

Oil India Limited

(A Govt. of India Enterprise)

Expression of Interest For 2D Seismic Data Acquisition & Processing

Oil India Limited (OIL), a premier National Oil Company, is engaged in the business of exploration, production and transportation of crude oil and natural gas for over five decades. It is a **Navratna** Company under Ministry of Petroleum and Natural Gas, Government of India and the second largest National Oil Company in the country. OIL is operating in blocks both in India and abroad.

OIL is planning to hire services of Internationally reputed service providers for 2D Seismic Data Acquisition & Processing in the logistically difficult terrains i.e. hilly terrains with dense vegetation cover, undulating topography and river bed areas falling within NE India i.e. states of Assam, Arunachal Pradesh, Tripura, Mizoram, Nagaland & Manipur.

OIL seeks expression of interest from experienced vendors capable of carrying out 2D Seismic Data Acquisition & Processing. Only those vendors who can comply with all the following and can demonstrate their capability should respond to the notice along with list of clients and clients' key contacts:

- ✓ Sufficient technical expertise in 2D Seismic Data Acquisition using its own resources viz. Survey planning, Survey equipment, Seismic Data Acquisition equipment and all necessary paraphernalia, shot hole drilling rigs, manpower, explosives etc. in similar terrains as described in para 2.
- ✓ Sufficient technical expertise in 2D Seismic Data Processing of thrust fold belt areas and foreland parts of similar terrains as described in para 2 using its own resources viz. Processing system, manpower etc.
- ✓ Vendor need to provide the list of clients along with client/user certification of successful completion of the projects. The document to be submitted shall also include scope of work and technical details of the equipment's used in the projects.

Interested parties are requested to visit our website www.oil-india.com for further details on Scope of Work and submit their 'Expression of Interest' with complete details and references stated above in writing within 21 days from the date of publication of this EOI. The envelope containing the offer should be marked "**Hiring of Services for 2D Seismic Data Acquisition and Processing**" at the top of the envelope and submit at the following address (15:00 Hrs)

HEAD GEOPHYSICS
GEOPHYSICS DEPARTMENT
OIL INDIA LIMITED
REGISTERED HEAD QUARTER
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SCOPE OF WORK / TECHNICAL SPECIFICATIONS

1.0 SCOPE OF WORK:

- 1.1** Oil India Limited (OIL), a Govt. of India Enterprise, presently engaged in exploration, drilling, production and transportation of hydrocarbons, proposes for Acquisition & Processing (AP) of **7860 GLKM** of regional wide spaced 2D Seismic data in parts of North East India covering seven states namely Assam, Arunachal Pradesh, Nagaland, Manipur, Mizoram, Meghalaya and Tripura by hiring the services of an internationally reputed and competent parties having required infrastructure, manpower and relevant working experience of carrying out comprehensive AP project including seismic surveys in similar terrain/areas in different parts of the world. The area of the seismic survey pertains to Hilly/Thrust Belt/Logistically Difficult Areas/Foreland part/Close to riverbed areas etc. with moderate to high vegetation cover and inaccessibility. The total areas have been divided into two parts (Area-I & Area-II) each on the either side of the river Brahmaputra. The party shall deploy sufficient number of crews & adopt terrain specific appropriate technology to meet the objective of the survey within stipulated timeline as per the contract. The area may require deployment of state of art acquisition technology (cabled or cable less equipment), mixed source, mixed receivers, advanced shot hole drilling technology (heliportable rigs, air compressor drilling, mechanized rigs, pneumatic drilling, mechanized water rotary drilling etc.) or vibrators apart from use of specialized type of explosive to meet the survey objective.

1.2 OBJECTIVES:

The objective of wide spread regional 2D seismic data is to map and study

- a. Tertiary sediments and fractured basement prospects
- b. Strati-structural and sub-thrust prospects in North Bank, Naga-Schuppen belt and Assam-Arakan fold belt.

