PROPOSAL FOR THE PRELIMINARY SURVEY (G-3) OF REE & RM MINERALIZATION IN NB-11 KHAKHARLAI BLOCK, TEHSIL-SIWANA, (2 SQ.KM AREA), DISTRICT-BALOTRA, RAJASTHAN. (PART OF TOPOSHEET NO 45C/06)

COMMODITY: REE & RM

BY

FCI ARAVALI GYPSUM & MINERALS INDIA LIMITED
2, WEST PATEL NAGAR, CIRCUIT HOUSE ROAD RATANADA,
JODHPUR, RAJASTHAN

PLACE: JODHPUR

DATE: 22ND November 2025

Summary of the REE-RM Mineralization block proposed for the Preliminary Survey (G-3)

General Information about the block

	Features	Details
	Block ID	NB-11 Khakharlai block, Balotra, Rajasthan
	Exploration Agency	FCI Aravali Gypsum and Minerals India Ltd.
	Commodity	REE and Rare Metals
	Mineral Belt	Siwana Ring Complex
	Budget and time schedule to complete the project	16 months
	G4 level exploration	GSI carried out G4 level of exploration in and around the siwana ring complex. The exploratory findings, aeromagnetic studies clearly delineate the regional continuity of magnetically susceptible litho-units within the SRC, even in soil-covered terrain. Further, the spectrometric potassium and thorium maps of the area also indicate the favourable potential of rare earth element (REE) mineralization within the exposed portions of the complex. Based on this observation, 15 blocks in the northern part of the SRC are allocated to 9 different NEAs and NPEAs. NB-11 is allocated to FAGMIL in the 4th Joint meeting of TCC on 10th November 2025.
	Objectives	The objectives of the current program are: i. To prepare a Geological map at a 1:2,000 scale to delineate the REE-RM bearing host rock, its structural features, and lateral and vertical extension. ii. To collect pit/trench and core samples for the REE and RM content through chemical analysis and evaluate the block for further course of action. iii. To quantify the REE & RM resource (333 category) as per UNFC norms & Minerals (Evidence of Mineral Contents) Rules- 2015.
	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	The drilling work will be done by FAGMIL. If necessary, one rig may be outsourced.

<table>
<tr><td></td><td>agency.</td><td></td></tr>
<tr><td></td><td>Name/Number of Geoscientists</td><td>3 (2 Field Geoscientists and 1 HQ Geoscientist)</td></tr>
<tr><td></td><td></td><td>Survey Party days: 30 days (for Topographical survey and BH location)</td></tr>
<tr><td></td><td></td><td>Sampling Party days: 480 days</td></tr>
<tr><td>1.</td><td>Location</td><td>The proposed block area partly falls under Survey of India Toposheet numbers 45C/06, in and around the villages of Bhati Khera, Meli, Kumpawas, in Tehsil- Siwana, District-Balotra, Rajasthan.</td></tr>
<tr><td></td><td>Latitude and Longitude</td><td>Coordinates of Corner Points of the Khakharlai Block
<table>
<tr><th>Corner points</th><th>Latitude (°N)</th><th>Longitude (°E)</th></tr>
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<tr><td>D</td><td>25.730263°</td><td>72.427479°</td></tr>
</table></td></tr>
<tr><td></td><td>Villages</td><td>Bhati Khera, Meli, Kumpawas</td></tr>
<tr><td></td><td>Tehsil/ Taluk</td><td>Siwana</td></tr>
<tr><td></td><td>District</td><td>Balotra</td></tr>
<tr><td></td><td>State</td><td>Rajasthan</td></tr>
<tr><td>2.</td><td>Area (Hectares/Square Kilometer)</td><td></td></tr>
<tr><td></td><td>Block Area</td><td>2 sq.km</td></tr>
<tr><td></td><td>Forest Area</td><td>0.1 sq. km forest area</td></tr>
<tr><td></td><td>Government Land Area</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>Mokalsar Railway Station is 23.2Km far from the Khakharlai Block area via Siwana Bypaas Rd and NH325.</td></tr>
<tr><td></td><td>Road</td><td>The proposed block is located 12 km NW of Siwana,132 Km E of Barmer, and 35 SE of Balotra. The area is well connected by motorable metalled roads.</td></tr>
<tr><td>4.</td><td>Hydrography</td><td></td></tr>
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	Local Surface Drainage Pattern (Channels) Rivers/Streams	Luni river is flowing 5 Km N of the Block area.
5.	**Climate**	
	Mean Annual Rainfall	The mean annual rainfall is very low, around 200mm to 300mm.
	Temperatures (December)(Minimum) Temperatures (June)(Maximum)	Minimum temperatures upto 4°C to 20°C (November to February) Maximum temperatures upto 30°C to 49° C (April-June)
6.	**Topography**	Overall flat topography with ground elevation ranging from 165 to 180m. Exposure of rocks is present in the SW part of the block with an elevation of avg. 225m.
	Topo-sheet Number	45C/06
7.	**Availability of baseline geoscience data**	
	Geological Map (1:50K)	Available in the NGDR portal
	Geochemical Map	Available
	Geophysical Map (Aeromagnetic, Ground geophysical, Regional as well as local scale GP maps)	Ground gravity and magnetic survey, Aeromagnetic survey report is available in NGDR
8.	**Justification for taking up Preliminary Survey/ Regional Exploration**	Preliminary sampling of the rhyolites and associated tuffs of Siwana Ring Complex, Balotra district, carried out by GSI during 2013-14, indicated anomalous REE values with ΣREE ranging from 1334 to 3319ppm ΣREE (Rastogi & Mukherjee, 2015). Bidwai *et al.*, 2014, reported the presence of high LREE, Zr, Nb, Th and U along with Ag in surface samples in the Siwana Ring Complex. Das *et al.*, 2015, carried G4 investigation in Siwana eastern and central block. Kumar and Sharma, 2020, carried out G-4 investigation and reported ∑ REE+Y ranges in various lithiounits are i) Plagioclase rich granite (n=79) ∑ REE+Y = 0.029%-0.70%. ii) K-feldspar rich granite (n=116) ∑ REE+Y= 0.047%-0.66%. iii) Younger Intrusives (n=146) ∑ REE+Y= 0.019%-2.66%. iv) Felsic volcanic (n=43) ∑REE+Y = 0.015%-0.96% and v) Enclave/Restite (n=19) ∑REE+Y = 0.022%-1.27%. LREE/HREE ratio indicates that LREE>>HREE in the area and LREE values ranges between 86.45ppm to 1.93%, however, HREE values ranges between 23.94ppm to 0.26%. LREE:HREE ratio in Siwana area is 4:1 approximately. Apart from REE, rare metals and some trace elements also indicate very encouraging results, Zr (0.1% to 1.1%), Nb (2.5ppm to 1039ppm), Ba (25ppm to 3948ppm), Zn (120ppm to 1258ppm), U (0.61ppm to 124ppm), Th (2ppm to 481ppm) and Hf (4.52ppm to 828.18ppm).

