CHANDRAPUR GROUP	Kansapathar Formation	Medium grained Quartz arenite
	Chapordih Formation	Dark grey Shale- Siltstone with quartz arenite, feldspathic arenite
	Lohardih Formation	Greenish grey arkosic and wacky arenite with basal conglomerate/ ferruginous sandstone-shale and grey chert.
	Discontinuity	
SINGHORA GROUP	Chhuipali Formation	Stromotolitic limestone and dolomite, variegated shale with minor bedded limestone, chert and siltstone inercalations.
	Bhalukona Formation	Quartz arenite/ siltstone and minor shale
	Saraipali Formation	Variegated shale, chert and minor limestone
	Rehatikhol Formation	Feldspathic arenite, arkose and conglomerate at base
	Unconformity	
	Archean and Lower Proterozoic Basement	

3.1.3 Singhora Group of rocks are unmetamorphosed and slightly deformed like other Proterozoic sedimentary basins. The general trend of the lithounits in the basement rocks is NE-SW in the north-eastern part, and EW to WNW-ESE in the southern part of the area.

3.1.4 Glauconite is well exposed within arenite of Bhalukona Formation along a NE-SW trending, 14 km long and 150 to 400m wide horizon. Glauconite occurs as green coloured, specified grains as framework element.

3.2.0 GEOLOGY OF THE BLOCK

3.2.1 GSI carried out geological mapping in Kelenda block on 1:4000 scales. Most of the area is covered under soil. The area exposes the rocks of Singhora Group of Chhattisgarh Supergroup. Lithologically, the area is occupied by different litho-units namely, glauconitic sandstone with shale intercalation of Bhalukona Formation and variegated shale, chert with occurrence of minor limestone of Chhuipali Formation. In the area due to warping, the bed shows deviation in their attitude. The trend NW-SE direction with an average southerly dip

of 10°-16°.Based on field studies, the local litho-stratigraphic set up arrived at the Kelenda block is as given below

Table No 3.2: Stratigraphy of the Kelenda block (After GSI)

AGE	SUPERGROUP	GROUP	FORMATION	LTHOLOGY
Recent				Laterites/Lateritic soil and alluvium
Meso-Neo-Proterozoic	Chhattisgarh Supergroup	Singhora Group	Chhuipali Formation	Variegated shale with minor dolomitic limestone, chert and siltstone intercalations.
			Bhalukona Formation	Siltstone and shale
				Glauconitic sandstone (Fine and coarse grained)
				Sandstone

3.2.2 **Description of the Rock Types:** The basal part of Chhattisgarh Supergroup is represented by the Singhora Group of rocks. Bhalukona overlies the Saraipali Formation and it is overlain by the Chhuipali Formation. It consists of sandstone (compositionally varies between subarkose to quartz arenite) intercalated with minor shale in its basal part. This Bhalukona Formation is glauconite and pyrite bearing, both pyrite and glauconites have mutually exclusive relationship in this sandstone in respect of occurrence. Chhuipali Formation conformably overlies Bhalukona Formation and is the topmost formation of Singhora Group. The dominant unit is shale with minor occurrences of chert and limestone. The unit covers about 70% of the area which is mostly under cultivation.

3.2.2.1 **Sandstone:** The sandstone is buff to milky white in color, hard, compact and massive in general and locally gritty. It is composed of quartz, feldspar, glauconite and pyrite. Clasts are mainly sub-rounded to round with moderate to high sphericity. Thus, the sandstone is both texturally and mineralogically matured. The sandstone band has been subdivided into two parts, glauconitic bearing sandstone and non- glauconitic sandstone. Both non-glauconitic and glauconitic sandstone is present as ridges in the western side of the block trending NE-SW from North boundary to south boundary of the Kelenda block. Glauconite granules are spherical and olive to deep green in colour. The size of the glauconite grains vary from 1 mm to 4 mm with elliptical and rectangular shapes mainly. These beds are characterized by parallel stratification, planar and tabular cross stratifications. Non glauconitic sandstones were harder and more compact while glauconitic sandstones were relatively friable and less compact.

3.2.2.2 **Shale:** Shale is pale green in colour occasionally dark grey at places. Dark grey shale is fissile and soils finger. Shale sometimes occurs as bands within sandstone. At places shale is finely laminated with thin glauconite bearing siltstone/sandstone which defines the bedding plane as observed in the borehole

3.2.1.3 **Laterite/ Lateritic Soil:** Laterites/Lateritic soil covers observed at places in the northern part of the block mostly between inferred contact areas of Saraipali Formation and Bhalukona Formation. However, Saraipali formation exposures were not exposed in the study area.

3.2.1.4 **Alluvium/ Soil cover:**The majority of the area viz. about 75% covered under soil. The soil is light yellowish-khaki to dull brown in colour. The thickness of the soil cover varies from less than 1m to up to 4m all over the area.

3.2.3 PETROLOGICAL STUDIES:GSI carried out petrographic studies in 10 samples. Bhalukona glauconitic sandstone is noticed to be well sorted. The grains exhibit high degree of roundness, from sub-angular to sub-rounded. It contains quartz, feldspar and fragments of glauconite mineral. Glauconite grains are well rounded with variable sizes. The rock is both mineralogically and texturally matured. Quartz is rounded to sub-rounded and rarely sub-angular. Quartz overgrowth is also observed in continuity with the host grain. Few quartz grains are deformed and fractured. Glauconitization process is observed along the fractures. Modal percentage of quartz is more than 90% whereas feldspar constitutes only 5%. Glauconite shows different shapes viz. ellipsoidal, circular, elongated, and fragmented. Glauconite varies from pale green to dark green. It may oxidize to brownish yellow or reddish brown. Glauconite is not found in ground mass as well as cementing material.

3.2.3 MINERALOGY OF THE ORE ZONES AND ORE TEXTURES: Glauconite is considered as a diagnostic mineral indicative of shelf marine depositional environments with slow rates of accumulation. Srivastava, (1978) studied grain size analysis and suggested that glauconite has been deposited in the littoral to sub littoral zone of continental shelf. Glauconite in the study area is present as an important mineral in quartz arenite. General strike of the glauconitic band is NE-SW, dipping 10 to 15° towards SE. Glauconitic band consists mainly of sub-rounded to rounded quartz grains and glauconite grains, the rock is well sorted and matured both mineralogically and texturally. In the study area glauconites of various sizes (1mm to 4mm) and shapes (spherical, sub-spherical, cubic, mainly elliptical), colour of glauconite grains varies from pale green to dark green to greenish black. The volume percentage of glauconite in the sandstone varies from 2 to 10% (both visual estimation and petrographic study). The textural relationship among the framework elements, glauconite, matrix and cement depict that glauconite occurs as replacing veins and peloids. Glauconite is not present as matrix or cement, rather it occurs as a replacing texture preserving the relict phase partly.The major mineralised target zone is the NE-SW trending glauconite bearing sandstone of Bhalukona Formation present towards eastern part of the block.

Mode of occurrence: Glauconite appears as small detrital grains which have attained rounding and sphericity Most of its concentration is along bedding planes. It appears to be green coloured and the highest glauconite noticed is ~7.51% in core samples. The glauconite peloids are present haphazard in nature. The mode of occurrence of glauconite is classified mainly in two types viz., discrete peloids and veins and stringers within quartz arenite mainly.

Nature of mineralization: Glauconite bearing horizons were demarcated at Kelenda, Khairmal and Kasalba villages along a NE-SW trending sandstone ridge comprising Glauconitic sandstone of Bhalukona Formation of the Singhora Group. It occurs as detrital grains in various sizes and shapes within sandstone and to some extent in shale. The sandstone appears to be green at the base due to higher concentration of glauconite mineral. The glauconitic band shows glauconites of various sizes (1 mm to 4 mm) and shapes (mainly elliptical), the colour of glauconite grains varies from pale green to dark green to

black. The volume percentage of glauconite in the sandstone varies from 0.15% to greater than 7.51%. Under microscope, two modes of occurrences were observed, as discrete peloids and veins and stringers.

