Executive Summery

Block No: AA-ONHP-2017/5

Prepared For:

Vedanta Limited

(Division: Cairn Oil & Gas)

Prepared By:

AECOM India Private Limited

Executive Summary

Introduction

Vedanta Ltd. (Division Cairn Oil & Gas), formerly known as Cairn India ltd, has been allocated the hydro-carbon Block namely AA-ONHP-2017/5 by Government of India under the Revenue Sharing Contract (RSC) for exploration and exploitation of hydrocarbons. RSC (Revenue Sharing Contract) has been signed between Vedanta Ltd and MoP&NG on 1st October 2018 for the exploration and exploitation of hydrocarbons. Vedanta Limited (Division: Cairn Oil and Gas) proposes to carry out exploration & appraisal of (12 nos. of wells) and setting up of early production units in the block. Block encloses an area of 758 Sq. Km.

Vedanta Limited (Division Cairn Oil and Gas) proposes to carry out exploration and appraisal well drilling and early production of oil and gas in the Block. In case of a discovery (ies), the exploratory and appraisal well(s) would be tested for extended duration by flowing hydrocarbons to ascertain the reservoir parameters and assess the quality and commercial viability. The exploratory and appraisal wells would be drilled to explore the reservoirs in the range of 1750m to 5000m.

The proposed exploratory and appraisal drilling activities fall under category 1(b) of the EIA Notification, 2006 and require Environmental Clearance (EC) from the Ministry of Environment and Forests and climate change (MoEF&CC). The Terms of Reference for the Project have been approved by MoEF&CC vide letter File No. IA-J-11011/128/2019-IA-II(I) dated 4th May 2019.

AECOM India Private Limited, a NABET-QCI Accredited firm has been entrusted to conduct the Environmental Impact Assessment (EIA) for the proposed Block AA-ONHP-2017/5. The EIA study comprised of initial scoping, site visits, environmental monitoring and surveys, conduct of Public Hearing (PH) and the preparation of draft and final EIA-EMP reports.

Block location and Accessibility

AA-ONHP-2017/5 block is located in Jorhat, Lakhimpur and Sibasagar Districts of Assam. Total area of AA-ONHP-2017/5 block is 758 sq. km. The nearest Town from the block are Teok- Within the block (North-East); Rajahauli 3 km (South -west) and Amguri- 0.66 km (South-East). State Highway 31, National Highways 37 & 61 (Within Block), Amguri and Shivasagar Railway Station and Jorhat Airport connects the block to the other cities of the state and country.

Land Requirement

During the site selection process, all legal requirements would be considered and surface location of the exploratory well would be finalized. Once surface drilling location is finalized, short term lease of the land would be taken from concerned owners. If well location falls in agricultural lands or other private lands, land and crop compensation would be provided to the land owner, and in case of govt. land, land allotment from Govt. to be applied. Initially temporary short-term lease would be taken for 3 - 5 years for exploration purpose and in case of commercially viable discovery of hydrocarbon resources; the land lease would be converted into long term lease up to life of the project. The estimated land required per drill site is approximately 9ha. There is no recorded forest land in the study area.

Description of the project

The proposed project includes proposed drilling of 12 onshore exploratory and appraisal wells and Setting up of Early Production Units (EPUs)/ Quick Production Units (QPUs) for produced well fluid processing and production of up to 8000 BOPD crude oil and up to 1.6 MMSCFD associated natural gas. Block Location on SOI Toposheet is presented below.