		Barman and Neog, 2018 mapped the peralkaline – peraluminous granite (A type) and in the Siwana area extending from Mokalsar in the east to Siner in the west through Mawri, Gugrot, Piplun, Goliyan Bhairan and Kalur Ka Danta area. REE bearing carbonates (perisite) and phosphates (monazite) were identified in both plutonic and volcanic rock types. In addition to REE bearing mineral phases, haematite, ilmenite and zircon are also identified from both plutonic and volcanic phases. The granite recorded values ranging from 182.77 ppm to 8611.11 ppm and the average being 2006.95 ppm (count=84). The volcanic recorded values ranging from 142.3 ppm to 8502.50 ppm, average value being 2008.03 ppm (count=116). Sukleswar Ka Mandir (G3) block yields tREE upto 2901ppm in microgranite dyke, 2121 ppm in alkali feldspar granite and 2996ppm in andesite. Lal and Ghosh, 2021 carried out large scale geological mapping (1:12500 scale) at the northern periphery of the Siwana Ring Complex, stretching from Sainji ki Beri to Meli area. They marked 32 nos. of rhyolitic flows along with several felsic dykes in the area. Several flows are found to be highly enriched in tREE concentration. Chemical analysis data from rhyolite samples of study area yielded ΣREE+Y values ranging from 91.76ppm to 9764.68ppm, with average value of 1844.84ppm. ΣHREE/ΣLREE ratio of the same is 0.15. 22 BRS samples from felsic/rhyolite dykes yielded ΣREE+Y values ranging from 144.77ppm to 7678.75ppm, with average value of 1400.14ppm. ΣREE+Y value in channel samples ranging from 261.73 to 6224.81ppm, with ΣHREE/ΣLREE ratio of 0.19. Flow no. 14 and 15 are highly enriched REE flow of rhyolite in the area. In the proposed block ΣREE+Y in flow no. 15 ranges between 2213.43ppm to 8027.71ppm with maximum value of LREE 5079.52ppm and maximum value of HREE 992.05ppm. In flow no. 14, ΣREE+Y ranges between 6944.16ppm to 7528.11ppm with maximum LREE 4848.19ppm and maximum HREE 941.11ppm. Remote Sensing and Aerial Survey for toposheet no. 45C/06 and 45C/10 were carried out by RSAS Division, GSI, Bangalore, during FS. 2017-18. Aeromagnetic maps help in delineating the regional continuity of magnetically susceptible lithounits of Siwana Ring Complex even under soil-covered terrain. Spectrometric maps of potassium and thorium further suggest that the proposed area possesses good potential for rare earth element (REE) mineralization in exposed area. Based on these chemical data and the Remote Sensing and Aerial Survey maps NB 11 block is recommended for G3 stage exploration.

MINERALIZATION IN THE NB-11 KHAKHARLAI BLOCK, TEHSIL-SIWANA, DISTRICT-BALOTRA, RAJASTHAN

1.0.0 INTRODUCTION

1.1.1 Rare Earth Elements (REEs) are a set of 17 chemically similar elements that consist of 15 lanthanides (elements with atomic numbers 57 to 71) along with scandium (Sc, atomic number 21) and yttrium (Y, atomic number 39). Although these elements are not particularly rare in the Earth's crust, they tend to occur in low concentrations and are difficult to extract economically in large quantities. REEs are classified into two categories based on their atomic properties: 1. light rare earth elements (LREEs), including elements such as lanthanum, cerium, praseodymium, neodymium, promethium, samarium, and europium; and 2. Heavy-rare-earth elements (HREE), such as gadolinium, terbium, dysprosium, holmium, erbium, thulium, ytterbium, and lutetium.

1.1.2 Rare Earth Elements (REE) are characterized by high density, high melting point, high conductivity, and high thermal conductance. These unique properties of REEs make them essential in a wide variety of modern technological applications. They are used in the production of permanent magnets, batteries, electronics, renewable energy technologies (such as wind turbines and solar panels), electric vehicles, and in military applications. Despite their significance in technological advancement, the extraction and refining of REEs are complex and energy-intensive processes, and the supply of these materials is limited to only a few countries.

1.1.3 In the context of India, Rare Earth Elements are increasingly recognized as crucial for the nation's technological and industrial advancement. With the growing demand for electronic devices, renewable energy solutions, and electric vehicles, India is becoming more dependent on REEs. In Global Economies like USA, Australia and Canada, the value chain for processing and beneficiation of REE is much better developed. As a result, such countries segregate and select fewer REE elements from the total 17 REE elements as per their present criticality. In India, the value chain of REE is yet to be fully developed. Hence, in the first instance, all the REEs are considered as critical mineral (Ministry of Mines, June 2023). The major sources of REE in India are - (i) from different sources like Carbonatites, Tuffs, Cherts etc. (ii) from beach sands. Resource estimate of monazite from beach sand in India is 11.93 Mt having 55%-65% of rare earth oxides. At present the country’s demand met through the domestic production by IREL (India) Limited and through imports from

countries like China, Japan, South Korea, USA.