Details of Mineralised Zones: Sedimentary litho-package of Singhora Group of Chhattisgarh Supergroup created favourable geological set-up for glauconite mineralization. Glauconite mineral is associated with sandstone of Bhalukona Formation of Singhora Group of rocks. In field, glauconite was observed in the lower horizon of Bhalukona Formation. Glauconite bearing horizons were demarcated at Khairmal, Kasalwa and Kelenda, villages along a NE-SW trending sandstone band. Glauconitic Sandstone occurs as detrital grains in various sizes and shapes within sandstone. The sandstone appears to be green at the base due to higher concentration of glauconite mineral. The glauconitic band shows glauconites of various sizes (1mm to 4mm) and shapes (mainly elliptical), the color of glauconite grains varies from pale green to dark green to black. Alteration zone was not present, howeverweathering was prominent at places forming Fe-oxides in glauconitic sandstone.

4.0.0 PREVIOUS WORK AND RECOMMENDATION

4.1.0 The glauconite-bearing formations of the Singhora Group within the Chhattisgarh Basin have been the subject of periodic geological investigations by the Geological Survey of India (GSI) over several decades. The Bhalukona–Kelenda–Khairmal–Saraipali sector in Mahasamund District was recognized early on as a prospective zone for glauconitic sandstone and shale occurrences based on regional geological mapping and reconnaissance surveys.

4.2.0 The earliest record dates back to 1956–57, when A.K. Roy and his team from GSI carried out regional geological mapping in parts of Mahasamund and Raigarh districts on a 1:63,360 scale. This work delineated the main lithostratigraphic divisions of the Singhora Group and noted the presence of greenish glauconitic sandstones and shales in the area for the first time. During 1979–80, R.P. Mohanty and K. Sekhar of GSI conducted a reconnaissance survey in the Bhalukona–Rajadih–Khairmal sector to locate glauconitic horizons within the Singhora Group. Their mapping, covering about 100 sq km at 1:25,000 scale, identified glauconitic sandstone and siltstone beds of the Bhalukona Formation and recommended more detailed mapping and sampling to evaluate their potash potential.

4.3.0 Subsequent systematic work was undertaken in 2018–19 under the National Mineral Exploration Policy (NMEP) initiative by GSI, Central Region, Raipur. The team led by A. Khan et al. carried out regional mapping on a 1:12,500 scale over 52 sq km, collecting 120 bedrock and 40 stream-sediment samples. The analytical results confirmed the presence of glauconitic sandstone with K_2O values ranging between 4.2% and 6.0%, thus highlighting the area's economic potential. Encouraged by these results, preliminary (G4) exploration was carried out by D. Bhoi and M. Asif during 2020–21 in the Bhalukona–Khairmal area, covering 1:5,000 scale mapping, 12 trenches totaling 350 m, and 256 chemical samples. This investigation established a continuous glauconitic horizon with K_2O grades ranging from 4.1% to 5.8%, recommending the block for G3 stage exploration.

4.4.0 Building upon the earlier findings, General Exploration (G3) was taken up by GSI, Central Region, Raipur during the Field Season 2022–23 under FSP Item No. M2ASMIF-MEP/NC/CR/SU-CG/2022/42962, specifically targeting the Kelenda Block. The objectives

were to delineate glauconite-bearing horizons of the Bhalukona Formation, determine grade and thickness continuity, and generate an initial resource estimate under UNFC classification. The work included 1:2000 scale geological mapping over 3.975 sq km, DGPS topographic survey, and core drilling of 16 boreholes totaling 634.00 m on a 400 m × 400 m grid. A total of 384 samples were analyzed for major and trace oxides, with K_2O values ranging between 4.25% and 6.34%, indicating good lateral grade consistency. Petrographic and XRD studies confirmed glauconite as the principal K-bearing mineral, accompanied by illite and chlorite.

The thickness of the glauconitic zone intersected in boreholes varied between 6.81 m and 42.01 m, at depths ranging from 0.50 m to 57.55 m. Resource estimation carried out using the extended-area (polygon) method yielded a total inferred resource of 64.08 million tonnes at an average grade of 5.45% K_2O and a cut-off grade of 4%, categorized under UNFC 333. The study established that the glauconitic sandstone–shale intercalations form a laterally persistent, gently dipping stratiform horizon within the Bhalukona Formation.

The earlier reconnaissance and mapping studies, supported by the recent G3 exploration results, have conclusively demonstrated that the Bhalukona Formation within the Singhora Group hosts a laterally continuous glauconitic horizon extending from Bhalukona to Kelenda. The G3 data confirmed consistent potash enrichment above 4% K_2O, indicating potential for fertilizer-grade application. However, due to the limited borehole density, absence of beneficiation characterization, and restricted subsurface coverage, the deposit remains in the inferred resource category (UNFC 333).

Overall, the progressive exploration history from reconnaissance through G4 and G3 stages has firmly established the Kelenda Block as a promising glauconite-bearing sector of the Chhattisgarh Basin. The GSI's 2022–23 results justify upgradation to G2-level exploration to confirm grade continuity, refine geometry and resource parameters, and undertake beneficiation studies for future feasibility evaluation.

During the G3 exploration (FS 2022–23), 16 vertical boreholes were drilled totaling 634.00 m. Boreholes were spaced approximately 400 m × 400 m, with average depths of 50 m. The glauconitic zone thickness varied between 6.81 m and 42.01 m, occurring from 0.50 m to 57.55 m depth.

Key lithological intersections recorded in boreholes (CMK-01 to CMK-16) included:

- **Glauconitic sandstone:** 5–25 m thick, 4.25–5.78% K_2O
- **Glauconitic shale–sandstone intercalation:** 8–20 m thick, 5.06–6.34% K_2O
- **Shale with fine glauconitic lamination:** 4–10 m thick, 5.42–5.97% K_2O

Petrographic studies (GSI, 2023) show glauconite pellets replacing K-feldspar and quartz, suggesting progressive glauconitization under reducing marine diagenetic conditions. Sulphide nodules (pyrite) and penecontemporaneous deformation structures were also noted in cores CMK-05 and CMK-06, indicating soft-sediment deformation within shallow marine muds.

5.0.0 OBJECTIVE OF THE PROPOSED GENERAL EXPLORATION (G-2 STAGE):

5.1.0 The present exploration program (G2) has been formulated on the basis of the outcomes of previous work to fulfill the following objectives:

I. To confirm the lateral and depth continuity of glauconite-bearing horizons within the Bhalukona Formation through detailed grid-based drilling and geological mapping.
II. To validate and refine grade distribution and variability within the mineralized zones using comprehensive chemical and mineralogical analyses.
III. To carry out mineralogical, petrographic, and XRD studies to establish the quantitative presence of glauconite and associated K-bearing minerals such as illite and chlorite.
IV. To assess beneficiation characteristics and recovery potential through laboratory-scale beneficiation studies.
V. To generate a three-dimensional geological model integrating surface, subsurface, and analytical data for resource estimation under UNFC Category 332.

6.0.0 PLANNED METHODOLOGY

In accordance to the objective set for General Exploration (G-2) of the block, the following exploration programme is proposed. The Exploration shall be carried out as per Minerals (Evidence of Mineral Contents) Rule-2015. Accordingly, the following scheme of exploration is formulated in order to achieve the objectives. The details of different activities to be carried out are presented in subsequent paragraphs.

6.1.0 DETAILED GEOLOGICAL MAPPING(1:2000 SCALE):

The entire 3.975 sq km area will be remapped on a detailed scale to refine stratigraphic boundaries, structural trends, and lithological variations within the Bhalukona and Chhuipali Formations. The mapping will focus on tracing glauconitic sandstone–shale intercalations, surface structures, and structural attitudes to delineate the mineralized zones with greater accuracy. The expected output will include a revised geological map and cross-sections, providing a precise geological framework for borehole correlation.

6.2.0 TOPOGRAPHICAL SURVEY (1:2000 SCALE):

A DGPS and Total Stationbased topographical survey will be conducted to generate detailed contour and planimetric data at 2 m contour intervals. The survey will aid in accurate borehole positioning, volume computation, and future mine-planning studies. The data will also serve as a base for 3D modelling of the deposit.

6.3.0 EXPLORATORY CORE DRILLING (TOTAL: 2800m):

A total of 53 boreholes, each averaging 55 m depth, are proposed on a 200 m × 200 m grid spacing to improve resource definition and confirm grade continuity both along strike and down dip. The drilling density will be optimized based on the G3 results and topographic constraints. Core logging will be carried out recording lithology, texture, color, mineral content, structure, and recovery. The core will be preserved for resampling and cross-verification.

