Executive Summary

ONGC proposes to drill four exploratory cum development wells (BKAC, BKDB-A, BUAf and BU-New One), reactivate two wells (BK-1 and BU-2), construct a GCS of 180000m$^3$ capacity and lay 29.3 km pipeline interconnecting the wells and GCS spread across two fields – Banskandi and Bhubandar in Cachar Forward Base in the Assam-Arakan Basin. The development and testing of hydrocarbons, construction of GCS and laying pipeline for hydrocarbon transportation is included under activities specified in Schedule (Activity 1b) of the new EIA Notification dated 14th September 2006. It requires Environmental Clearance (EC) from the Ministry of Environment and Forests (MoEFCC).

ERM India Private Limited, a NABET-QCI accredited firm that has been entrusted with the task of preparing the EIA report for the proposed project by ONGC.

Project Location and Accessibility
The wells and GCS in Banskandi and Bhubandar Field are located in Sonai Block, in the Cachar District of Assam. The proposed wells (BKAC, BK-1 and BKDB-A) and the GCS in Banskandi field can be accessed from Silchar through NH-306 till Sonabarighat Part I and thereafter through Silchar-Sonai Road. The wells (BU-2, BUAf, BU New One) in Bhubandar Field can be accessed from Silchar through NH-306 till Lantugram and thereafter through the road leading to Mahadebpur.

Land lease
A total of 16.7 acres of land will be required for the wells and GCS. Approximately, 3.80 acres of land will be required for drilling of each well - BKDB-A, BKAC, BUAf, BU New One. Approximately 14.3 acres of land will be required for constructing the GCS. A total of 9 acres of land is present at the drill site BK-1 where the GCS is proposed under the ownership of ONGC. Additionally 5.3 acres of land will have to be acquired by ONGC. The proposed wells and additional land required for the GCS is proposed in agricultural land. BKDB-A will be drilled from existing drill pad. For the other wells, land lease will be initiated after stakeholder consultation and through District Commissioner after paying for land and crop compensation. Land for GCS will be acquired for long term. Pipeline will be routed through the ROW of existing roads after obtaining due permission from the concerned authority. For agricultural land crossing, the land will be leased and crop compensation will be paid.

Project Activities
Project activity will involve the following:
- Well site preparation, construction of access roads;
- Drilling of well and testing
- Decommissioning and restoration of well site that are not indicative of potential hydrocarbon reserves
- Construction of GCS
- Operation of GCS
• Laying of pipeline

Well site preparation and construction of access road
The drill sites will be properly reclaimed and rehabilitated if no commercial reserve is established. This process will involve the decommissioning of rig and all associated machineries; disposal of drilling waste as per CPCB guidelines, disposal of fill materials, top soil restoration.

Drilling and testing of wells
The well will be drilled to a depth between 1500-2500m where prospectively the target reservoir lies. Standard Land Rig or Mobile Land Rig with standard water based drilling mud will be used for the drilling. Drill cuttings generated will be collected and separated using a solid control system and temporarily stored on-site in HDPE lined pits. Drilling and wash wastewater generated will also be stored at an onsite HDPE lined pit. The water will be adequately treated in a mobile ETP to ensure conformance to the S No. 72 A (ii) Schedule I Standards for Emission or Discharge of Environmental Pollutants from Oil Drilling and Gas Extraction Industry stipulated by CPCB.

Site closure and decommissioning
The drill sites will be properly reclaimed and rehabilitated if no commercial reserve is established. This process will involve the decommissioning of rig and all associated machineries; disposal of drilling waste as per CPCB guidelines, disposal of fill materials, top soil restoration.

Construction and Operation of GCS
The construction of the GCS will involve setting up of concrete boundary walls around the land parcel, clearing of vegetation, storage of top soil upon after gauging and scraping. Storm water drains would be built along the periphery of the site to contain any sudden discharge to adjoining lands. Thereafter, a concrete pad will be set upon which the following components will be set at:

• Indirect water bath heaters – Fluids are heated to prevent hydrate formation;
• Inlet Separation System - Separation of condensate droplet from gas stream will take place;
• Liquid handling and disposal system;
• Safety Relief and Flare system and
• Associate Utilities

Pipeline Laying
The laying of pipeline will involve similar land preparation as fencing (fluorescent ribbons), vegetation clearing, storage of top soil. Sections of pipe will be lowered after trenching and boring to suitable depth. The trench will be first backfilled by excavated soil barring stones or rocks after lowering the pipeline. The laying of pipeline will progress in a manner where each section of the pipeline will be laid individually, covered with soil and then the trenching for the next section will begin in continuum.