1.1.0 BACKGROUND

1.1.1 GSI carried out G4 level of exploration in and around the siwana ring complex. The exploratory findings, aeromagnetic studies clearly delineate the regional continuity of magnetically susceptible litho-units within the SRC, even in soil-covered terrain. Further, the spectrometric potassium and thorium maps of the area also indicate the favourable potential of rare earth element (REE) mineralization within the exposed portions of the complex. Based on this observation, **15 blocks** in the northern part of the SRC are allocated to 9 different NEAs and NPEAs. **NB-11** is allocated to FAGMIL in **the 4th Joint meeting of TCC on 10th November 2025**.

2.0.0 BLOCK DESCRIPTION

2.0.1 The proposed block area partly falls under Survey of India Toposheet numbers 45C/06, in and around the villages of Bhati Khera, Meli, Kumpawas, in Tehsil- Siwana, District-Balotra, Rajasthan. The location map is provided in Annexure I. The coordinates of the corner points of the block area are provided in the table below (dd:mm:ss.ss).

Co-ordinates of Cardinal Points for NB-11 Khakharlai Block, Tehsil: Siwana, Dist: Balotra (Table-1).

Corner points	Latitude (°N)	Longitude (°E)
A	25.736830°	72.424862°
B	25.744778°	72.450243°
C	25.744775°	72.462066°
D	25.730263°	72.427479°

2.1.0 LOCATION AND ACCESSIBILITY

2.1.1 The proposed block is located 12 km NW of Siwana,132 Km E of Barmer, and 35 SE of Balotra. The area is well connected by motorable metalled roads.The Jaisalmer Airport (Rajasthan) is 137 km from this block via NH 68 (Annexure-I).

Mokalsar Railway Station is 23.2Km far from the NB-11 Khakharlai Block area via Siwana Bypaas Rd and NH325.

2.2.0 PHYSIOGRAPHY

2.2.1 Overall flat topography with ground elevation ranging from 165 to 180m. Exposure of rocks is present in the SW part of the block with an average elevation 225m.

2.2.2 Minimum temperatures upto 4°C to 20°C (November to February) Maximum temperatures upto 30°C to 49° C (April-June).

3.0.0 REGIONAL GEOLOGY

The magmatic evolution of Siwana Ring Complex, part of Neoproterozoic Malani Igneous Suite (MIS); ca. 771±2 Ma (Torsvik et al. 2001), 745 Ma (Dhar et al., 1996; Rathore et al., 1999) can be divided into three phases (Kumar and Sharma, 2020). First phase is represented by bimodal volcanism of acid and basic flows (acid flows > basic flows). It is intruded by second, plutonic phase comprising arfvedsonite-reibeckite-aegirine bearing per-alkaline Siwana Granite. The third phase being later intrusive phase includes rhyolite, microgranite, andesite and felsite dykes. All these three phases host anomalous ΣREE+Y concentration and the third phase is more enriched (Kumar and Sharma, 2020). Peralkaline igneous rocks, carbonatites, feldspathoid bearing rocks are the main source of REE minerals (± HFSE, U & Th etc) and therefore are suitable host for targeting REE/RM mineralisation. Peralkaline granites, volcanics and associated zoned pegmatoids are considered to be storehouse of REE and rare metals (Nb–Ta, Zr–Hf, Sn, W, Be) (Pollard, 1995) and in layered intrusions, the mineralisation mostly appears in the more evolved parts of the complexes (Dostal, 2017).

In the Western Indian Craton of Rajasthan, basement rocks and overlying supracrustal belts of Aravalli and Delhi Supergroups have witnessed magmatic events of volcanics and granitoids of Palaeo- to Neo-Proterozoic ages. Granitoids of different ages (~ 1.8 Ga, ~1.7 Ga, ~1.4 Ga, ~ 1.1Ga and 850-750 Ma) have intruded these belts. MIS magmatism occurred during Neoproterozoic age and comprises peralkaline (Siwana), metaluminous to mildly peralkaline (Jalore) and peraluminous (Tusham and Jhunjhunu) granites with cogenetic carapace of acid volcanics (welded tuff, trachyte explosion braccia and perlite) and is characterised by volcano-plutonic ring structure and radial dykes (Singh and Vallinagayam, 2009). Three phases in Siwana magmatic activity is widely observed: i) the basal peralkaline (lower 24 flows), ii) middle meta-aluminous (top 21 flows), and iii) reappearance of peralkaline phase as intrusives (Siwana granite) at the end (Chittora and Bhushan, 1994) (Annexure-II,III)

Table- Classification of Malani Igneous Suite (Bhushan et al., 1984)

Supergroup	Group	Formation	Member	Mode of Magmatism	Lithology
Malani Igneous Suite	Sankara	Basic Dykes Acid Dykes Trachyte porphyry Andesite porphyry Aplite and diorite		Intrusive	Gabbro, dolerite Felsite, Trachyte porphyry, Andesite porphyry, Aplite and diorite
	Sanawara	Rhyolite Andesite		Extrusive	Rhyolite, Andesite
	Jalore	Malani Siwana Jalore		Intrusive	Hornblende Granite Alkali Granite Biotite Granite
	Karara	Rhyolite	Phalsund Kailana Jodhpur Fort	Extrusite	Ash bed Rhyolite Pyroclastics
		Andesite Basalt			

4.0.0 PREVIOUS WORK & JUSTIFICATION FOR TAKING UP THE BLOCK

4.1.1 Preliminary sampling of the rhyolites and associated tuffs of Siwana Ring Complex, Balotra district, carried out by GSI during 2013-14, indicated anomalous REE values with ΣREE ranging from 1334 to 3319ppm ΣREE (Rastogi & Mukherjee, 2015). Bidwai *et al.*, 2014, reported the presence of high LREE, Zr, Nb, Th and U along with Ag in surface

samples in the Siwana Ring Complex. Das *et al.*, 2015, carried G4 investigation in Siwana eastern and central block. Kumar and Sharma, 2020, carried out G-4 investigation and reported ∑ REE+Y ranges in various lithiounits are i) Plagioclase rich granite (n=79) ∑ REE+Y = 0.029%-0.70%. ii) K-feldspar rich granite (n=116) ∑ REE+Y= 0.047%-0.66%. iii) Younger Intrusives (n=146) ∑ REE+Y= 0.019%-2.66%. iv) Felsic volcanic (n=43) ∑REE+Y = 0.015%-0.96% and v) Enclave/Restite (n=19) ∑REE+Y = 0.022%-1.27%. LREE/HREE ratio indicates that LREE>>HREE in the area and LREE values ranges between 86.45ppm to 1.93%, however, HREE values ranges between 23.94ppm to 0.26%. LREE:HREE ratio in Siwana area is 4:1 approximately. Apart from REE, rare metals and some trace elements also indicate very encouraging results, Zr (0.1% to 1.1%), Nb (2.5ppm to 1039ppm), Ba (25ppm to 3948ppm), Zn (120ppm to 1258ppm), U (0.61ppm to 124ppm), Th (2ppm to 481ppm) and Hf (4.52ppm to 828.18ppm).