2.0 BRIEF GEOLOGY & LOCATION OF THE STUDY AREAS:

- 2.1** The North-Eastern part of India constitutes the seven federal states of erstwhile mother state of Assam. These are; Assam, Arunachal Pradesh, Meghalaya, Nagaland and the contiguous states of Manipur, Mizoram and Tripura. It constitutes the sedimentary basin complex of Assam Shelf and Assam-Arakan. Physiographically, Cachar, the southern district of Assam, forms an entrenched part of Manipur – Mizoram and Tripura. Myanmar and Bangladesh are, respectively, to the east and west of these states. The Assam-Arakan sedimentary basin is a shelf-slope-basinal system. The shelf part of the basin spreads over the Brahmaputra valley. The basinal part (geosynclinal) is occupied by the Naga Schuppen belt and the Cachar, Tripura, Mizoram and Manipur fold belts. The Assam-Arakan fold belt extends southward to the Cachar-Mizo fold zone. West of this zone, lies the frontal belt of Tripura with mostly closed folds which gradually become tighter towards east in Mizoram.
- 2.2** Assam - Arakan region, Mizoram, Manipur and Tripura have drawn the attention of exploration geologists ever since the discovery of Digboi and Makum oil fields of Upper Assam around 1490. The Badarpur oil field in Cachar district of Assam, presently abandoned, was discovered in 1901. This discovery followed a spate of other discoveries in Assam since Sixties of the last Century. Gas occurrence in Tripura is very relevant to the

exploration of the region. Commercial gas in this state was discovered during the late seventies of previous century within the Surma sequence of Miocene age. Several other gas fields have also been found since then.

2.3 Cachar- Tripura- Mizoram fold belt constitutes a distinct part of Assam-Arakan tectonic system. Myanmar's Shan Plateau and the Ophiolite complex extend to the east of it. The Bangladesh flood plains are to the west. The Naga Schuppen belt of Assam forms the northern extreme and Chittagong hill track (Bangladesh) lies to the south of it.

2.4 The area of operation is a part of Tripura – Cachar – Mizoram fold belt of Assam Arakan Basin. The Mizoram fold belt is composed of tight linear folds with their axes almost in north-south direction. The intensity of folding increases from west to east where the rocks of Indian plate subducted below the Burmese plate. The anticlines are long, narrow and tight, whereas the synclines are broad and gentle. As per the geological section of the area of operation, the area has Tipam formation exposed in the central part and Bokabil formation is exposed in the eastern and western part. The Bhuban formation is divided in three formations as Lower, Middle and Upper Bhuban formations. Lower Bhuban formation is mainly alternations of sandstones and shale. The Middle Bhuban consists of mainly shale with subordinate sandstones. The Upper Bhuban consists of alternations of sandstones and shales.

2.5 The main objective of the survey is to acquire high quality regional seismic data for appraisal of these unapprised areas.

3.0 LOGISTICS AND TOPOGRAPHY:

3.1 The blocks are covered with thick tropical forests, river channels/riverine sands, rocky/hilly terrain with steep slopes & cliffs and flat terrain. The areas in and around forests hosts a variety of vegetation with thick undergrowth. Parts of these forest-covered areas are unapproachable by motorable roads throughout the year. Proposed seismic lines may traverse through these thick forests, marshy lands, uneven/rugged topography, frequent water logged and surface/near surface boulder covered areas. Surface elevations in the areas of operation are highly varying.

3.2 Interested party must visit the area of operation prior, to make himself fully aware and understand the topography, accessibility, resource requirement, job involvement and logistics including but not limited to environmental issues.

4.0 DETAIL DESCRIPTION OF WORK:

4.1 TOPOGRAPHIC SURVEY:

- a.** Before start of normal seismic survey, interested parties are required to fix appropriate requisite number satellite points/reference points all over the areas.
- b.** Interested party will properly fix permanent pillars at every line crossings, road crossing, river crossing and important cultural features with details engraved on the pillars. All these must be validated based on above DGPS observations. The survey accuracy should be less than 2 meters.