6.4.0 CORE LOGGING AND LITHOLOG PREPARATION:

All drill cores will be systematically logged and photographed to document lithological variations and glauconite distribution. Lithologs will be digitally compiled using GIS for correlation with existing G3 boreholes to establish 3D stratigraphic continuity.

6.5.0 SAMPLING AND CHEMICAL ANALYSIS:

Core samples will be collected at 1 m intervals from mineralized zones. About 1460 samples are expected for XRF analyses for major oxides (SiO_2, Al_2O_3, Fe_2O_3, K_2O, MgO, CaO, Na_2O, TiO_2, MnO, P_2O_5& LOI) and selected trace elements. This will provide grade distribution patterns and compositional consistency of glauconite within the block.

6.6.0 XRD AND MINERALOGICAL STUDIES:

About 50 representative samples from borehole cores and surface exposures across all lithounits of the Kelenda Block will be analyzed by X-ray Diffraction (XRD) using the Rietveld refinement method. The study will quantitatively determine major mineral phases—glauconite, illite, chlorite, quartz, and feldspar—and assess fine clay fractions (<2 µm) to understand glauconite distribution and purity.

The XRD results will confirm mineralogical homogeneity, validate that the K_2O content originates from glauconite, and identify associated clays influencing beneficiation response. These findings will directly support resource estimation, beneficiation planning, and UNFC upgradation from 333 to 332, ensuring higher confidence in grade continuity and processing potential of the glauconite-bearing horizons.

6.7.0 PETROGRAPHIC AND MODAL ANALYSIS:

Around 20 representative samples from borehole cores and surface exposures across the Kelenda Block will undergo thin section and modal analysis to quantify glauconite, detrital quartz–feldspar, and accessory minerals. The study will define mineral proportions, textures, and grain relationships to confirm the authigenic origin and maturity of glauconite.

The results will help correlate mineral mode with K_2O grade, refine tonnage–grade estimation, and provide key inputs for beneficiation design by identifying liberation characteristics and cementing materials. These findings will also strengthen geological confidence and support UNFC upgradation from 333 to 332, ensuring reliable resource evaluation and process planning for the G2 stage.

6.8.0 BENEFICIATION AND PROCESS STUDY:

Laboratory-scale beneficiation tests will be undertaken to evaluate the amenability of glauconitic material to physical upgrading and potash extraction. Representative composite samples (50–200 kg each) from borehole cores Kelenda Blockto determine the most effective process route for enhancing K_2O recovery. Supporting analyses such as XRDand chemical assays will guide process optimization and characterize mineral behavior. The results will provide key inputs for assessing fertilizer-grade suitability, defining a preliminary

beneficiation flowsheet, and improving the accuracy of resource evaluation and UNFC upgradation through validation of recoverable K_2O potential.

6.9.0 DATA INTEGRATION, INTERPRETATION, AND RESOURCE ESTIMATION:

All geological, geochemical, and drilling data will be integrated for updated resource estimation as per UNFC guidelines. The revised tonnage–grade model will target upgrading of the present 64.08 MT (5.45% K_2O) inferred resource to indicated (332) category through improved geological confidence and verified sampling density.

The proposed exploration plan is structured to confirm geological continuity, establish grade reliability, and assess beneficiation behavior of the glauconite-bearing horizon. Upon completion, the block will attain a robust database suitable for feasibility-level (G1) planning and techno-economic evaluation in the subsequent stage. The entire programme will be executed adhering to MEMC&UNFC standards and in compliance with environmental and safety regulations of the Ministry of Mines and IBM.

6.10.0 DENSITY DETERMINATION

A total of 10 representative samples from selected drill cores will be utilized to determine the bulk density of different lithounits within the Kelenda Block, particularly the glauconitic sandstone and associated shale horizons. Density measurements will be carried out using the wax-coated (paraffin) displacement method, ensuring accurate determination of in-situ dry and saturated densities.

The purpose of this study is to obtain reliable tonnage conversion factors essential for resource estimation and volumetric calculations. Accurate density data will improve the precision of tonnage–grade computations, support UNFC resource upgradation, and provide valuable inputs for mine planning and beneficiation studies. Additionally, density variations between lithounits will help assess porosity, compaction, and diagenetic changes, offering insight into the physical characteristics and storage capacity of the glauconitic sequence.

6.11.0 TRACE ELEMENT ANALYSIS

A total of 20 Nos of samples is proposed for trace element analysis. Trace element analysis is essential to comprehensively evaluate the chemical quality, environmental safety, and genetic character of the glauconitic horizon in the Kelenda Block. It helps identify deleterious elements such as As, Cd, Pb, Cr, and Ni to ensure the material meets fertilizer-grade and environmental standards, while also determining trace and rare elements (Rb, Sr, REE, etc.) that provide insights into the provenance, diagenesis, and maturity of glauconite formation. Analysis for 34 elements (REE, RM, Basemetals, HFSE elements) by ICPMS method for As, Cd, Pb, Hg, Se, Cr, Ni, Cu, Zn, Co, Mo, V, U, Th, F, Cl, S- Ti, Mn, P, Sr, Ba, B, REE + Y, Rb, Cs, Li, Ga, Sc, Zr, Hf, Nb, Ta will be carried out.

7.1.0 QUANTUM OF WORK:

7.1.1 The quantum of work proposed by MECL in Kelenda Block (G-2 Stage of Exploration) is given in Table 6.1.

Table: 7.1

Proposed Quantum of Exploratory Work in Kelenda Block, District-Mahasamund, Chhattisgarh.

Sl. No.	Item of Work	Unit	Proposed Quantum of work
1	Geological Mapping (1:2000 scale)	sq. km	3.975
2	Topographic Survey (1:2000 scale)		3.975
3	DGPS Survey	Nos.	53
4	Drilling (53 nos)	m.	2800
5	Primary Sample - Major Oxides viz. SiO_2, Al_2O_3, Fe_2O_3, K_2O, MgO, CaO, Na_2O and selected trace elements + 10% External Check	Nos.	1460+ 146= 1606
6	Analysis for 34 elements (REE, RM, Basemetals, HFSE elements) by ICPMS method	Nos.	20
7	XRD Studies	Nos.	50
8	Petrographic Studies	Nos	20
9	Modal Analysis	Nos	20
10	Beneficiation Studies	Nos.	1
11	Density studies	Nos	10
12	Report Preparation (Digital format)	Nos.	1

7.2.0 MANPOWER DEPLOYMENT

7.2.1 Manpower deployment List may be provided later.

7.3.0 TIMELINE AND BREAK-UP OF EXPENDITURE

7.3.1 The proposed exploration programme is planned for General Exploration (G-2). The work activities like camp setting, geological work, exploratory drilling, laboratory work, report writing will be completed within 15 months' time. The bar chart showing activities wise time schedule is placed at **Table-7.2.**

Table-7.2.

Estimated time schedule for General Exploration (G-2) for Glauconitic Sandstone in Kelenda Block, Districts: Mahasamund, State: Chhattisgarh [Block area- 3.975 sq. km; Schedule timeline- 15 months]																		
Sl.	**Particulars**	**Months**	**1**	**2**	**3**	**4**	**5**	**6**		**7**	**8**	**9**	**10**		**11**	**12**	**13**	**14**	**15**
1	Camp Setting/ mobilization	Months							REVIEW					REVIEW					
2	Geologist days (Mapping, Core Logging, Sampling)	days																	
3	Survey Days	days																	
4	Drilling	m																	
5	Sampling days	days																	
6	Camp winding	Months																	
7	Laboratory Studies	days																	
8	Beneficiation Studies																		
9	Geologist days, HQ	days																	
10	Report Writing with Peer Review	days																	

7.3.2 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 and the total estimated cost is **Rs. 577.64 Lakhs.**The summary of tentative cost estimates for General Exploration is given in **Table No.-7.3** and details of tentative cost estimates are given as Annexure-I.