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Based on the chemical data, the Remote Sensing and Aerial Survey maps NB 11 Khakharlai block is allocated to FAGMIL in the 4th Joint TCC meeting on 10th November,2025, for G3 stage exploration.

5.0.0 OBJECTIVES OF THE PROPOSED PRELIMINARY SURVEY

i. To prepare a Geological map at a 1:2,000 scale to delineate the REE-RM bearing host rock, its structural features, and lateral and vertical extension.

ii.

iii. To collect pit/trench and core samples for the REE and RM content through chemical analysis and evaluate the block for further course of action.

iv. To quantify the REE & RM resource (333 category) as per UNFC norms & Minerals (Evidence of Mineral Contents) Rules- 2015.

6.0.0 PLANNED METHODOLOGY

6.0.1 In accordance with the objective set for Preliminary Exploration (G-4) of the block, the exploration programme is proposed. The Exploration shall be carried out as per the 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 the subsequent paragraph.

6.1.0 GEOLOGICAL MAPPING

6.1.1 Geological mapping will be conducted over an area of 2 square kilometers at a scale of 1:2,000. The survey will focus on the geological mapping of the area. Other structural and geological features will be systematically studied in the core samples.

6.2.0 DRILLING

6.2.1 The depth, continuity, grade, and thickness of these zones will be assessed by drilling approximately 24 vertical boreholes, each 125m in depth, on a grid of 400m x 200m. Initially, 4 to 5 boreholes will be drilled, and respective core samples will be tested for REE and associated RM concentrations. If encouraging results are received, the remaining drilling and core sampling will be done simultaneously.

6.3.0 BOREHOLE GEOPHYSICAL SURVEY/WIRELINE LOGGING

6.3.1 A total of 1000m BH geophysical logging is proposed for this preliminary survey. Based on the interpretation of the geophysical data, sampling of the identified REE bearing zones will be undertaken for further analyses.

6.4.0 DRILL CORE LITHOLOGGING

6.4.1 Detailed core logging will be conducted for all boreholes, documenting various aspects such as lithological units/formations, core recovery, colour, structures, textures, and other relevant features. In first BH samples will be collected at each meter interval, while in the rest of the BH samples will be collected and preserved for the mineralized zone. A total of 800 samples will be collected.

6.6.0 LABORATORY STUDIES

6.6.1 Chemical Analysis:

A total of 950 core samples (primary) will be analysed for 17 REE elements, and 10% of the total sample i.e, 95 samples will be taken for external check.

6.6.2 15 samples will be taken for the petrographic study, and 5 samples will be taken for XRD and EPMA analyses to identify the mineral phase.

7.0.0 QUANTUM OF WORK

The details of the quantum of work for the NB-11 Khakharlai REE Block, Tehsil-Siwana, Dist. Balotra is furnished below:

Sl. No.	Item of Work	Unit	Proposed Quantum of work
1.	Geological Mapping (1:2,000)	sq. km	2
2.	Topographic survey	Nos.	2
3.	Pitting/trenching	m	50
4.	Drilling of 24 BHs at 400×200m interval (24×125m)	m	3000
5.	Borehole Geophysical Logging	m	1000
6.	Sampling and laboratory analyses		
A.(i).	Nos. of Channel samples	Nos.	100
(ii).	Nos. of Pit/Trench samples	Nos.	50
B.(i)	Primary samples for ICP-MS test for REE	Nos.	950
(ii)	External Check sample (10 % of Primary samples) for ICP-MS test	Nos.	95

(iii)	Preparation of thin section	Nos.	15
(iv)	Complete Petrographic/mineralographic study of rock	Nos.	15
(v)	Whole rock analyses	Nos	100
(vi)	XRD Studies	Nos	5
(vii)	EPMA studies	Nos	5
(viii)	Density	Nos.	5
7.	Report Preparation (Digital format)	Nos.	1

8.0.0 COST ESTIMATE

Tentative Cost has been estimated based on the 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. **788.09** Lakhs. The summary of cost estimates for the Preliminary Survey (G-3 Level) is given in Table 4, and details of cost estimates are given in Annexure-VI. The tentative Time schedule/action plan for the proposed Preliminary Survey (G-3) for REE & RM is given in Table No.5.

Table-4. Estimated Cost for The Preliminary Survey (G-3) for REE & RM in NB-11 Khakharlai Block, Tehsil-Siwana, District: Balotra, Rajasthan.

S.N	Item of Work	Total Amount (Rs)
A	Geological Work (Mapping, Borehole logging, Sampling, Report writing, and Survey)	**95,73,960**
B	Pitting/Trenching	**4,33,000**
C	Drilling	**4,26,11,600**
D	BH Geophysical Logging	**10,88,941**
E	Laboratory Studies (Chemical Analysis, Physical, Petrographic and Minerologic Study)	**86,82,270**
F	Preparation of Exploration Proposal (5 Hard copies with a soft copy)	**31,19,489**
G	Peer review Charges	**30,000**
H	Total Estimated Cost without GST	**6,67,87,055**

I	Provision for GST (18% of GST)	**1,20,21,670**
J	Total Estimated Cost with GST	**7,88,08,725 Or 788.08 Lakhs**

Table-5. The tentative time schedule/action plan for the proposed Preliminary Survey (G-3) for REE & RM Mineralization.