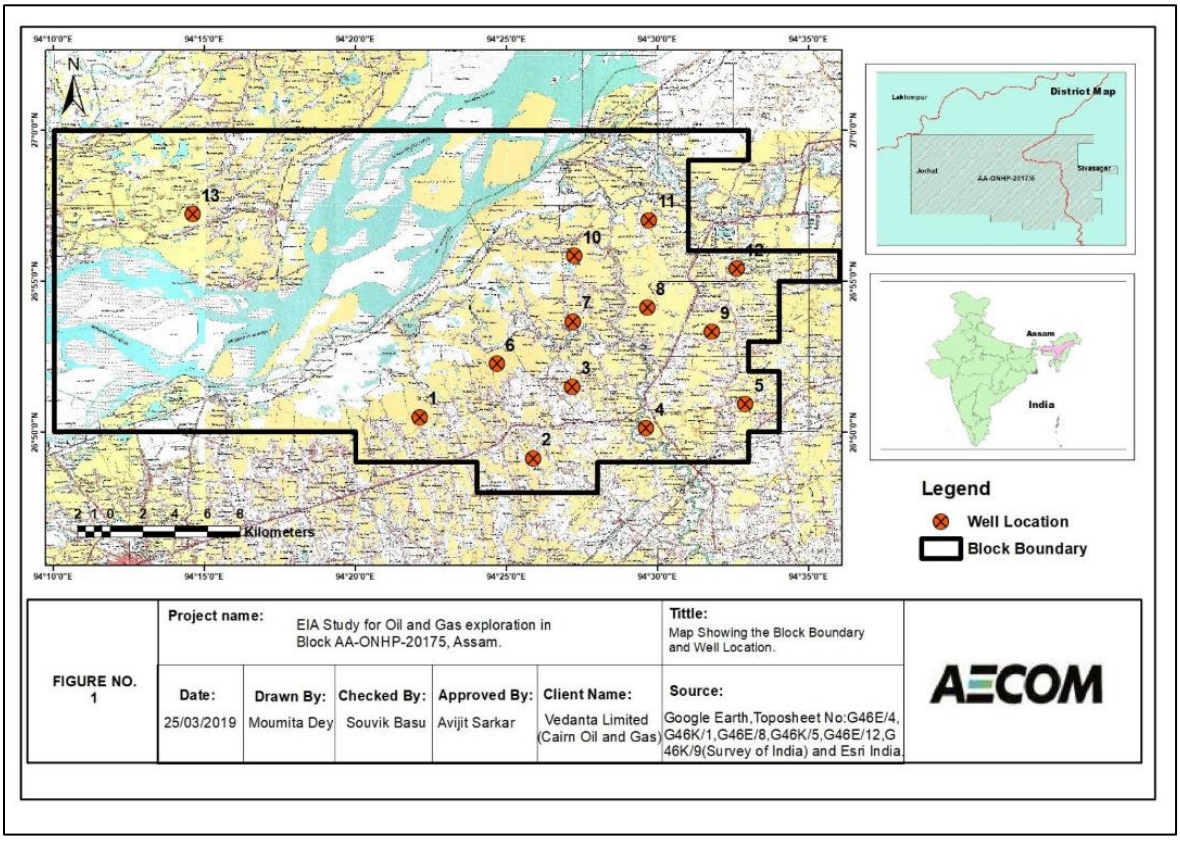

Figure 1: Block Location on SOI Toposheet

Drill Site Preparation

Drill Site Selection –

An initial assessment of the exploratory well site would be carried out through analysis of satellite imageries. Field surveys would be carried out to earmark the drill site location maintaining maximum possible distance from any settlement and sensitive receptors. Ease of accessibility to the site would also be considered.

Site Preparation –

Detailed site surveys would be carried, and the boundary of the drill site to be earmarked. Site levelling, and excavation works would be carried out for site preparation. Individual sites would be duly fenced. New approach roads to drill sites would be constructed or existing village roads would be strengthened to provide access for the drilling equipment and machinery. If the earmarked site has vegetation cover, clearance of vegetation is the first activity that would be undertaken during drill site construction. Following this, the preparation and construction of drill site would involve top soil scraping and storage for future use, elevating the drill platform by excavated material from the drill site and authorized quarry area. Reinforced Cement Concrete (RCC) would be used for the construction of foundation system. For making foundations of the main rig structure, cast in-situ bored under- reamed piles of specified lengths would also be used.

Rig Mobilization - After completion of the construction activities and with the provision of the basic facilities, drill rig would be transported to the site. The drill equipment is designed as standard land rig or a "Mobile Land Rig" type, which facilitates quick mobilization and demobilization. Rig essentially comprises of a Drilling mud system, Effluent Treatment Plant (ETP), Cuttings disposal, Drill Cementing equipment along with utilities to supply power (DG sets), water and fuel (HSD).