- c. Interested party will carry out control survey and line implantation using latest survey equipment such as DGPS, RTK mode total stations etc. with the accuracy less than 1 meter from the planned lines.
- d. **Interested party must visit the area of operation prior, to make himself fully aware and understand the topography, accessibility, resource requirement, job involvement and logistics including but not limited to environmental issues.**

4.2 **SEISMIC DATA RECORDING :**

The area is expected to have complex sub-surface geology due to severe thrusting and thrust imbricates. Pre-Seismic survey modelling on the basis of available information/ data in or in the vicinity of the area would be necessary for the most scientific spread generation to acquire data in these highly complicated thrust fold belts. Interested party will have to carry out data acquisition based on the model and maintain regular 2D geometry. However, Company's requirement is a continuous, full-fold data coverage along each profile with the following tentative survey parameters:

No. of Channels active/shot	:	600
Group Interval	:	10 mts, 20 mts ($\pm 25\%$)
Shot Interval	:	40/60/80 mts
Minimum Offset	:	10-200 mts ($\pm 25\%$)
Maximum Offset	:	3000-5000 mts
Offset Distribution	:	Uniform
Type of Spread	:	End-On/Split-Spread
Shot Hole Depth	:	~20 meter
Foldage	:	60 - 72

Note: Final acquisition parameters like charge size, shot hole pattern, receiver array, near and far offsets and spread type may be decided after the necessary experimental work in the field.

4.3 **ENERGY SOURCE:**

Interested party will have option to select energy source such as explosives/vibrators/airgun etc. or any other appropriate energy source for data acquisition in thick forest zones, land, marshy land/ swamps, boulder covered areas etc. depending upon the logistics and terrain conditions. Interested party must ensure the following geophysical requirements:

- a) Adequate energy penetration in subsurface to image target horizons.
- b) Proper shot hole drilling depth.
- c) The quantity of explosive per shot/shot hole will be decided through field experiment.
- d) Advanced shot hole drilling technology (heliportable rigs, air compressor drilling, mechanized rigs, pneumatic drilling, mechanized water rotary drilling etc.) or vibrators apart from use of specialized type of explosive to meet the survey objective.
- e) Arrangement for Procurement, storage, transportation and all statutory clearances pertaining to explosive magazine licenses.

4.4 **RECEIVERS:**

Interested party should use High Sensitivity & Low Distortion Geophones. The Geophones must be fully compatible with seismic data acquisition system along with interface/telemetry cables/nodes (in case of cable less systems). In regard to receiver type, sensitivity & array, Interested party must maintain followings up to satisfaction of Company.

- a) All the receivers must be compatible to 24-bit recording for high bandwidth signal, which is necessary to resolve the thin reservoirs.
- b) Proper receiver coupling (tightly planted or buried geophones).
- c) Array of receivers will be decided after field tests & noise analysis for recording data with high S/N ratio up to the satisfaction of the Company.

4.5 **RECORDING EQUIPMENT:**

Interested party will deploy latest state-of-art 24 bit telemetry system with Delta-Sigma technology and compatible accessories/ground electronics, suitable to acquire the required quality data in the logistics and the terrain condition prevailing in the areas mentioned above. The equipment should be able to record data from different source and receivers as selected.

4.6 **LVL/ UPHOLE SURVEY:**

Interested party is required to provide accurate and model validated source, receiver statics model along each profile and for the entire area by Acquisition & Interpretation of Uphole/LVL survey at:

- a) Uphole at every 5 KM interval in normal and flat terrain and 2.5 KM interval in the highly undulating terrain
- b) LVL at every 1 KM interval in normal and flat terrain and 500 meters interval in the highly undulating terrain

4.7 **EXPERIMENTAL SURVEY:**

- a) Interested party shall carry out all necessary experiments and tests to determine optimum field parameters prior to the commencement of the survey. The tests shall be carried out as per the practice in the international geophysical industry.
- b) The experimental work shall be carried out for a maximum period of 10 days in the area of operation to decide upon Shot hole pattern, Receiver array, shot charge size and near & far offsets. The period of 10-days or parts thereof can be availed prior to or during the operation to meet the geological /geophysical requirements.
- c) The interested party shall hire an internationally reputed seismic survey design consultant for finalization of acquisition parameters.