COST SHEET FOR THE PRELIMINARY SURVEY (G-3) FOR REE & RM IN NB-11 KHAKHARLAI BLOCK, TEHSIL-SIWANA, DISTRICT: BALOTRA, RAJASTHAN																		
Total Area - 2 Sq Km; Bore Hole -24 (125m) Completion Time - 16 Months																		
		Months																
Sr. No	**Activities**	**1**	**2**	**3**	**4**	**5**	**Review**	**6**	**7**	**8**	**9**	**10**	**Review**	**11**	**12**	**13**	**14**	**15**	**16**
1	Camp Mobilisation																		
2	Geological mapping																		
3	Pitting/trenching																		
4	Drilling																		
5	Laboratory Studies																		
6	Sampling Party																		
7	Camp Demobilisation																		
8	Geologist Party in HQ																		
9	Geologist Report Writing with Peer Review																		
*The commencement of the project shall be deemed effective from the date the exploration acreage is made available, along with the receipt of all necessary statutory clearances																		
*Any time lost due to monsoon conditions, agricultural activities, forest clearance delays, or local law and order issues shall be considered an addition to the above timeline.																		

References:

Barman, B.J and Neog, P. 2018. Reconniassance survey for Rare Earth Elements Mineralization in Siwana area, Barmer district, Rajasthan. GSI, Unpublished Report, FS 2017-18.

Bidwai, R., Srinavasan, S., Nanda, L.K., Banerjee, A., Bangroo, P.N., Rai, A.K. and Parihar, P.S., 2014. Anomalous silver concentration in volcano-plutonic rocks of Siwana Ring Complex, Barmer district, Western Rajasthan. Current science, Vol. 106, January 2014, pp.159-162.

Chittora, V.K. and Bhushan S.K., 1994. Flow-straigraphy, geochemistry and petrogenesis of Malani Igneous Suite arround Kankani, Siwana & Bhadrajan, Western Rajasthan. GSI, Unpublished Report, F.S. 1990-94.

Das, U.K., Gantait, A. and Panda, L., 2015. Investigation for REE and other rare metals in Siwana area, Barmer district, Rajasthan. GSI, Unpublished Report, F.S. 2014-15.

Dhar, S., Frei, R., Kramers, J.D., Nägler, T.F. and Kochhar, N. 1996. Sr, Pb and Nd isotope studies and their bearing on the petrogenesis of the Jalore and Siwana complexes, Rajasthan, India. Journal of the Geological Society of India 48, 151–160.

Dostal, J. 2017. Rare Earth Element Deposits of Alkaline Igneous Rocks. Resources, 6, 34. doi:10.3390/resources6030034.

Kumar, S. and Sharma, R. 2020. Reconnaissance survey for Rare Earth Elements mineralization in and around Chhappan-ka-Pahar, Siwana Ring Complex (SRC), Siwana area, Barmer district, Rajasthan. GSI, Unpublished Report, FS 2018-19.

Lal, S. and Ghosh, I. 2023. Reconnaissance survey for Rare Earth Elements and associated mineralisation around Sainji ki beri-Meli area, northern part of Siwana Ring Complex, Siwana (SRC), Barmer district, Rajasthan (Stage: G4). GSI, Unpublished Report, FS 2021-22.

Pollard, P. J., 1995. Geology of rare metal deposits: an introduction and overview, Econ. Geology. 90, 489-494.

Rastogi S. K. and Mukherjee T., 2015. Specialized thematic mapping of the Malani Igneous Suite (MIS)

around Siwana, Barmer district, Rajasthan. GSI, Unpublished Report, F.S. 2013-15.

Rathore, S.S., Venkatesan, T.R., Srivastava, R.K. 1999. Rb-Sr isotope dating of Neoproterozoic (Malani Group) magmatism from southwest Rajasthan, India: evidence 82 of younger pan African thermal event by 40Ar–39Ar studies. Gondwana Research 2, 271–281.

Singh, A.K. and Vallinayagam, G., 2009. Radioactive element distribution and rare-metal mineralization in anorogenic acid volcano-plutonic rocks of the Neoproterozoic Malani Felsic Province, Western Peninsular India. Jour. Geol. Soc. India, v.73, pp.837-853.

Torsvik T. H., Ashwal L. D., Tucker R. D. and Eide E. A. 2001. Neoproterozoic geochronology and palaeogeography of the Seychelles micro-continent: The India link; *Precamb. Res.* 110 47–59.