Table No.-7.3

Summary of Tentative cost estimates for General Exploration in Kelenda Block

Sl. No.	Item	Total
1	Geological Work & Survey Work	5,571,720
4	Drilling	33,511,400
5	Laboratory Studies	7,928,770
	Sub total	**47,011,890**
6	Report	1,410,357
7	Peer Review	30,000
8	Proposal Prepration	500,000.00
	Total	**48,952,247**
9	GST (18%)	8,811,404.41
Total cost including 18% GST		**57,763,651**
SAY, in Lakhs		**577.64**

8.0.0 GAPS IN G3 EXPLORATION AND HOW G2 STAGE WILL ADDRESS THEM

- **Limited Borehole Density:** G3 drilling was executed at ~400 m × 400 m spacing, adequate for inferred category only. G2 will reduce spacing to 200 m × 200 m to enhance data density and confirm grade and thickness continuity.
- **Inadequate Depth Correlation:** Boreholes in G3 were confined mostly to 50 m depth, leaving deeper extents unexplored. G2 drilling will test greater depths (up to 70 m where required) to confirm the complete vertical continuity of glauconitic horizons.
- **Absence of Bulk Density Verification:** Limited core samples were analyzed for density during G3. G2 will include systematic bulk density and moisture determination from every lithounit for precise tonnage estimation.
- **Lack of Beneficiation and Process Studies:** No beneficiation or potash recovery studies were conducted in G3 stage. G2 will include laboratory-scale beneficiation trials (magnetic separation, flotation, leaching) to assess K_2O recovery efficiency.
- **Incomplete Mineralogical Characterization:**XRD and petrography were conducted on limited samples. G2 will expand mineralogical analysis (XRD, SEM, and petrography) to establish glauconite purity, grain morphology, and associated phases.
- **Limited Geochemical Data Density:** Sampling during G3 was at wide intervals. G2 will generate closer-spaced chemical sampling (1 m intervals) for accurate grade modeling and statistical validation.
- **Insufficient Structural Data:** Structural interpretation during G3 relied on surface mapping and core correlation. G2 will undertake detailed structural mapping and borehole correlation to refine dip, strike, and geometry of mineralized zones.
- **No Beneficiation–Grade Linkage Established:** The relationship between glauconite content and K_2O grade remains unquantified. G2 will establish grade–mineral proportion correlation through modal and XRD data integration.

- **Resource Estimation at Inferred Confidence Only:** G3 data supported only 333-category estimation. G2 will produce a 3D geological and grade model to upgrade resource classification to **UNFC 332 (Indicated)**.
- **No Environmental or Hydrogeological Baseline:** G3 focused purely on geological delineation.G2 will document baseline environmental and hydrogeological parameters to support future feasibility and mine planning.

9.0.0 JUSTIFICATION FOR G2 PROPOSAL

- **Confirmed Glauconite Mineralization:** G3 exploration established a laterally continuous glauconite-bearing sandstoneshale horizon with an inferred resource of 64.08 MT @ 5.45% K_2O, requiring further confirmation for upgradation to 332 categories.

- **Need for Closer-Spaced Drilling:** The existing borehole spacing (400 m × 400 m) is adequate only for inferred category and maintained not all over the block; a 200 m × 200 m grid under G2 will validate grade and thickness continuity.

- **Grade Consistency and Geological Simplicity:** The deposit exhibits uniform grade, consistent lithology, and simple structure, ideal for higher confidence exploration.

- **Beneficiation and Recovery Studies Pending:** No beneficiation or process tests were conducted during G3; G2 will include mineral beneficiation and K_2O recovery evaluation.

- **National Strategic Importance:** Glauconite represents a potash substitute mineral of national relevance, supporting Atmanirbhar Bharat and import substitution initiatives in fertilizer minerals.

- **UNFC Compliance Requirement:** To upgrade from UNFC 333 to 332, data on grade reliability, density, beneficiation, and continuity are mandatory, which the G2 programme will generate.

- **Alignment with NMEP & MoM Priorities:** The proposed work supports National Mineral Exploration Policy (2019) and Ministry of Mines' focus on indigenous K-mineral resource development.

- **Technical Feasibility and Data Gaps:** G2 exploration will fill existing data gaps, refine geological understanding, and enable future G1 feasibility studies and techno-economic assessment.

10.0.0 CONCLUSION

In conclusion, the Kelenda Block presents a strong geological, mineralogical, and logistical foundation for G2-level exploration, having demonstrated consistent glauconite mineralization within the Bhalukona Formation. Implementation of the above suggestions will significantly enhance data integrity, ensure robust grade continuity validation, and enable upgradation from UNFC 333 to 332 with high confidence. The work will also contribute meaningfully toward India's goal of developing indigenous potash resources under the Atmanirbhar Bharat initiative and the National Mineral Exploration Policy (NMEP) framework.

11.0.0 References:

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15. **IBM (2017):**United Nations Framework Classification (UNFC) for Mineral Resources – Indian Adaptation (2017 Version). Indian Bureau of Mines, Nagpur.

12.0.0 List of Plates:

i. Plate-I: Location Map showingKelenda Block in Toposheet no. 64K15 & 64K16, MahasamundDistrict, Chhattisgarh.
ii. Plate-II: Regional Geology Map showingKelenda Block, Mahasamund District, Chhattisgarh.
iii. Plate-III: Geological map of Kelenda Block, Mahasamund District, Chhattisgarh.
iv. Plate-IV: Proposed Geological Section ofKelenda Block, Mahasamund District, Chhattisgarh.

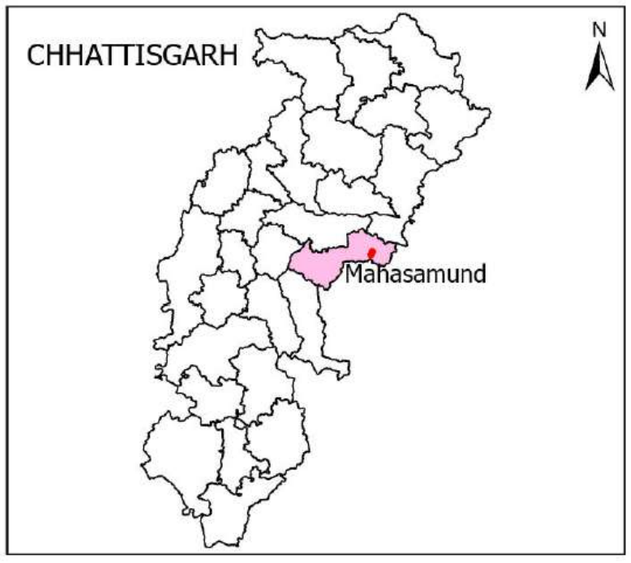
13.0.0 List of Annexures:

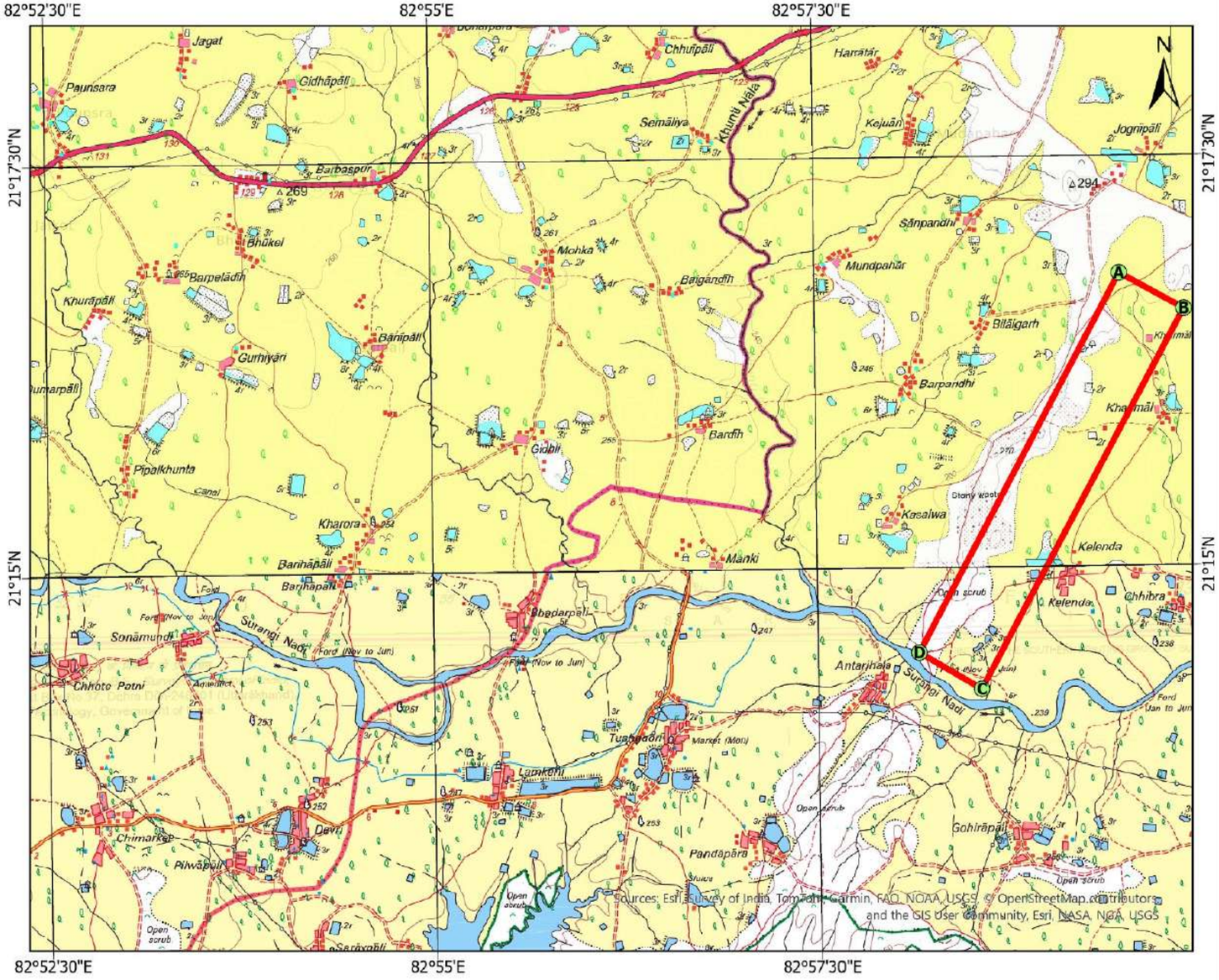
i. Annexure-I: Estimated Time Schedule and Details of Tenative Cost for General Exploration (G-2) for Glauconitic Sandstone in Kelenda Block (Area- 3.975 sqkm), Districts: Mahasamund, Chhattisgarh.