Drilling Operation

A rig would be installed at the potential site of drilling after thorough inspection for its working capability and quality standards. Well spudding shall be the start of drilling activity. Wells would be drilled in sections, with the diameter of each section decreasing with increasing depth. Before commencing the actual drilling, large diameter pipe (Conductor) would be lowered into a hole and cemented/grouted. Top-hole section would be drilled to a desired depth based on well design. After drilling top-hole section, it would be cased with a pipe called "Casing". Once each section of the well is completed, the drill string is lifted, and protective steel pipe or casing lowered into the well and cemented into place. The lengths and diameters of each section of the well would be determined prior to the starting of the drilling activities and are dependent on the geological conditions through which the well is to be drilled. This process of drilling and casing the hole section continues until the final well depth (target) is achieved.

Drill cuttings generated from the drilling activity, would be collected and separated using a solid control system and temporarily stored on-site in HDPE lined pits. Drilling and wash wastewater generated would also be stored at an onsite HDPE lined pit. The water would 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 of CPCB.

Hydraulic Fracturing Activity-

Hydraulic fracking may be conducted in wells with low permeability formation and the wells with low pressure. Fracking fluid would typically be 99% water and sand (or other granulated material) and approximately 1% gelled chemicals that would be pumped at a high rate (in excess of 20 bpm) and high pressure (up to 5000 psi) to fracture the formation and improve the well deliverability. Sites for the wells with more than 2 fracs per well (multi-stage fracturing) would have provision of additional space for water storage for better continuity of operations.

Well Testing & Flaring-

During the exploration and appraisal drilling, where a hydrocarbon formation is found, initial well tests (generally about one month of duration) would be carried out to establish flow rates, formation pressure and other parameters. However, depending on the need, based on nature of the reservoirs, the exploratory and appraisal wells would be tested for longer/extended durations to ascertain the reservoir parameters.

Associated Facilities –

Each drill site would be provided with facilities such as drilling rig foundation and cellar pit, waste and water storage pits, chemical storage area including fuel storages, drill cutting disposal pit, flare pit and mobile STPs. The drill cutting and spent mud disposal pits would be provided with a HDPE lining for temporary storage. Adequate drainage and wastewater conveyance system also would be installed.

Liquid Mud Plant (LMP)-

The Liquid Mud Plant (LMP) shall be located at suitable locations of the fields to prepare synthetic/ water-based mud for the drilling operations. Water Base Mud (WBM) will be used as drilling fluid for initial, shallower sections where massive shale not encountered. The deeper and difficult to drill geological formations will be drilled using Synthetic Base Mud (SBM) as drilling fluid.

Appraisal –
When, exploratory drilling is successful, more wells (termed as Appraisal wells) would be drilled to determine the size and the extent of the field. The technical procedures and activities in appraisal drilling would be the same as those employed for exploration wells Deviated or directional drilling at an angle from a site adjacent to the original discovery well may be used to appraise other parts of the reservoir

Quick Production Unit (QPU) –
In case of commercially viable discovery, QPUs would be installed for the processing of produced well fluid processing and early production of up to 8000 BOPD crude oil and up to 1.6 MMSCFD associated natural gas. A QPU would be a packaged/ modular mobile unit and would mainly consists of a three-phase separator & production heater or heater-treater, oil storage tanks, oil tanker loading system, produced water (PW) separation and disposal system, power generation (GEG or DG), utility systems such as fuel gas, flare & Inst. Air packages, firefighting equipment, etc. Each QPU capacity would be ~2,000 BFPD (Barrels of Fluid per Day).

Accommodation and Camp Site:
Temporary camp site (porta cabin) for the drilling of exploratory (including) appraisal wells are envisaged, which would be dismantled after drilling of the wells. At any point of time, it is anticipated that about 50 personnel per shift would be housed in the campsite during the well drilling campaign.