Project Utilities and Resource Requirements
Power
Wells - The power requirement for each drill sites will be met through the DG sets. One DG set of 950 KVA will be used during site construction. Two DG sets of 950 KVA each will be simultaneously operable and one will be kept as standby during drilling operation. It is estimated that 6 KLD of diesel will be required during drilling phase alone.
GCS - One DG set of 160 KVA will be operated during the construction of GCS. During operation phase, power will be drawn from ASEB.
Pipeline laying - One DG set of 160 KVA will be operated during laying of pipeline.

Water
Water demand during construction period is estimated to be 5 m³/day for construction at each well site. During the drilling operation, water requirement would be around 25 m³/day.
Total water requirement at each well site during drilling activities is estimated to be 675-900 m³/day, considering a total of 45-90 days of drilling operation (including testing & contingency period). The water requirement at the drilling sites during construction and drilling phase will be met through procurement of surface water from approved local sources/suppliers.
GCS – The total water requirement during construction of GCS is 3m³.
The water requirement during operation phase is 7m³/day.
Pipeline – Approximately, 182m³ of water will be required during hydrostatic testing of water.

Manpower
During peak construction phase (including site preparation), approximately 45-50 personnel will be engaged including skilled and unskilled labour at each well site. Both locals and labourers from outside will be engaged depending on skills and project requirements.
25 personnel will be employed at the drill site at each shift. Provisions for drinking water and water for other purposes, sewage disposal will be provided at drill site and campsite.

Baseline Environmental Status
Baseline study was conducted between December, 2016 to March, 2017 for collecting information on physical environment, biological environment and socio-economic environment of the study area comprising of geographical expanse of 10 km radius around the proposed ONGC facilities including the pipeline.

Soil Environment
The soil sampled in the study area was generally found to be acidic, high in Nitrogen but low in Phosphorus and Potassium at majority of the sampling locations but is not deficient in micro-nutrients. Heavy metal contamination is not observed. The texture of the soil is clayey and having low permeability.

Climate
The daytime temperature varied between 24.5°C and 30°C and the night time temperature varied between 9 and 19°C during the study period (December, 2016-March, 2016).

The monthly average wind speed ranged between 4.2 and 5.8m/s. The predominant wind direction was from East.

**Air Environment**
Ambient Air Quality (PM$_{10}$, PM$_{2.5}$, SO$_2$, NO$_x$, CO, Methane and Non-methane hydrocarbon) was monitored at 8 locations for 24 hours twice a week for three months. The 24 hour average concentration of PM$_{10}$ in the study area ranged between 51.57 µg/m$^3$ and 76.31 µg/m$^3$ and PM$_{2.5}$ ranged between 32.20 µg/m$^3$ and 41.15 µg/m$^3$. SO$_2$ in the study area ranged between 5.25 µg/m$^3$ and 6.14µg/m$^3$. NO$_x$ in the study area ranged between 18.36 µg/m$^3$ and 23.19µg/m$^3$. CO in the study area ranged between 0.30 µg/m$^3$ and 0.39 mg/m$^3$. The above parameters were below the NAAQS level.

Average methane concentration in the study area ranged between 1.22ppmv and 1.78 ppmv. Non-methane hydrocarbon was reported less than 0.1 ppmv. Volatile Organic Compounds was reported less than 2.08µg/m$^3$.

**Noise Environment**
Ambient Noise was monitored at 8 locations. The day time (58.9-62.7dBA) and night time (41.6-44.5) equivalent ambient noise level measured at two commercial locations in the study area was within the stipulated NAAQS value. The day time (52.5-54.8dBA) and night time (39.8-44.5dBA) equivalent ambient noise level measured at six residential locations in the study area was within the stipulated ambient noise standard values.

**Ground Water**
Ground water was sampled from tube wells and open well at four locations in the study area. The concentration of majority of the parameters analysed were within the desirable limit of standard. The parameters e.g. Iron, were close to the permissible limit of Drinking Water Standard IS 10:500, 2012.

**Topography and Drainage**
The terrain of study area is flat. The project site lies within the catchment of Barak river, Sonai and Rukni river. Sonai is the left bank tributary of Barak river and flows towards North close to the site. Rukni river is tributary of Sonai River. There are streams flowing within 1km of the proposed wells.

**Surface Water**
Surface water has been monitored at 4 locations within the study area. The water bodies sampled are generally used for domestic purposes (Class B of Designated Best Use Category of CPCB). However, it is observed that coliform count of the water samples were high and hence not found suitable for Class B but is suitable for Class C (Drinking water source after conventional treatment and disinfection) and Class D (Propagation of wildlife and fisheries).