Annexure-I

Estimated cost for General Exploration (G-2) for Glauconitic Sandstone & Shale in Kelenda Block, District: Mahasamund, Chhattisgarh. [Block area- 3.975 sq. km; Nos. of Borehole- 53; Borehole depth range: 55 m; Schedule timeline- 15 months, Review after: 6 & 10 months]							
S. No.	**Item of Work**	**Unit**	**Rates as per NMET SoC 2020-21**		**Estimated Cost of the Proposal**		**Remarks**
			SoC-Item -Sl No.	**Rates as per SoC**	**Qty.**	**Amount (Rs)**	
A	**GEOLOGICAL WORK**						
1	**Geological Mapping (1:2,000)**						
i	Charges for one Geologist- Field	day	1.2	11,000	180	1,980,000	
ii	Charges for one Geologist - HQ	day	1.2	9,000	60	540,000	
iii	2 labours/ party (As per rates of Central Labour Commissioner)	day	5.7	541	360	194,760	Amount will be reimbursed as per the notified rates by the Central Labour Commissioner or respective State Govt. whichever is higher
iv	Sampling -1 Samplers Labour charge not included	day	1.5.2	5,100	210	1,071,000	
v	4 labours/ party (As per rates of Central Labour Commissioner)	day	5.7	541	840	454,440	Amount will be reimburse as per the notified rates by the Central Labour Commissioner or respective State Govt. whichever is higher
B	**SURVEY WORK**						
i	Topographical Survey (1:2,000)	day	1.6.1.a	8300	30	249,000	
ii	4 labours/ party (As per rates of Central Labour Commissioner)	day	5.7	541	120	64,920	
iii	Bore Hole Fixation and determination of co-ordinates & Reduced Level of the boreholes by DGPS.	Per Point of observation	1.6.2	19,200	53	1,017,600	53 Boreholes
				Sub Total- A + B		**5,571,720**	
C	**EXPLORATORY DRILLING**						
i	Drilling upto 300m (Medium hard Rock) (2 rig)	m	2.2.1.3a	10,100	2,800	28,280,000	53 Boreholes
ii	Land / Crop Compansation	per BH	5.6	20,000	53	1,060,000	Amount will be reimburse as per actuals or max. Rs. 20000 per BH with certification from local authorities
iii	Construction of concrete Pillar (12"x12"x30")	per borehole	2.2.7a	2,000	53	106,000	
iv	Transportation of Drill Rig & Truck associated per drill	Km	2.2.8	36	1,800	64,800	2 Rigs. Certification in this regard is required to be provided
v	Monthly Accomodation Charges for drilling Camp (up to 2 Rigs)	month	2.2.9	50,000	6	300,000	
vi	Drilling Camp Setting Cost	Nos	2.2.9a	250,000	2	500,000	
vii	Drilling Camp Winding up Cost	Nos	2.2.9b	250,000	2	500,000	
viii	Approach Road Making (Flat Terrain)	Km	2.2.10a	22,020	10	220,200	Road Making will be considered as per the requirement and Road Making Charges will be reimbursed later
ix	Core Preservation: One complete borehole plus mineralised cores of all the remaining Bhs	m	5.3	1,590	1,560	2,480,400	This amount will be reimbursed after successful delivery of the cores to concerned libraries/ authorities
				Sub Total- C		**33,511,400**	
D	**LABORATORY STUDIES**						
1	**Chemical Analysis**						
i	Primary Sample - Major Oxides viz. (SiO_2, Al_2O_3, Fe_2O_3, K_2O, MgO, CaO, Na_2O, TiO_2, MnO, P_2O_5 & LOI)	Nos	4.1.15a	4,200	1,460	6,132,000	
ii	External(10%) Check samples from NABL Lab for Major Oxides viz. (SiO_2, Al_2O_3, Fe_2O_3, K_2O, MgO, CaO, Na_2O, TiO_2, MnO, P_2O_5 & LOI)	Nos	4.1.15a	4,200	146	613,200	
iii	Analysis for 34 elements (REE, RM, Basemetals, HFSE elements) by ICPMS method (As, Cd, Pb, Hg, Se, Cr, Ni, Cu, Zn, Co, Mo, V, U, Th, F, Cl, S- Ti, Mn, P, Sr, Ba, B, REE + Y, Rb, Cs, Li, Ga, Sc, Zr, Hf, Nb, Ta)	Nos	4.1.14	7,731	20	154,620	
2	**Physical & Petrological Stusies**						
i	XRD analysis for identification of mineral phase	Nos	4.5.1	4,000	50	200,000	
ii	Beneficiation Studies	Nos	4.7.2	1,500,000	1	600,000	Actual expenses as per IBM or any agency rate. As per actual
iii	Preparation of thin section	Nos	4.3.1	2,353	20	47,060	
iv	Complete petrographic study report	Nos	4.3.4	4,232	20	84,640	
v	Digital Photographs	Nos	4.3.7	280	20	5,600	
vi	Modal Analysis of thin section	Nos	4.3.8	3,780	20	75,600	
vii	Density studies	Nos	4.8.1	1,605	10	16,050	
					Sub Total- D	**7,928,770**	
D					**Total A to D**	**47,011,890**	
E	**Geological Report Preparation**		**5.2.iv**	For the projects having cost exceeding Rs. 300 lakhs - A minimum of Rs. 9 lakhs or 3% of the value of work whichever is more		**1,410,357**	Reimbursement will be made after submission of the final Geological Report in Hard Copies (5 Nos) and the soft copy to NMET.
F	**Peer review Charges**		**As per EC decision**			**30,000**	
G	**Preparation of Exploration Proposal (5 Hard copies with a soft copy)**	**5 Hard copies with a soft copy**	**5.1**	2% of the Cost or Rs. 5 Lakhs whichever is lower		**500,000**	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.
H	**Total Estimated Cost without GST**					**48,952,247**	
I	**Provision for GST (18% of I)**					**8,811,404**	GST will be reimburse as per actual and as per notified prescribed rate
J	**Total Estimated Cost with GST**					**57,763,651**	***or Say Rs. 577.64 Lakhs***
Note:							
1	If any part of the project is outsourced, the amount will be reimbursed as per the Paragraph 3 of NMET SoC and Item no. 6 of NMET SoC. In case of execusion of the project by NEA on its own, a Certifiate regarding non outsourcing of any component/project is required.						