Well decommissioning

After the completion of the drilling activity, partial de-mobilization of the drilling rig and associated infrastructure would be initiated. As discussed earlier, well testing may be carried out immediately after the drilling is completed. The complete de-mobilization of the facilities at site would happen once well-testing completed successfully, in case of commercially viable discovery (s) of hydrocarbons in the Block and having established the size of the hydrocarbon field (s), proposes to immediately bring the field (s) into production using one or more of the appraisal wells for the production of crude oil by setting up of QPU (Quick Production Unit). All other equipment, materials, fuel and wastes would be removed from the drilling site and reused for other drilling activities or disposed as per the applicable regulatory requirements.

If hydrocarbons are not found, a full abandonment plan would be implemented. All concrete or steel installations would be removed to at least 1m below ground level, to ensure that there would be no protruding surface structures. All waste at the site would be removed and the pits would be closed. The drill sites and associated sites (for camps and liquid mud plant) would be restored to its original conditions or as required by the landowner.

Utilities and Resource Requirement

Water – Total of 102 m^3 per day fresh water would be required per well. From the total water, 22 m^3/day water would be used for mud preparations, 50 m^3/day would be required for drilling activities and 30 m3/day freshwater would be used for domestic purposes including drinking, washings and domestic use. The water requirement for all the project activities would be sourced locally through approved/authorized sources of surface water and/or ground water (e.g. PHD bore wells, privately owned bore wells, irrigation Department/water resources Dept. Of State Govt.). In case, required water would not be sourced from locally available approved sources, ground water will be extracted after obtaining permission from CGWA/State Govt

During early production, EPU/QPU unit water requirement for process, domestic consumption, greenbelt and miscellaneous use would be 15-18 m^3/day.

Power – Power – For a drilling operations site, the power would be provided through diesel generator (DG) sets (Camp site - 2x350 KVA (including one as standby), Drilling site - 3x1000 KVA (including one as standby) or 2X1850 KVA (1 Working + 1 Standby) depending on the rig capacity / availability during E&A drilling phase as per rig requirement and Radio Room -2x100 KVA (including one as standby).

For early production power requirement will be met through the State Electricity and or installation of Diesel/Gas Engine Generator (GEG) of 1 MW output using produced natural gas and a 500 KVA DG will be used as backup in emergency conditions for each early production unit.

Labour– It is anticipated that, at any given time, there would be about 80 - 100 personnel working on site including technical staff, drilling crew, security staff etc.

Project Cost

The cost of the project has been estimated to be about INR 368 Crores.

Pollution Sources

Air emissions: Point source air emissions would be generated from DG sets. Fugitive emissions would occur from vehicles involved in the drilling operations and from windblown dust from storage and staging areas within the drill site. During early production stage emissions would be generated from GEG/DG sets and flaring

Noise & Vibrations: Noise and vibration would be generated due to operation of drilling rig, DG sets and vehicles.

Liquid wastes: During the drilling phase, approximately 30-40 m^3 per day of waste water would be generated from the drilling activity and 16-25 m^3 per day of domestic waste water would be generated from each drill site. During early production stage produced water would be generated which would be properly treated.

Drill cuttings & spent mud: Approximately 500-1500 Tons/well of drill cuttings from SBM, 250-500 Tons/well of drill cuttings from WBM and 250-500 Tons/well of spent mud would be generated per site.

Existing Baseline Environment of the Project Area

Baseline information about the Block was collated by review of other published literature, site surveys, stakeholder interactions and primary monitoring carried out during the period of March-May 2019 by Mitra S. K. Private Limited (NABL Accredited Laboratory).

Sub-surface Geology-

The Block is situated in Sibsagar, Lakhimpur and Jorhat district. Geological set-up of both Lakhimpur and Jorhat district is represented by hilly tract and alluvial flood plain of River Brahmaputra. foot hill region is marked by the older terrace deposit. Two terrace surfaces have been identified as the Harmuti and Joyhing surfaces that represent high- and low-level terraces. These terrace deposits are characterised by undulating surface comprising boulders, pebbles of quartzitic and gneissic rocks with fine sand, silt and clay. The alluvial flood plain consists of younger and older alluvial deposits. It represents various sub-features, viz., palaeo channel, swampy/marshy land, river terraces, flood plains, point bars, channel bar and river channel.