**Natural Hazards**
As per BIS, 2000, the study area lies in Zone V of seismic zone map for India.
As observed from the Flood Hazard Maps (1998-2007) prepared by National Remote Sensing Agency (NRSA), the location of the proposed GCS, BKAC, BK-1 and BKDB-A lie under Low Hazard Flooding zone. The route of the proposed pipeline runs through Low and Very Low Hazard Flooding zone. The terminal point of the pipeline, BU-2, BU New One and BUAF do not lie in a flood prone area.

**Biological Environment**
Sensitive ecological areas such as National Park, Wild Life Sanctuary, Tiger Reserves, IBA, etc are not present in study area. Sonai Reserve Forest partially falls in the North-eastern part of the study area. Approximately, 63 bird species were recorded during the primary survey of the study area. Five Schedule I species were recorded viz. Indian Pied Hornbill, Great Pied Hornbill, Hill Myna, Black Kite and Brahminy Kite. A total of 17 species of mammalian species were recorded/reported from the study area.

**Socioeconomic Environment**
A total of 33 villages located in 14 Gram Panchayet of 3 community development block in Cachar district lie within 1km radius of proposed wells, GCS and the pipeline alignment. In Banskandi Field, Dhanipur (3131) has the highest population among the study area villages of Banskandi gas field followed by Dhanehari Pt I (3079) and Sonabarighat Pt II (2037). The lowest populations were recorded for Satkarakandi Pt II with a total population of 1884. The highest literacy rate was observed in Dhanehari Pt I (89.47%) and the lowest in Sonbarighat Pt II (79.35%). The total working population in the study area villages varies from 25.58% to 39.84%.

In Bhubandar field, Sadagram (4238) has the highest population which lives in about 1022 households and the lowest populations were recorded in Lantugram (880). The highest and lowest literacy rate was observed in Mahadevpur (98.88%) and Bhubandahar Pt I (63.60%). The total working population in the study area villages of Bhubandar gas field varies from 24.89% to 36.38%.

In pipeline corridor, Rukni T.E (6687) has the highest population with highest number of household (1657) and the lowest populations was recorded in Rakhaltila (819). The highest and lowest literacy rates were observed in Berabak (96.25%) and Bhubandahar Pt I (63.60%). The total working population among the 24 study area villages of varies from 25.82% to 48.33%.

**Basic Infrastructure and Amenities**
Supply of tap water is exists in 90 percent study area villages. Other source of drinking water comprises of ground water extracted through hand pump.

In the 33 study area villages of Cachar districts considered for the study, all villages have health sub center in their respective Panchayets. Primary Health centre are present only in Sonai and Sadagram village and a hospital present in Rukni Pt II. Other than that villagers have to go to nearest town to avail medical facilities.
Among the study area one primary school is present in every study area villages, middle school is present in 24 villages, secondary school is present in 16 villages, Sr. Secondary school is present only in 4 villages and degree college present in 4 villages. ICDS is present in all the villages.

**Environmental Impact Assessment**
The potential impacts arising due to the Project activities were assessed in terms of their severity, extent and duration. The significance of all the impacts outlined; in normal condition; can be reduced to low scale by adopting best practices, adhering to the guidelines as issued by CPCB, OISD and other regulations and through common knowledge and understanding of the study area. Potential impacts arising out of construction and operation of the project activities are as follows:

**Impact on Air Quality**
The operation of DG sets, movement of vehicles and machineries during construction and drilling at drill sites and for GCS and pipeline construction will result in the generation of air pollutants viz. PM, NOx and SOx which may affect the local ambient air quality temporarily. Air pollutants like NOx will also be generated as a result of flaring of natural gas, which may need to be done intermittently.

**Impact on Noise Quality**
Operation of heavy machineries/equipment and vehicular movement during site preparatory and road strengthening/construction activities may result in the generation of increased noise levels. Operational phase noise impacts are anticipated from operation of drilling rig and ancillary equipment viz. shale shakers, mud pumps and diesel generators.

**Impact on Soil Quality**
Stripping of top soil will affect the soil fertility of the well sites. Potential impact on soil quality may result from site preparation, access road construction, storage and handling of fuel, lubricants and from storage and handling of drilling mud and drill cuttings.

**Impact on Topography and drainage**
For the proposed drill sites and at the GCS location, elevating the land to about 1 m from the ground level during site preparation may lead to alteration of onsite micro-drainage pattern. This might lead to the flow of untreated waste water and excess rain water/runoff to the adjoining agricultural land thereby adversely impacting the fertility of the soil.