Annexure -I

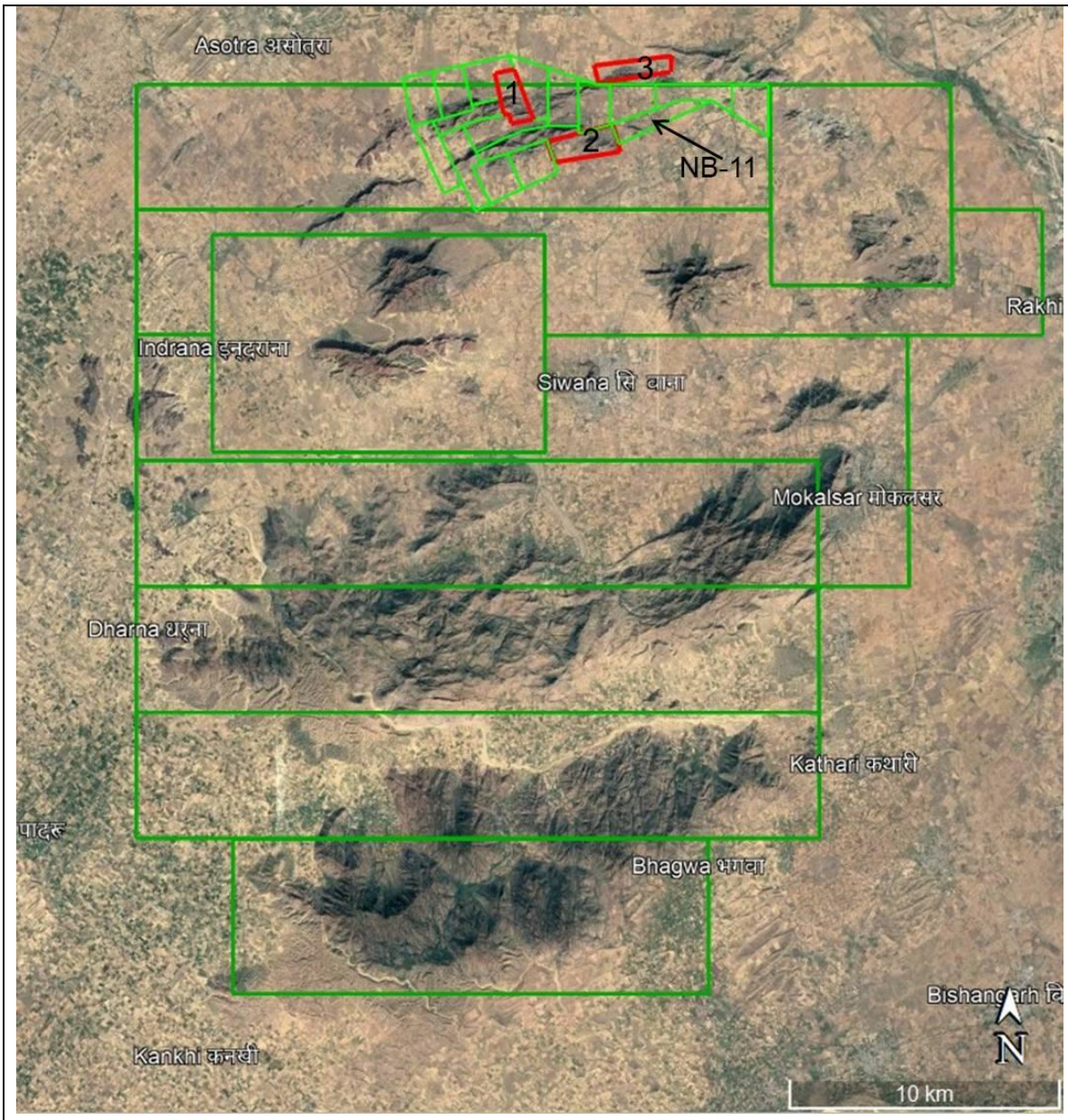


Figure 1. Location map of the NB-11 Khakharlai Block (G3), Balotra, Rajasthan. Blocks in red are NPEA blocks (1 & 2 nos.) approved by TCC of NMET and Bhatikhera G2 block (3 no.) of AMD

Annexure -II

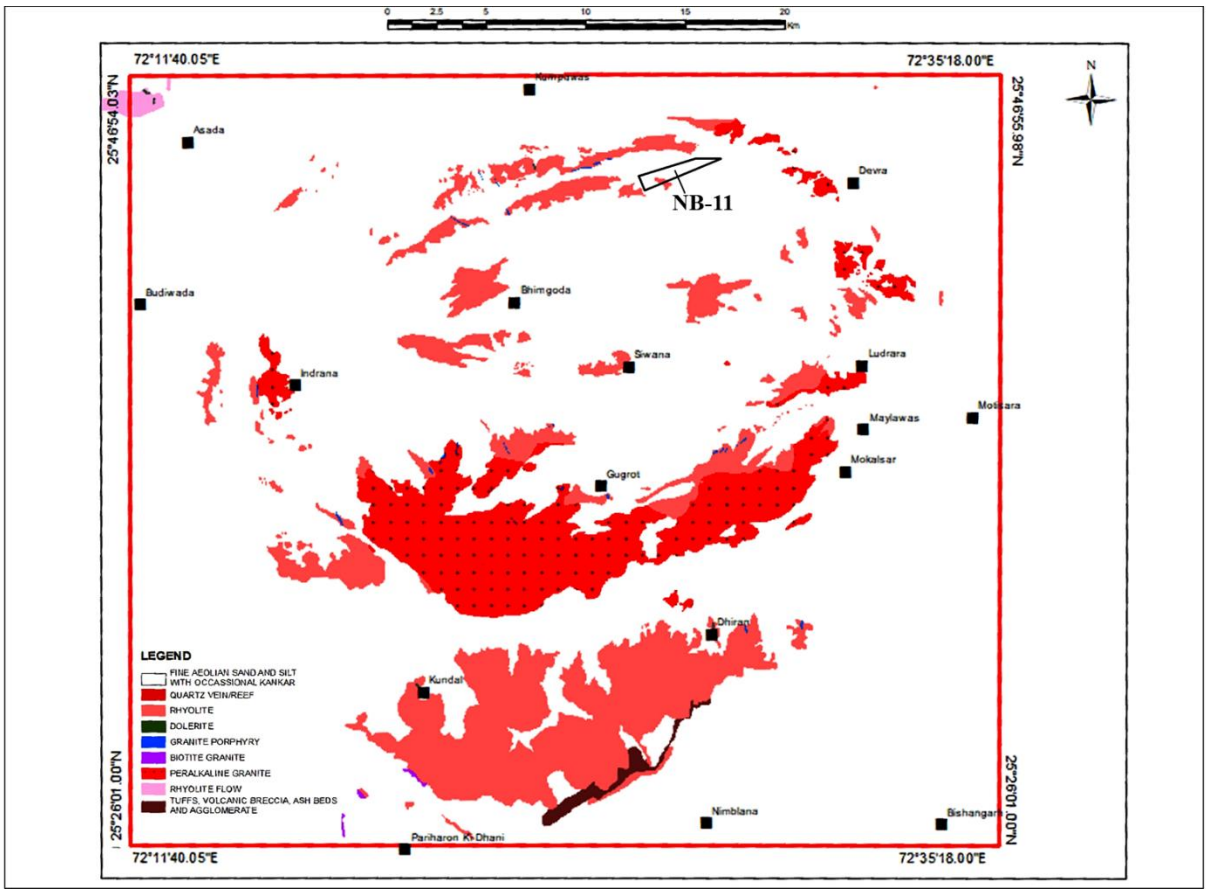
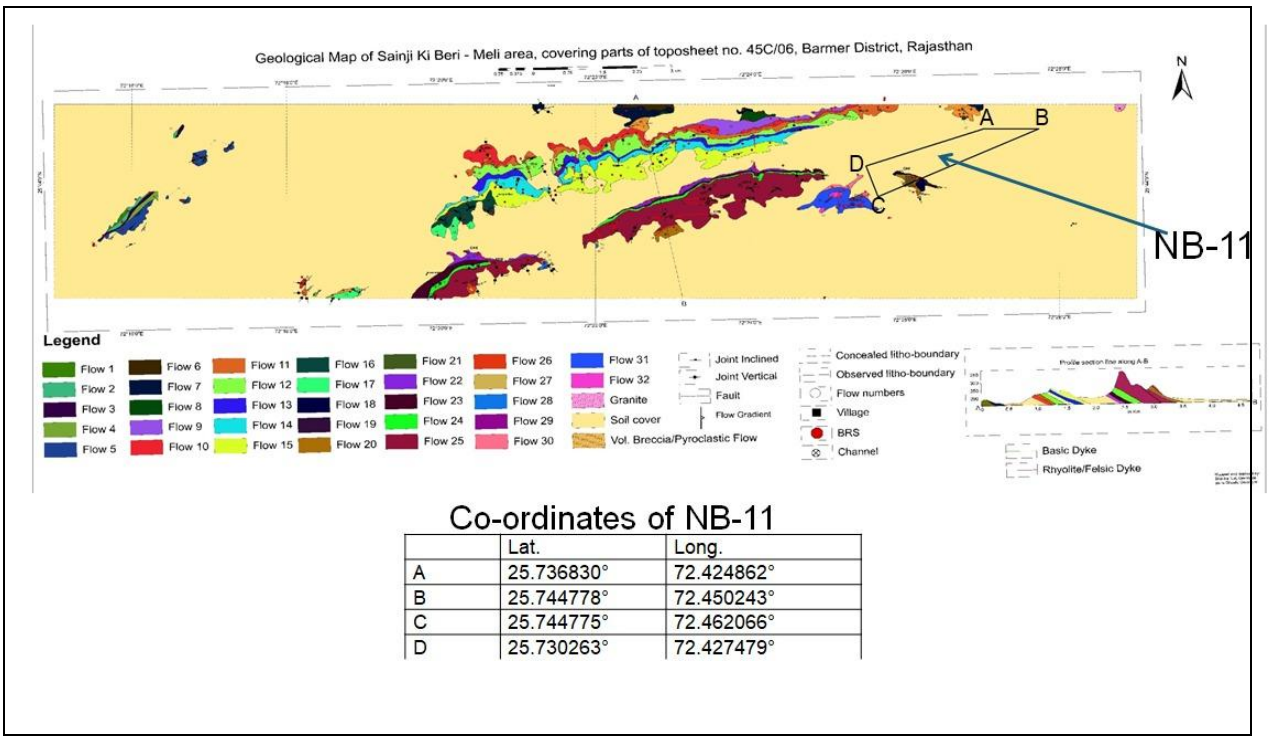