The geology of Sibsagar district consists of alluvial deposits. Geological surveys have indicated that under the recent deposits there are many thousand feet of tertiary sediments which lie over an Archean basement complex. These Tertiary rocks represent the foreland facies and are distinguishable from the geosynclinals facies of Tertiary rocks which form the hills on the south and south east of the district. Rocks of the later facies are found as outcropping in a small area within the district along the hills to the south of the railway near the north-eastern boundary.

Drainage - Brahmaputra is the main river is flowing within the block boundary from north east to south waste and comprising of 212 sqkm of block area.

On the east of the Sibsagar district flows the Disang river starting its maiden journey from the Patkai Bum. The maximum altitude near about this origin is 8,511 feet. Then the river Tisa, as the Disang is known near about its origin, moves towards north and travels about 38 miles horizontally before it meets with its first tributary Towaijo. West of the Disang river is the Dikhou, which originates from a Sema Naga area. Near its origin this river is known as the Longa river, which moving north- west for about 12 miles, turns north-east and proceeds in this way about 16 miles and then meets its first tributary Chimel Nadi on the right bank. Its principal tributary in Sivasagar is the Darika, which flows a little northeast of Sivasagar town and falls into the Dikhou near its mouth.

The mighty Brahmaputra mainly regulates the drainage pattern of district Lakhimpur. The Subansiri–Ranganadi–Dikrong–System that emerges in Brahmaputra, forms an intricate drainage pattern in the district. The Subansiri regarded as the largest tributary of river Brahmaputra.

Drainage pattern of Jorhat district is characterized by river Brahmaputra, and its tributaries like south Dhansiri, Bhogdoi and Kakodonga drain the district. The tributaries originate in Naga-Patkai range and flow northward to join the Brahmaputra River, almost at right angles which give rise to subparallel type of drainage.

Hydrogeology– The geology of Upper Assam as a whole is quite interesting and can be clearly visualised only if we know the geological history of Assam which has been discussed in detail by many workers of the Geological Survey of India, Oil India and the Oil and Natural Gas Commission. References are found in the publications of G.S.I. & O.N.G.C. Without going into the details of the geological history, it can be stated that the sedimentation in Upper Assam particularly covering parts of Jorhat and Sivasagar districts has been affected by the Naga Patkai range. The Naga-Patkai range consists of a series of complex over thrusts with an imbricate pattern, one thrust overlapping the other. The outer most boundary thrust of the “belt of schuppen” known as the Naga thrust closely follows the boundary of the Assam valley alluvium for about 350 km and continues southwest ward for another 50 km upto Haflong.

The southern foot hills of Sivasagar district falls in the upthrust block of Naga thrust. The various rocks exposed in this strip belong to Barail Group, Tipam Group and post Tipam sediments, oriented in NE-SW to ENE-WSW direction.

Lakhimpur district can be divided between two major hydrogeological unit. semi-consolidated and unconsolidated formations based on geology and hydrogeological character. The semi-consolidated formation composed of Neogene Siwalik Group of rocks bordering the northern boundary of the district. The Siwalik rocks are not suitable for ground water development. The major water bearing formations include alluvial sediments in foothills and flood plain that constitute the unconsolidated formation.

Ground water in Jorhat district mainly present in under water table to semi-confined conditions in the near surface conditions and in the deeper horizon, under semi-confined to confined conditions. Depth

to water level in the water table zone varies from 3.79 to 8.32 m bgl in the pre-monsoon period and 0.50 to 4.26 m bgl during post-monsoon period.