**Impact on Surface Water Quality**
The surface run off from drilling waste (cuttings and drilling mud), hazardous waste (waste oil, used oil etc) and chemical storage facilities on open soil is likely to contaminate surface water if allowed to flow into nearby water bodies viz. natural drainage channels, ponds etc.

**Impact on Ground Water Quality**
Possibility of contamination of subsurface and unconfined aquifers may exist if the casing and cementing of the well is not carried out properly leading to infiltration of drilling chemicals local porous local aquifer of the region. Also, the improper disposal of drill cuttings can lead to leaching of toxic chemicals with a potential to contaminate the ground water.

**Impact on Biological Environment**
The generation of dust, noise and illumination due to proposed drilling activity may cause disturbance to the fauna. Some trees will also be felled for setting up the GCS and along the pipeline alignment. The projected number of trees to be felled will be small in number - 10-15 for GCS and 45-50 for pipeline.

**Impact on Socio-economic Environment**
The proposed project would not require any displacement of villagers. However, there will be temporary loss of livelihood as agricultural land will be lost for well drilling and trenching for laying of the pipeline. Further, land will also be required for constructing approach roads whose length will vary in for each well and GCS. The landowners will be adequately compensated for the land. Local people will be benefitted through creation of job opportunities and livelihood measures.

**Quantitative Risk Assessment**
The quantitative risk assessment has been done to provide a systematic analysis of the major risks associated with onshore exploratory cum development drilling activities, operation of GCS and pipeline across Banskandi and Bhubandar Field.

Blow out from a hydrocarbon exploratory cum development well was modelled for Vapour Cloud Explosion (VCE) scenario with ignition at the rate of 50kg/s. For congested conditions, the blast overpressure of 1.0 psi is likely to be experienced within a radial distance of 428 m. The Level of Concern (LOC) was never exceeded at higher blast overpressures of 8.0 psi and 3.5 psi. Potential failure cases in the form gas leaks may result from the gas header extension at GCS due to corrosion, mechanical failure and/or faulty operations leading to process deviations. Risk scenarios with different rupture sizes (20mm, 50mm and complete rupture of Group Header) leading to Jet fire shows the Thermal Radiation of Concern (>10KW/sq.m) to reach a maximum distance of 11-15m.

Pipeline failure could lead to potential hazard due to ignition of leaks that might result into a jet fire or Vapour cloud explosion. The level of concern for thermal radiation from Jet Fire caused by a 20mm and 50mm rupture is 17m and 35m respectively (10KW/sq.m). The level of concern for overpressure caused by VCE was never exceeded for >8.0psi.

**Environmental Management Plan**
Environment Management Plans (EMP) has been developed to prevent and mitigate significant adverse impacts and accentuate beneficial impacts will be
implemented by ONGC for the proposed project. The key mitigation measures specific for each management plan have been discussed in the Table below:

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<th>Sl. No</th>
<th>Components</th>
<th>Environment Management Plan</th>
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| 1     | Pollution Prevention and Abatement Plan | • The top soil generated from site clearance activities will be stored in designated area and stabilized to prevent fugitive dust emissions.  
      |                                   | • Preventive maintenance of DG sets to be undertaken as per manufacturers schedule to ensure compliance with Sl No 95 GSR 371(E) dated 17.5.2002.  
      |                                   | • All vehicles, equipment and machinery used for construction will be subjected to preventive maintenance as per manufacturer norms.  
      |                                   | • Flaring will be undertaken in accordance with the CPCB Guidelines S No. 72 B. for Discharge of Gaseous Emissions for Oil & Gas Extraction Industry.  
      |                                   | • High combustion efficiency, smokeless flare/burner will be used.  
      |                                   | • Installation of acoustic enclosures and mufflers on engine exhaust of DG sets to ensure compliance with generator noise limits specified by Sl No 94 GSR 371(E) dated 17.5.2002.  
      |                                   | • Effective noise barrier at the fence-line of the sites.  
      |                                   | • Install and maintain effective run-off controls, including silt traps, straw barriers etc so as to minimize erosion.  
      |                                   | • Fuel and chemical storage areas will be paved and properly bunded.  
      |                                   | • Proper casing and cementing of drilling well will be done to prevent contamination of sub-surface aquifers.  
      |                                   | • Water based mud to be used as a drilling fluid or else eco-friendly synthetic based mud in necessary conditions. |
| 2     | Waste Management Plan             | • Use of low toxicity chemicals for the preparation of drilling fluid.  
<pre><code>  |                                   | • Management of drill cuttings, waste drilling mud, waste oil and domestic waste will be made in accordance with S No. 72 C.1.a Schedule I Standards for Emission or Discharge of Environmental Pollutants from Oil Drilling and Gas Extraction Industry of CPCB as modified in 2005 Necessary spill prevention measures viz. spill kit will be made available at the hazardous... |
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<td>3</td>
<td>Wild Life Management Plan</td>
<td>- The drill site will be properly fenced (chain-linked) to avoid straying of any outsider as well as wildlife; &lt;br&gt; - No temporary electric supply connection line from the grid will be laid for the proposed project activity. All electric requirements will be supplied from the internal DG sets. &lt;br&gt; - Noise Levels at the drill site will be controlled through selection of low noise generating equipment and installation of sufficient engineering controls viz. mufflers, silencers etc. &lt;br&gt; - Movement of heavy vehicles will be restricted at night time</td>
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<td>4</td>
<td>Road Safety &amp; Traffic Management Plan</td>
<td>- Project vehicular movement involved in sourcing and transportation of borrow material will be restricted to defined access routes. &lt;br&gt; - Precautions will be taken to avoid damage to the public access routes including highways during vehicular movement. &lt;br&gt; - Clear signs, flagmen &amp; signal will be set up at major traffic junctions and near sensitive receptors viz. primary schools in discussion with Gram Panchayat and local villagers.</td>
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<td>• Movement of vehicles during night time will be restricted. Speed limits will be maintained by vehicles involved in transportation of raw material and drilling rig.</td>
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<td>• A Traffic Management Plan will be formulated and implemented by the contractor to control construction and operational phase traffic.</td>
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<td>• Routine maintenance of project vehicles will be ensured to prevent any abnormal emissions and high noise generation.</td>
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<td>• Adequate training on traffic and road safety operations will be imparted to the drivers of project vehicles. Road safety awareness programs will be organized in coordination with concerned authorities to sensitize target groups viz. school children, commuters on traffic safety rules and signage.</td>
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<td>5</td>
<td>Occupational Health &amp; Safety Management Plan</td>
<td>• All machines to be used in the construction will conform to the relevant Indian Standards (IS) codes, will be kept in good working order, will be regularly inspected and properly maintained as per IS provisions and to the satisfaction of the site Engineer.</td>
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<td>• Contractor workers involved in the handling of construction materials viz. borrow material, cement etc. will be provided with proper PPEs viz. safety boots, nose masks etc.</td>
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<td>• No employee will be exposed to a noise level greater than 85 dB(A) for a duration of more than 8 hours per day. Provision of ear plugs, ear muffs etc. and rotation of workers operating near high noise generating areas.</td>
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<td>• All chemicals and hazardous materials storage container will be properly labeled and marked according to national and internationally recognized requirements and standards. Materials Safety Data Sheets (MSDS) or equivalent data/information in an easily understood language must be readily available to exposed workers and first-aid personnel.</td>
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<td>• The workplace must be equipped with fire detectors, alarm systems and fire-fighting equipment. Equipment shall be periodically inspected and maintained to keep good working condition.</td>
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<td>• Adequate sanitation facilities will be provided</td>
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<td>6</td>
<td>Management of Social issues and</td>
<td>- People from adjoining areas especially given job preference through local contractors according to the skill sets possessed.</td>
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<td>concerns</td>
<td>- Prior to the commencement of the proposed activity, a consultation program will be conducted by ONGC with the target groups and local authorities. The primary objective of such consultation will be to share with the concerned villagers/stakeholders the objective of the proposed project associated impacts and their mitigation.</td>
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<td>- ONGC will give more emphasis and priority on periphery development, development of health facilities and provision for drinking water facility as per Corporate Social Responsibility (CSR) Plan.</td>
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<td>- During the drilling phase and for the rest of the project activities proper safety measures will be undertaken both for transportation as well as the other operations.</td>
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<td>- The drill site would be fenced and gates would be constructed so that the children are refrained from straying into the site.</td>
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<td>7</td>
<td>Emergency Response Plan</td>
<td>- Drilling rig and related equipment to be used for development drilling will be conformed to international standards specified for such equipment.</td>
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<td>- Blow-out preventers and related well control equipment shall be installed, operated, maintained and tested generally in accordance with internationally recognized standards.</td>
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<td>- Appropriate gas and leak detection system will be made available at each of the drilling location.</td>
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<td>- Adequate fire-fighting equipment shall be provided at each drilling site.</td>
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