Location Map of Proposed Kelenda Block (Part of Toposheet No. 64K15 &64K16), Mahasamund District, Chhattisgarh





Corner Points of Proposed Kelenda Block, Mahasamand District, Chhattisgarh					
SL. NO.	UTM Zone-44N (m)		GCS (DMS)		POINTS
	NORTHING	EASTING	LATITUDE	LONGITUDE	
1	2354409.15	706596.14	21° 16' 47.0" N	082° 59' 28.68" E	A
2	2354011.98	707325.76	21° 16' 33.79" N	082° 59' 53.81" E	B
3	2349726.73	705057.37	21° 14' 15.42" N	082° 58' 33.27" E	C
4	2350135.69	704354.06	21° 14' 29.0" N	082° 58' 9.07" E	D

Scale: 1:50,000

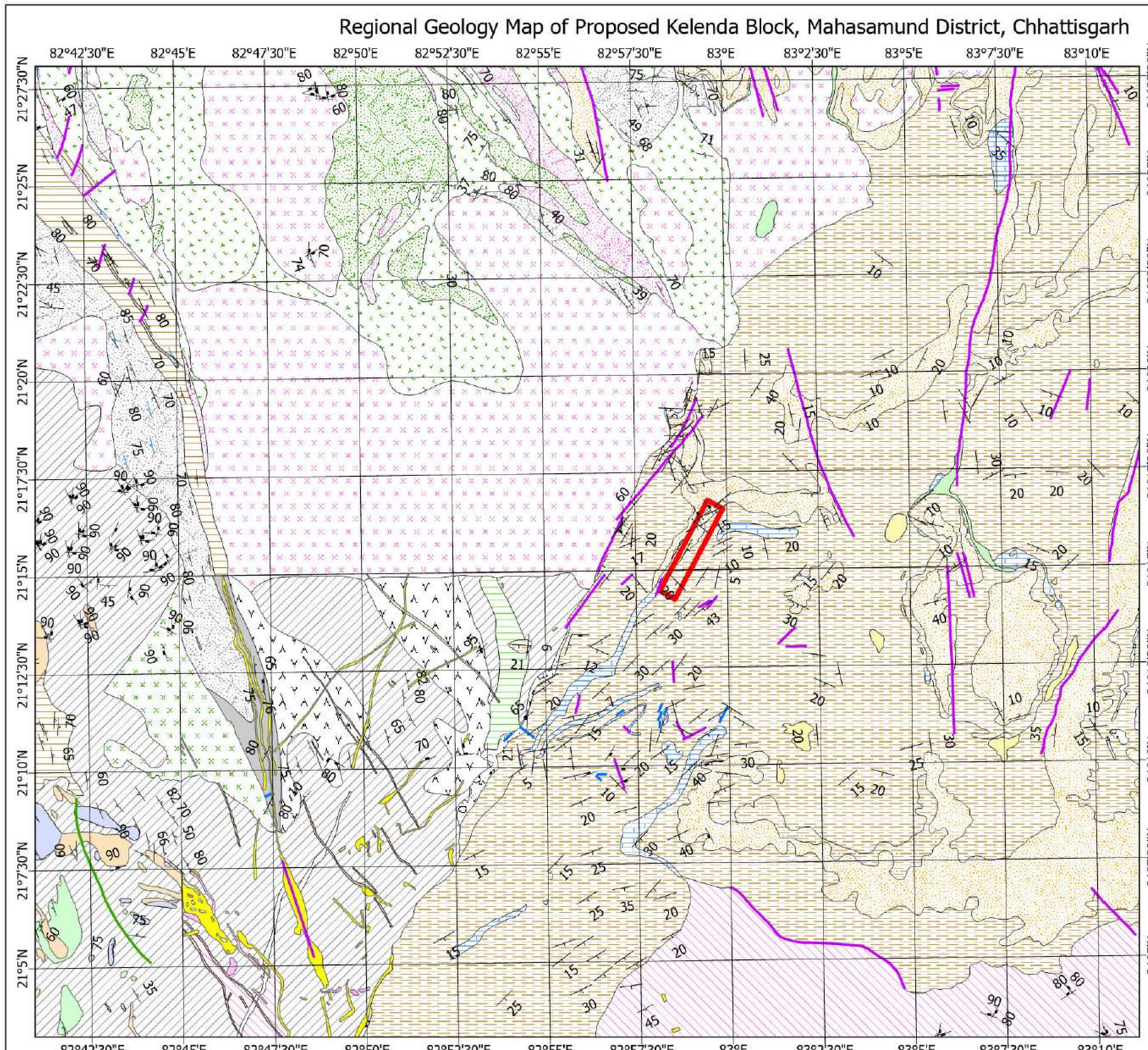
0 0.5 1 2 3 4 5 Kilometers

Source: Part of Survey of India Toposheet No. 64K15 &64K16

Legend

- Corner Points of Proposed Kelenda Block
- Proposed Kelenda Block

Regional Geology Map of Proposed Kelenda Block, Mahasamund District, Chhattisgarh



N
W E
S

Source: NGDR Portal, GSI

0 1 2 4 6 8 10
Kilometers

Legend

Proposed Kelenda Block

lithologic

- ALKALI GRANITE
- ARGILLITE, GREYWACKE
- BIF
- BMQ, BHQ
- CHERT AND JASPILLITE
- CONGLOMERATE
- CONGLOMERATE/GRIT
- DOLERITE
- GABBRO
- GRANITE
- GRANITE GNEISS
- GRANITE GNEISS/MIGMATITE
- GRANOPHYRE
- HORNBLENDE SCHIST, AMPHIBOLITE, META BASIC ROCKS
- LATERITE
- LIMESTONE
- META BASALT
- META CONGLOMERATE
- META GABBRO
- META RHYOLITE
- META ULTRAMAFITE
- MICA SCHIST,QUARTZ MICA SCHIST
- PHYLLITE
- PYROXENE GRANULITE, ACTINOLITE SCHIST
- QUARTZ MICA SCHIST
- QUARTZ VEIN/REEF
- QUARTZITE
- SANDSTONE
- SHALE
- SILTSTONE
- STROMATOLITIC LIMESTONE

point_type

- BEDDING
- CLEAVAGE/FOLIATION/SCHISTOSITY (S1)
- CLEAVAGE/FOLIATION/SCHISTOSITY (S2)
- JOINT
- shear_zone_gcs_ngdr_2025110410305484
- fault_gcs_ngdr_20251104095036011
- fold_gcs_ngdr_20251104095036011