Groundwater Quality-

Total of 8 ground water samples have been collected and analysed for parameters as per IS: 10500:2012 standards. The colour of the samples was found <1 hazen units and with agreeable odour. The pH of water samples ranged from 6.30 to 7.8. The TDS in the water samples varied from 71 mg/l to 292 mg/l. The total alkalinity of the samples varied from 41 to 255 mg/l which falls within their corresponding permissible limit of 600 mg/l. Total hardness of the samples varied from 31 to 104 mg/l and was within the permissible limit of 600 mg/l. The concentrations of heavy metals such as Aluminium, Manganese, Iron, Nickel, Copper, Zinc, Arsenic have been found to be below their corresponding permissible limits. Cadmium, Mercury, Lead and other parameters like Residual Chlorine, Cyanide, Hexavalent Chromium, Phenol, Total Phosphorus, Free Ammonia, Cyanide, polychlorinated bi-phenyls, PAHs have been found to be below detection limits.

Climate and Meteorology - As per climatological table of 1971-2000 of Indian Meteorological Department (IMD) nearest weather station to AA-ONHP_2017/5 is located in North Lakhimpur Airport which is located approximately 35 km in north west direction of the block. As per the data, temperature reaches around 36.0^{o}C during the month of June. Summer is generally wet in nature with very humidity in the air. Whereas, winter experience very low temperature. The lowest temperature recorded in the month of January which reaches up to 5.4^{o}C. Annual mean rainfall of 1239.2 mm throughout the year

Ambient Air Quality- Ambient air quality was monitored at 8 locations (for a period of 12 week - March to May'19). PM_{10} concentration in the study area varied from 79.2 µg/m^3 to 43.5 µg/m^3. The monitoring location at AAQ 9, observed the maximum concentration of PM_{10} i.e 79.2 µg/m^3, whereas minimum PM_{10} concentration was observed at AAQ 4, i.e 43.5 µg/m^3. The $PM_{2.5}$, NOx, SO_2, and NH_3, values were in the range of 44.7 µg/m^3 to 21.7 µg/m^3, 32.5 µg/m^3.to 15.7 µg/m^3, 7.5 to 6.2 µg/m^3 and 12.3 to 10.2 µg/m^3 respectively and well within the National Ambient Air Quality Standards (NAAQS). Other parameters such as lead, CO, Benzene, VOC, HC, Ni, As and [Ba(p)] were observed to be below their detectable limits.

Ambient Noise Levels - Noise levels were monitored at 8 locations within the study area. The locations for the noise levels are selected on the basis of locations of sensitive receptors such as health centre, educational centres, market place etc. The day time noise levels and night time noise levels were found to be higher than the prescribed standards of 55 and 45 dB respectively during day and night time for rural areas.

Soil Quality -Soil samples were collected from 8 locations. The soil in general indicates saline to slightly acidic properties in the study area. Soil texture at all locations was observed to be clay to clay loam. pH of the soil samples ranged from 5.04 to 6.49. The concentrations of heavy metals namely cadmium, mercury, antimony was observed to below detectable limit. The values for Zinc, Lead, Cadmium, Copper, Nickel were found to be much below soil remediation intervention values.

Ecology– An Ecology and Biodiversity study of Block AA-ONHP-2017/5, located in Lakhimpur, Jorhat and Sivasagar district of Assam was conducted for assessment of biological diversity of the area and probable impacts on it due to development of exploratory as well as appraisal well. The study was carried out in pre-monsoon season during month of May, 2019. The study area is dominated by terrestrial vegetation consisting of, scrubland, agricultural fields and plantation of bamboo and sassi. Aquatic habitats in the area include riverine ecosystem, wetland, small lakes and ponds. Total 40 species of trees, 35 species of shrubs, 53 species of herbs, 5 species of climbers, 2 species of grass and 11 species of aquatic plants were recorded in the study area. Among trees *Mangifera indica, Bambusa species* and *Streblus asper* are the dominant species observed in the study area. Shrub species such as *Eupatorium odoratum, Maesa indica* and *Clerodendrum viscosum* were found to be dominant. Also,

dominant herb species such as *Ageratum conyzoid, Eichhornia crassipes and Boerhavia diffusa*. Simpson's and Shannon's index indicates medium to high biodiversity. The floral diversity was found to be medium to high as Shannon's index value varied from 2.028-2.722, whereas Simpson's index value varied from 0.8294- 0.9632.