4.8 **QC MEASURES:**

The Interested party will install a state of-the-art workstation with requisite hardware & latest software's to carry out QC tests with acceptable plotting facilities at field site:

- a) QC of navigation data viz. survey data processing & plot generation.
- b) Planning of Seismic Survey
- c) Analysis for design of field parameters viz. offset, foldage, S/N ratio analysis etc.

- d) Uphole & LVL data interpretation and model based statics computation.
- e) Monitor display and pre-processing for quality control.
- f) On line Field QC processing system with capability up to post stack migration, at field to check the quality of output for every line completed.

5. 2D SEISMIC DATA PROCESSING

- 5.1. The Interested party shall carry out basic processing, special processing of newly acquired 2D Seismic Data by deploying state-of-the-art hardware and leading seismic data processing packages presently in use globally.
- 5.2. The Interested party must use state-of-the-art processing facilities in India, which must be capable of carrying out special processing, Pre-stack Time / Depth Migration (Pre-STM/ Pre-SDM).
- 5.3. The objective of wide spread regional 2D seismic survey is to obtain geologically conformable images of the subsurface that are amenable for meaningful interpretation leading to understanding of regional prospectivity.
- 5.4. **Processing Sequence:** The tentative processing sequence as envisaged to process the 2D seismic data is mentioned below. However, the actual sequence will be determined after completion of test processing in consultation with Company representatives:

- Reformat to internal format
- Geometry QC
- Application of Straight/Crooked Line geometry
- Refraction static analysis Tomo statics
- Random noise attenuation (testing and application in different domains)
- Linear noise attenuation (testing and application in different domains)
- Non Linear noise attenuation (in multiple domains)
- Surface Consistent Deconvolution
- Derivation and application of static solutions giving better resolution
- 1st pass velocity analysis (every 1 LKM)
- Surface Consistent Residual Statics
- 2nd pass velocity analysis (every 500 LKM)
- Surface Consistent Residual Statics
- Long period multiple attenuation
- Surface Consistent Amplitude Scaling
- Output "Pre-Mig gathers" (statics in headers only)
- Common offset regularization (with 2D, 3D, 4D and 5D regularization techniques).
- Common Offset noise attenuation
- Inverse Q (Phase only) - if required
- Pre-PSTM data conditioning (Scaling, Band pass filtering) if required
- PSTM velocity analysis (every 250 m.)
- Kirchhoff isotropic PSTM
- Residual velocity analysis (every 250 m.)
- Radon Demultiple
- High density automatic residual NMO
- Output "Migration Gathers"

- Edge preserving spatial filtering
- Inverse Q (amplitude only)
- Deconvolution after stack if required
- Noise Attenuation (FX-Deconvolution, FK)
- Phase correction if required, based upon a maximum of 5 well (will be decided in consultation with OIL QC)
- Output near, mid & Far angle static
- TV filter
- Scale
- Shallow spectral enhancement
- 2D F-K
- Shallow scaling enhancement
- Output "Final Stack"

The tentative Pre-SDM processing sequences are given below; however it may vary during final processing:

- Input "Pre-Mig gathers" from PSTM sequence
- Pre-PSDM data conditioning
- Initialize velocity model
- Anisotropic velocity model building using available well information (if any)
- Velocity model updating
- Pre SDM (anisotropic using derived model)
- Output "Final Stack"

6. SCHEDULE OF WORK PLAN

The work plan and yearly targets to be achieved are mentioned in Annexure – I & Annexure –II.

7. OPERATIONAL AREAS

7.1 **Area – I:** Foreland & Thrust/Fold belt areas of Assam & Arunachal Pradesh mainly on the North Bank of river Brahmaputra. Thrust/Fold Belt or logistically difficult area with respective quantum of GLKM of identified 2D seismic profiles. Approximately 25% of area is in thrust fold belt of Arunachal Pradesh & 75% of area is in foreland parts of Assam. The area covers mainly Barpeta, Udalguri, Nalbari, Tezpur, Nagaon, Pasighat, Jorhat, Dhemaji districts of Assam. The enclosed **Figure -1 & 3** shows the approximate location of Area – I.