Figure 2. Geological map in and around the NB-11 Khakharlai REE block, Tehsil-Siwana, Balotra, Rajasthan. (after GSI)

Annexure -III



Co-ordinates of NB-11

	Lat.	Long.
A	25.736830°	72.424862°
B	25.744778°	72.450243°
C	25.744775°	72.462066°
D	25.730263°	72.427479°

Figure 3. Geological map of the NB-11 Khakharlai REE Block.

Annexure-IV

Figure 4. Proposed block NB-11 with TREE concentration in surface samples.

Annexure-V

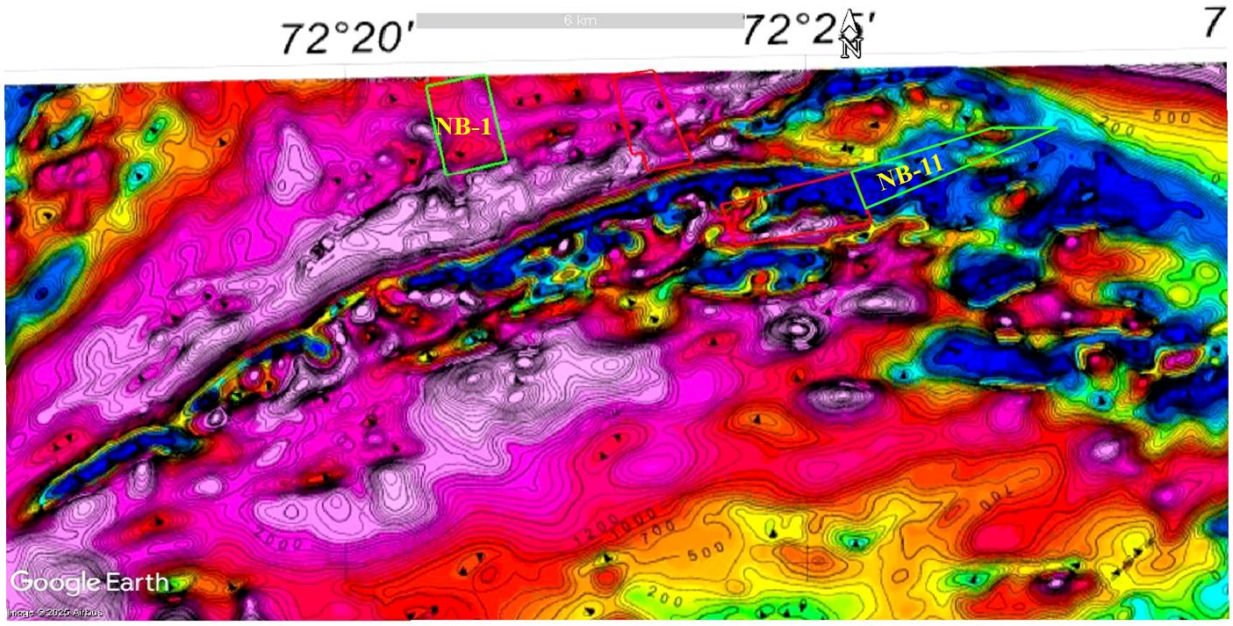


Figure 5. Aeromagnetic map of the area with NB-11 Khakharlai Block marked.