Socio- Economic Conditions- A total number of 112 villages are coming under core zone area, where the proposed wells are located. According to Census 2011, As per census 2011, the sex ratio of the villages was found to be 940 whereas that of Jorhat and Lakimpur district is 956 and 968 respectively. The sex ratio of the villages in the block is less than the sex ratio of Assam, i.e, 958. As per Census 2011, 4 villages has more than 99 percent ST population whereas ST population is not present in 65 study area villages.

Impact Assessment and Mitigation Measures

Site Selection & Land Procurement –

Impact

An area of approximately 300m X 300m would be taken on temporary short-term lease basis for the construction of well pad (drill site) for exploratory and appraisal wells and the Quick Production unit/ Early Production unit. For the preparation of suitable access roads connecting to well pads, accommodating OHL and other utilities in future, a width of 30m (approx.) RoU would be required. The drill sites are planned to be located in agricultural land. Their procurement for project purposes would result in loss of landowner's income for the lease period. The procurement of land on lease can lead to moderate impact mainly due to expectations on compensation package.

Mitigation Measures

- During the construction of the access road adequate cross drainage structures to be provided considering the topography of the alignment.
- Levelling and grading operations would be undertaken with minimal disturbance to the existing contour, thereby maintaining the general slope of site;
- Consultations to be carried out with land owners for finalizing compensation packages;
- Compensation for standing crops to be considered.
  The excavated material from the drill site should be stored (temporarily /permanently) in uncultivated land and should be away from any drainage channel.

Site Clearance and Grading

Impact

The site preparation works at campsite and drill site may result in clearance of vegetation, dust generation and loss of topsoil. The earthworks to be carried would typically involve excavation, levelling / grading; and rolling and compaction.

Mitigation Measures

- Water sprinkling to be carried out, while working in proximity of agricultural fields or settlements/habitations;
- Runoff from drill sites located near ponds
- If any tree felling is involved, permission from the concern department to be undertaken.

Construction/ site preparation of Drill Site/ Well pad

Impact

Construction of cellar pit, water storage pit and drilling waste storage pits would result in excavation of soil from each site. Noise from construction activity would be generated from bull dozer, DG sets and concrete-mixing plant.

Mitigation Measures

- Temporary storage sheds to be provided for storing of construction material such as cement;
- Excavated soil to be used for construction at other project sites;
- Detailed Health & Safety Plan to be provided to all civil contractors, as part of their contract with Vedanta Limited (Division: Cairn Oil & Gas).

Campsite Installation

Impact

The campsites would be located in the vicinity of the drill site. A typical campsite would require portable cabins to accommodate about drilling crew and the contractor personnel. Installation of porta-cabins with associated facilities would involve Health and Safety issues pertaining to transportation, loading - unloading of cabins and installation of cabins.

Mitigation Measures

- Crane to be is equipped with a legible, durable load chart that shows the manufacturer's recommended load configurations and maximum load weights; and
- Surface conditions to be examined prior to movement of crane.

Transportation of Drilling Rig and Other Components –

Impact

Transportation of drilling rig, drilling equipment, materials and manpower would involve movement of about trailer loads spread over days use the existing roads till they reach the access road for each well site. The potential impacts may include congestion of roads, wear and tear of existing roads and oil leaks from vehicle maintenance areas.

Mitigation Measures

- Movement of rig & associated machinery to be avoided to the extent possible during peak traffic hours
- All vehicles (light, medium and heavy) to be required to have valid PUC (Pollution under Check) certificate.
- Periodic maintenance of all project vehicles and machinery to be carried out.

Drilling and Well Testing

Impact

During drilling operation Water for WBM preparation would be 600 to 1000 m^3/Well, for SBM preparation would be 150 to 300 m^3/Well, for drilling water consumption would be 25-50 m^3/day/well and water for domestic use would be 20-30 m^3/day/well.

Mitigation Measures

Water requirement for all the project activities would be sourced locally through approved/ authorized sources of surface water and/ or ground water (e.g. PHD bore wells, privately owned bore wells, Irrigation Dept./ Water Resources Dept. of State Govt.). In case, required water could not be sourced from locally available approved sources, ground water would be extracted after obtaining permission from CGWA/ State Govt.