7.2 **Area – II:** Thrust/Fold Belt areas in the state of Arunachal Pradesh, Nagaland, Manipur, Mizoram, Meghalaya and Tripura. Approximately 90% of the area lies in thrust fold belt. The area comprises of in-accessible hilly terrain (hills and gorges) covered with thick vegetation. The enclosed **Figure – 2 & 4** shows the approximate location of Area – II.

8 GENERAL INFORMATION

Interested parties are requested to submit their 'Expression of Interest' with complete details and references as stated above in writing within 21 days from the date of publication of this EOI. The envelope containing the offer should be marked "**Hiring of Services for 2D Seismic Data Acquisition and Processing**" at the top of the envelope and submit at the following address (15:00 Hrs).

Parties are requested to put forward their concerned queries (if any) at the address mentioned below.

HEAD GEOPHYSICS
GEOPHYSICS DEPARTMENT
OIL INDIA LIMITED
REGISTERED HEAD QUARTER
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E MAIL ADDRESS: hgp@oilindia.in
: oilunapprised@gmail.com

Seismic Data Acquisition Yearly Plan / Targets**Area-I**

(Foreland Part & Thrust Belt Logistically Difficult Area)	Total GLKM identified	No. of Proposed Crews	Seismic Data Acquisition Target				
			F.Y 2015-16 (GLKM)	F.Y 2016-17 (GLKM)	F.Y 2017-18 (GLKM)	F.Y 2018-19 (GLKM)	F.Y 2019-20 (GLKM)
ARUNACHAL AREA (Thrust Belt Logistically Difficult Area)	667.00	2		67.00	300.00	300.00	
BARPETA, NALBARI & TEZPUR AREA (Foreland Part)	1998	2	398.00	500.00	500.00	600.00	
GOALPARA AND NAGAON AREA (Foreland Part)	148.35+216.15 =364.50	2	364.50				
Total (Total Crews/Year)	3029.50	4	762.50 (4)	567.00 (4)	800.00 (4)	900.00 (4)	

Area-II

(Thrust Belt Logistically Difficult Area)	Total GLKM identified	No. of Proposed Crews	Seismic Data Acquisition Target				
			F.Y 2015-16 (GLKM)	F.Y 2016-17 (GLKM)	F.Y 2017-18 (GLKM)	F.Y 2018-19 (GLKM)	F.Y 2019-20 (GLKM)
NAGALAND & ARUNACHAL PRADESH	640.74	2	140.74	250	250		
HALFLONG-LUMDING-KARBI-ANGLONG (NC HILLS)	1113.58	2	113.58	400	300	300	
MANIPUR	1314.67	2	114.67	400	400	400	
MIZORAM & TRIPURA	1760.61	3	260.61	500	500	500	
Total (Total Crews/Year)	4829.6	9	629.6 (9)	1550 (9)	1450 (9)	1200 (7)	

Annexure - II

Seismic Data Processing Yearly Plan / Targets

Area-I					
Area	Seismic Data Processing Target				
	F.Y 2015-16 (GLKM)	F.Y 2016-17 (GLKM)	F.Y 2017-18 (GLKM)	F.Y 2018-19 (GLKM)	F.Y 2019-20 (GLKM)
ARUNACHAL PRADESH (Thrust Belt Logistically Difficult Area)			67	300	300
BARPETA,NALBARI & TEZPUR AREA(Foreland Part)		398	500	500	600
GOALPARA AND NAGAON AREA(Foreland Part)		364.5			
Total		762.50	567.00	800	900
Area-II					
NAGALAND & ARUNACHAL PRADESH		140.74	250	250	
HALFLONG-LUMDING-KARBI- ANGLONG (NC HILLS)		113.58	400	300	300
MANIPUR		114.67	400	400	400
MIZORAM & TRIPURA		260.61	500	500	500
Total		629.6	1550	1450	1200



Figure-1: Operation area (Area – I) with proposed 2D profiles covering parts of North Bank of river Brahmaputra / Lower Assam in Assam and hilly terrain of Arunachal Pradesh