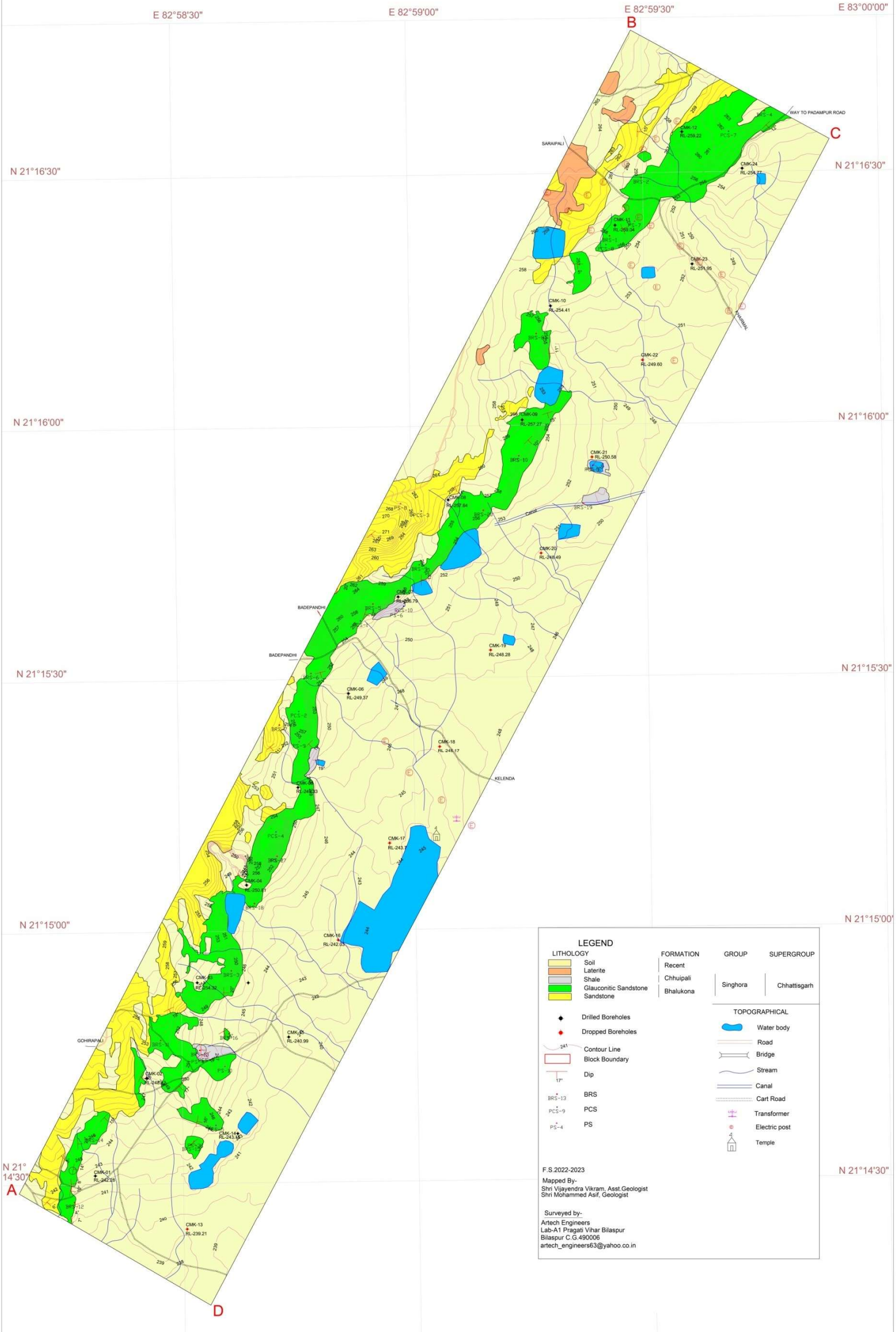
Plate -III

DETAILED GEOLOGICAL MAP OF KELENDA BLOCK MAHASAMUND DISTRICT, CHHATTISGARH

Scale - 1:4000

160 0 80 160 320 640

Part of Toposheet no-64K/15&16



LEGEND

LITHOLOGY	FORMATION	GROUP	SUPERGROUP
Soil	Recent		
Laterite			
Shale	Chhuipali	Singhora	Chhattisgarh
Glauconitic Sandstone	Bhalukona		
Sandstone			

- Drilled Boreholes
- Dropped Boreholes
- Contour Line
- Block Boundary
- Dip
- BRS
- PCS
- PS

TOPOGRAPHICAL

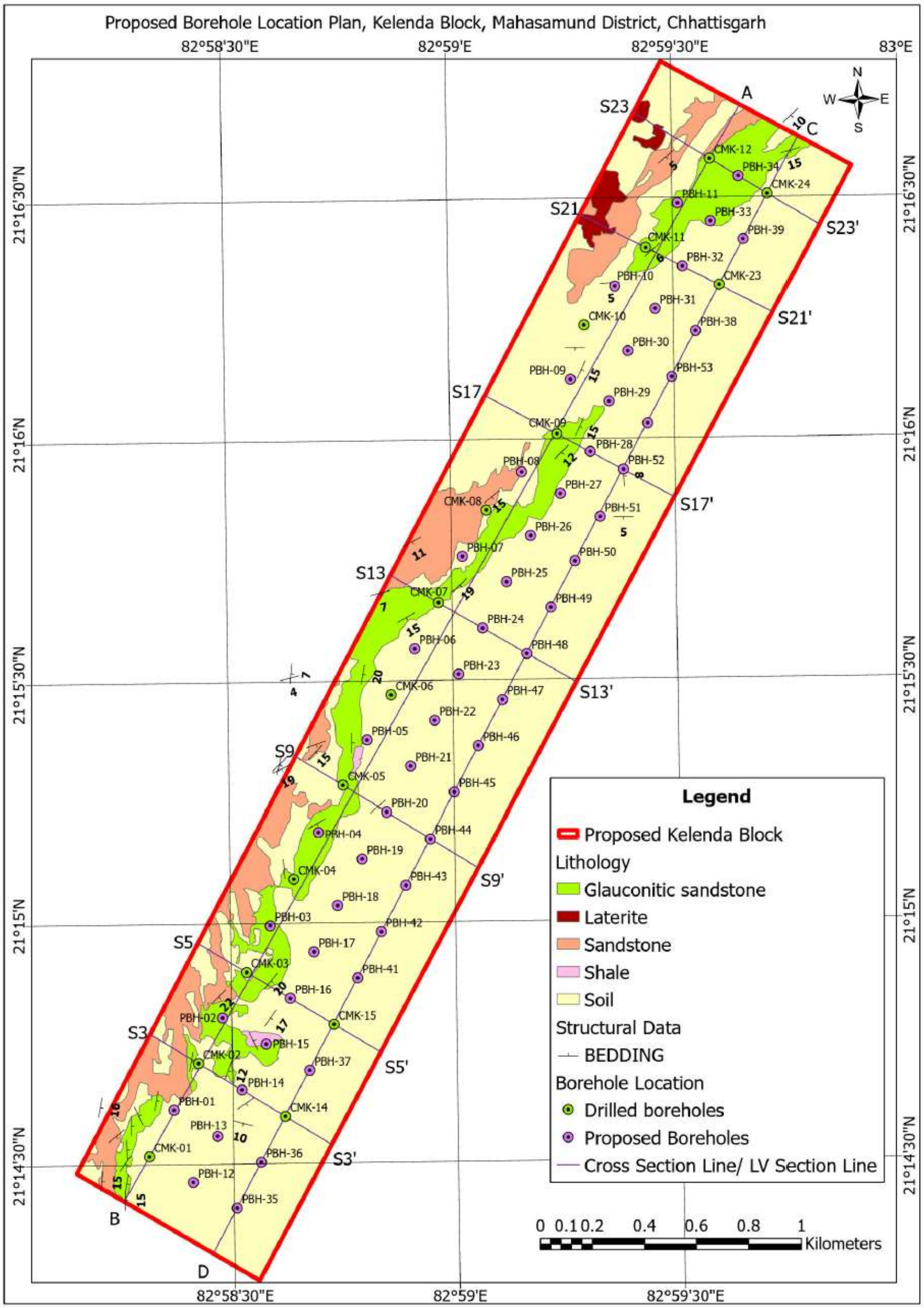
- Water body
- Road
- Bridge
- Stream
- Canal
- Cart Road
- Transformer
- Electric post
- Temple

F.S.2022-2023

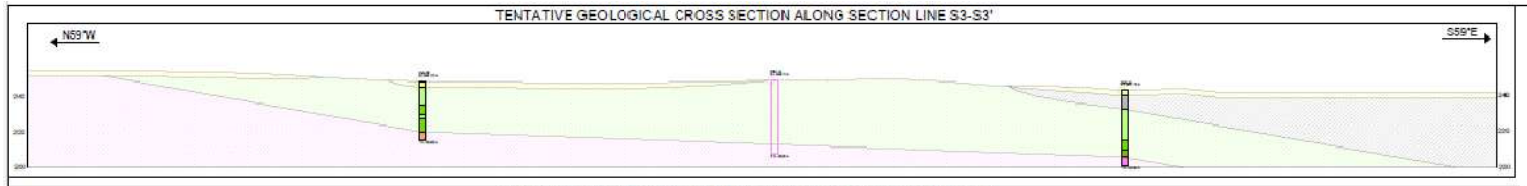
Mapped By-
Shri Vijayendra Vikram, Asst.Geologist
Shri Mohammed Asif, Geologist

Surveyed by-
Artech Engineers
Lab-A1 Pragati Vihar Bilaspur
Bilaspur C.G.490006
artech_engineers63@yahoo.co.in

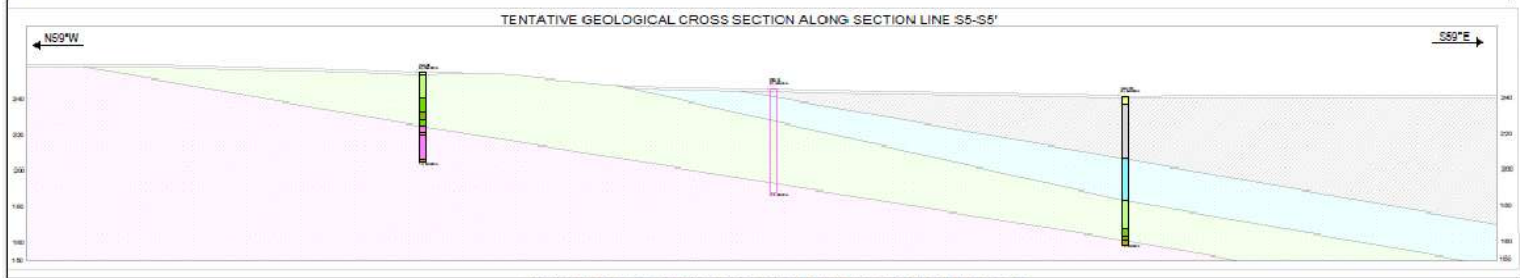
Proposed Borehole Location Plan, Kelenda Block, Mahasamund District, Chhattisgarh