Annexure-VI

COST SHEET FOR THE PRELIMINARY SURVEY (G-3) FOR REE & RM IN THE NB-11 KHAKHARLAI BOCK, TEHSIL-SIWANA, DISTRICT: BALOTRA, RAJASTHAN.							
Total Area - 2 Sq Km; Bore Hole -24 (125m), Review after 5 and 10 months, Completion Time - 16 Months							
S. N	**Item of Work**	**Unit**	**Rates as per NMET SoC 2020-21**		**Estimated Cost of the Proposal for**		**Remarks**
			SoC-Item - Sl No.	**Rates as per SoC**	**Qty.**	**Total Amount (Rs)**	
A	**GEOLOGICAL WORK**						
1	**Mapping ,Excavation, & sampling**						
a	Charges for one Geologist per day at HQ for monitoring, data processing etc.	day	1.3	**9,000**	**60**	**5,40,000**	
b	Charges for two Geologists per day at the field for mapping, channel sampling, and BH logging.	day/geologist	1.3	**11,000**	**480**	**52,80,000**	2 Field Geologists for two drilling sites. (8 Months each)
c	Labour Charges(2 Nos) for two Geologist; (Base rate - Rs.541/-+PF Rs.64.92/-+ESI- Rs.17.58/-+Bonus- Rs.45.07/-+EL- Rs.3.30/-=Rs. 698.87/-)	day	5.7	**541**	**480**	**2,59,680**	
d	Charges for Sampler (2 party) (for pit and BH sample)	one sampler per day	1.5.2	**5,100**	**480**	**24,48,000**	
e	Labour Charges(2 Nos) (Base rate - Rs.541/-+PF Rs.64.92/-+ESI- Rs.17.58/-+Bonus- Rs.45.07/-+EL- Rs.3.30/-=Rs. 698.87/-)	day	5.7	**541**	**480**	**2,59,680**	
2	**Survey**						
a	Topographical Survey	day	1.6.1a	**8300**	30	249000	
a	Determination of boundary points and BH by DGPS	Per Point of observation	1.6.2	**19,200**	**28**	**5,37,600**	4 Boundary Points & 24 BHs
					Total - A	**95,73,960**	

B	**EXCAVATION**						
1	Pitting (Upto 5m on weathered surface)	per Cu.m	2.1.3	**5,330**	**50**	**2,66,500**	The location of the pit will be decided by the geologist after cosidering the lithology
2	Excavation of trenches upto 2m	per Cu.m	2.1.1	**3,330**	**50**	**1,66,500**	
					Total - B	**4,33,000**	
C	**DRILLING**						
b	Drilling up to 125 m (very hard Rock) (0-300m)	Meter	2.2.1.5 a	**12,650**	3000	37950000	**24 BHs of 125 meter depth =3000m total**
e	Land /Crop Compensation (in case the Bh falls in agricultura land)	per Bh	5.6	**20,000**	24	480000	**As per actuals**
f	Construction of Concerte pillar (12"x12"x30")	per hole	2.2.7 a	**2,000**	24	48000	
g	Transportaion of Drill rig & Truck Associated per drill (2 rigs)	km	2.2.8	**36**	600	21600	**From Barmer to Khakharlai (150km)**
h	Monthly Accomodation Charges for drilling Camp (2 rig)	Month	2.2.9	**50,000**	24	1200000	**12 months for 1 rig. Total =12*2=24 months**
i	Drilling Setting Cost camp	Nos	2.2.9a	**2,50,000**	2	500000	
j	Drilling Camp Winding up cost	Nos	2.2.9b	**2,50,000**	2	500000	
k	Road making (Undulary terrain)	km	2.2.10 b	**32,200**	10	322000	**As per actuals**
l	Drill Core Preservation	per m	5.3	**1,590**	1000	1590000	**125m in one BH and rest in the mineralized zone.**
					Total C	**4,26,11,600**	
D	**BH GEOPHYSICAL LOGGING**						
a.	Borehole Geophysical Logging (5 BHs of 350m each)	5 BHs of 350m each	3.12	1088941	1	10,88,941	
					Total D	**10,88,941**	
E	**CHEMICAL ANALYSES**						
1.a.	ICP-MS test for 17 REE elements (Primary samples)	Nos	4.1.14	**7,731**	**950**	73,44,450	
b	ICP-MS test for 17 REE elements (External samples) (10% of primary samples)	Nos.	4.1.14	**7,731**	**95**	7,34,445	
c	Whole rock analyses for major elements	Nos.	4.1.15 a	**4,200**	**100**	4,20,000	
2	**Petrographic Study**						

i	Preparation of thin section	Nos	4.3.1	**2,353**	**15**	35,295	
ii	Study of Thin Section	Nos	4.3.4	**4,232**	**15**	63,480	
iii)	Digital photo micrograph	Nos	4.3.7	**280**	**15**	4,200	
3	**Mineragraphic Study**	Nos					
i)	XRD study	Nos	4.5.1	**4,000**	**5**	20,000	
ii)	EPMA	Nos	4.4.1	**8,540**	**5**	42,700	
iii)	Bulk Density	Nos.	4.1	**3,540**	**5**	17,700	
					Total E	**86,82,270**	
					Sub Total (A to E)	**6,23,89,771**	
E	**Geological Report Preparation**		5.2	**For the projects upto Rs. 50 Lakhs : A Minimum of Rs. 1.5 lakhs or 5% of the work whichever is more**	1	**31,19,489**	EA has to submit the final Geological Report in Hard Copies (5 Nos) and the soft copy to NMET.
F	**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. 3.8 Lakhs whichever is lower**	1	**12,47,795**	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.
G	**Peer review Charges**		As per EC decision			**30,000**	
H	**Total Estimated Cost without GST**					**6,67,87,055**	

I	**Provision for GST (18% of GST)**	**%**				**1,20,21,670**	GST will be reimbursed as per actual and as per notified prescribed rate
J	**Total Estimated Cost with GST**					**7,88,08,725**	
				or Say Rs. In Lakhs		***788.09***	
Note - 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.							