Figure-2: Operation area (Area – II) with proposed 2D profiles covering parts of different states namely Assam, Arunachal Pradesh, Nagaland, Manipur, Mizoram and Tripura

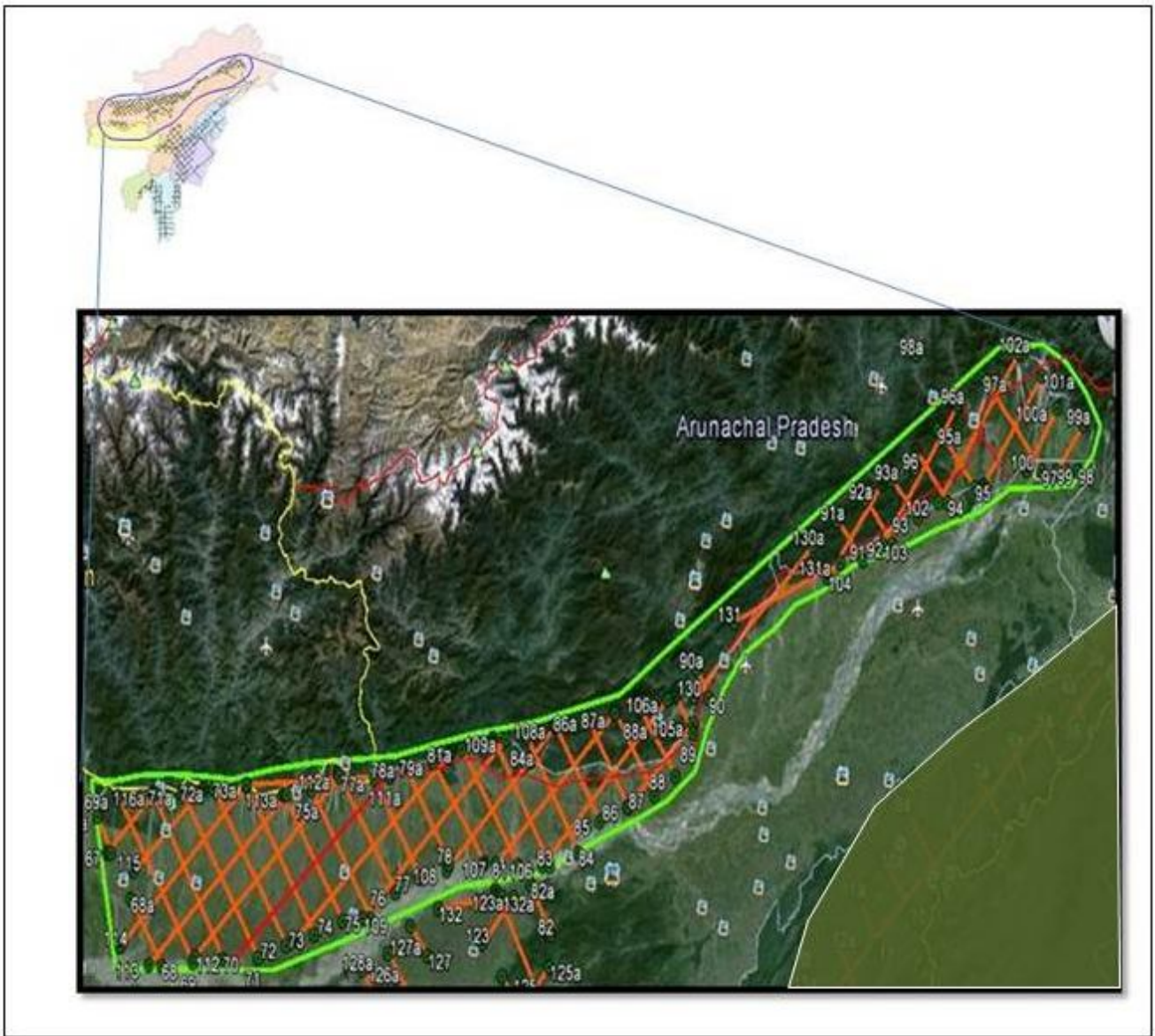


Figure - 3: Showing the tentative location of Area -I

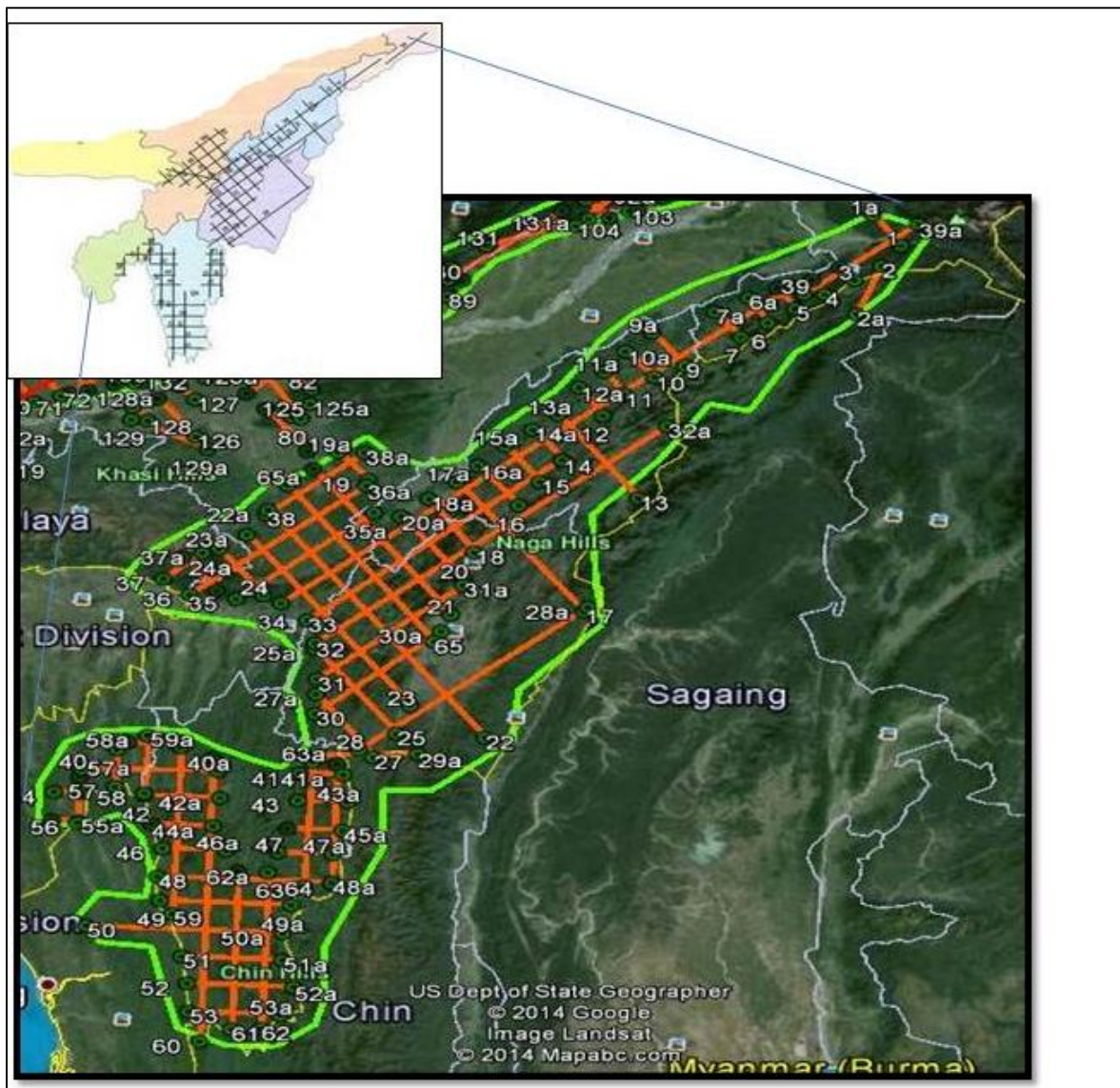


Figure - 4: Showing the tentative location of Area -II