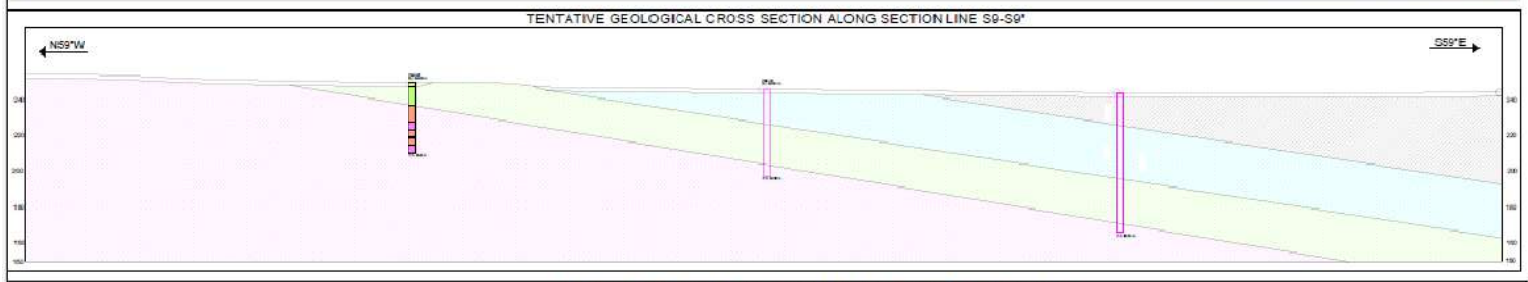
TENTATIVE GEOLOGICAL CROSS SECTION ALONG SECTION LINE S3-S3'



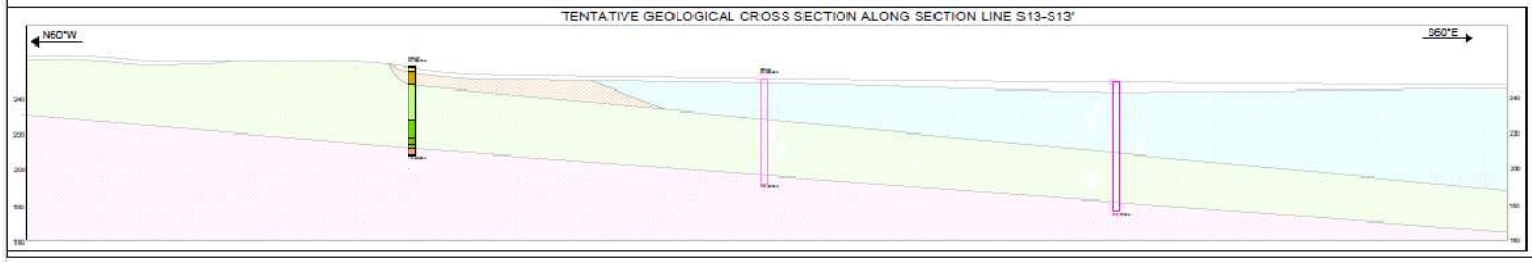
TENTATIVE GEOLOGICAL CROSS SECTION ALONG SECTION LINE S5-S5'



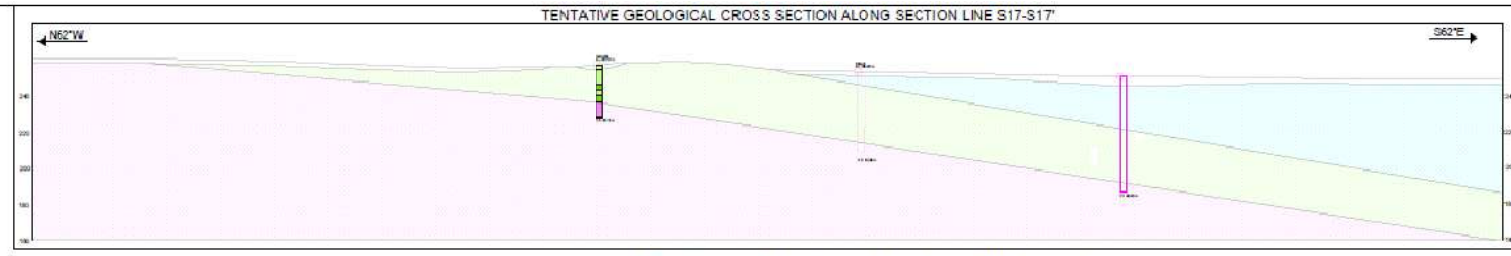
TENTATIVE GEOLOGICAL CROSS SECTION ALONG SECTION LINE S9-S9'



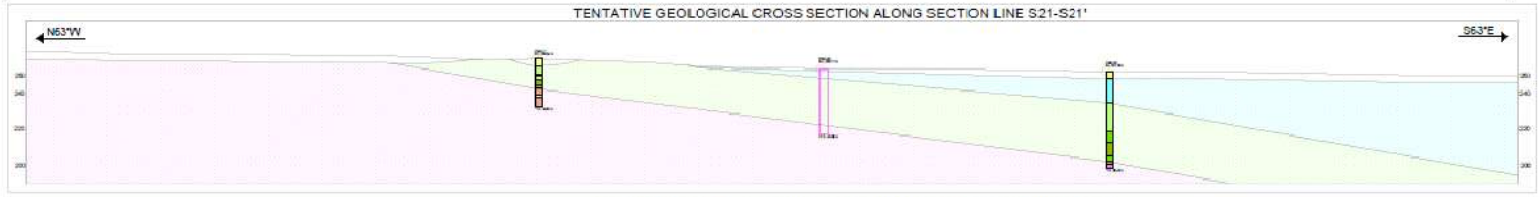
TENTATIVE GEOLOGICAL CROSS SECTION ALONG SECTION LINE S13-S13'



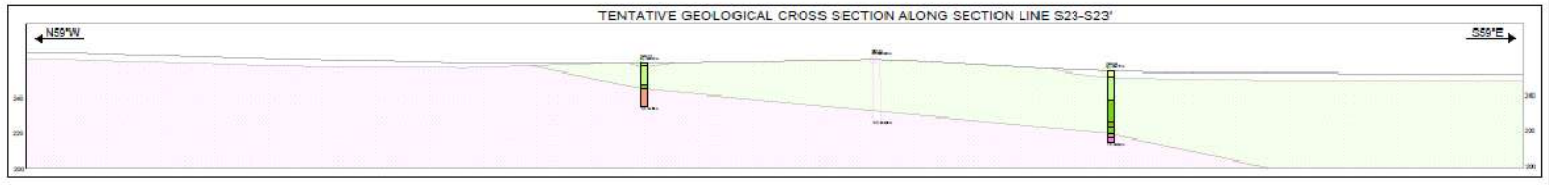
TENTATIVE GEOLOGICAL CROSS SECTION ALONG SECTION LINE S17-S17'



TENTATIVE GEOLOGICAL CROSS SECTION ALONG SECTION LINE S21-S21'



TENTATIVE GEOLOGICAL CROSS SECTION ALONG SECTION LINE S23-S23'



Scale

0 40 80 120 160 200

Metres

LEGEND

- SOIL
- SHALE WITH SST LAMI
- GLAUCONITIC SST
- INT OF GLAUCONITIC SST & SHALE
- INT OF SHALE WITH GLAUCONITIC SST
- SANDSTONE
- INT OF SST WITH SHALE
- SHALE
- SHALE WITH CLAY LAMI
- SHALE WITH CHERT
- SILTSTONE WITH SHALE LAMI

PBH-14 R.L.249.12 m — Proposec Borehole by MECL, Tentative RL (m)

P.D. 40.00 m — Proposed Depth (m)

GMK-09 R.L.257.27 m — Borehole drilled by GSI, Reduced Level of Borehole (m)

T.D. 30.15 m — Total Depth (m)