Handling, transport and storage of Chemicals and wastes

Impact

The drilling operations would involve generation of spent drilling mud, drill cuttings, waste oil, used containers, etc. The drill site would also involve storage of hazardous chemicals and fuels which has the potential to contaminate soil and groundwater.

Mitigation Measures

- Separate drill cutting disposal pits to be provided for WBM and SBM
- Drill pits to be provided with HDPE lining on bottom and side surfaces
- The drill cuttings from the drilling operations associated with water-based mud would be used for filling low lying areas as a sub grade construction material in construction of well pads, etc. Synthetic base mud would be re-used.
- Used hazardous chemical barrels and waste oil to be sent to SPCB authorized vendors
- Fuel tanks to be provided with secondary containment facilities and maintained as per statutory requirements.
- All mixing tanks and chemical storage area to be paved and provided with secondary containment.

Air emissions

Impact

The drilling activities would lead to emissions from operation of diesel generator sets and flaring during well testing. Fugitive dust emissions due to the proposed project would be principally associated with emissions of dust during the site preparation. The dust generated would be primarily from the handling and transportation of fill material and re-entrainment of dust during movement of the vehicles on unpaved roads

Mitigation Measures

- DG set emissions shall be as per CPCB standards
- In case of ground flaring to minimize the effects of flaring, the flare pit would be designed as per the CPCB/MoEFCC guidelines, to reduce the radiation and glaring effects in the adjoining areas.
- In case of elevated flaring system: Elevated flare system would be adopted, with adequate height;
- Location of the flare stack would be decided at the design stage taking into consideration nearest habitations, vegetation, public amenities or any sensitive locations
- Efforts would be made to avoid flaring of crude and crude oil would be effectively separated at the drill site and stored in barrels/tankers for transportation to the nearest terminal for management; and
- No cold venting would be resorted instead flaring would be done with combustion efficient elevated flare tip; and
- Location of flare stacks would be chosen considering the sensitive receptors adjoining the site

Noise Generation

Impact

The noise generation sources would include DG sets, pumps for rig and other miscellaneous equipment's.

Mitigation Measures

- Installation of adequate engineering control on equipment and machinery (like mufflers & noise enclosures for DG sets and mud pumps) to reduce noise levels at source, carrying out proper maintenance and subjecting them to rigid noise control procedures.
- The DG set would be kept in an acoustic enclosure.
- Periodical monitoring of noise level within 500 mts buffer area around well pad.
- Providing Personnel Protective Equipment (PPEs) like ear plugs/muffs to workers at site.
- Undertaking periodic maintenance of vehicles to reduce noise levels

Surface water quality

Impact

Site clearance and stripping of top soil during site construction would result in an increase in soil erosion potential leading to an increased sediment load in the surface run-off during monsoon. Also, surface run off from drilling waste (cuttings and drilling mud), hazardous waste (waste oil, used oil etc) and chemical storage areas may lead to the pollution of receiving water bodies viz. natural drainage channels etc.

Mitigation Measures

- Proper treatment of all wastewater and produced water and any water discharge from well site should comply with CPCB Water Discharge Standards for Oil and Gas Industries
- Waste mud to be stored in the HDPE lined pit
- Drainage and sediment control systems at the well site would be efficiently designed
- All chemical and fuel storage areas, process areas would have proper bunds so that contaminated run-off cannot escape into the storm-water drainage system.

Ground water

Impact

In absence of supply of surface water resource, the potential impacts on groundwater resource would be due to ground water abstracted for domestic needs and for civil construction activities.

Mitigation Measures

• All water storages in the drill sites would be kept covered and leakage prevented;

Soil Quality

Impact

During the site preparation stripping of soil would be happened during the construction phase. Site preparatory activities would involve the sourcing of earth-fill from borrow areas. Since in most of the cases efforts would be made to procure the fill material from nearby existing borrow areas. Storage of drill cuttings associated with WBM, spent drilling mud and sludge containing oil and other waste are likely to be generated, would be stored at HDPE lined pit. Fuels, lubricants and chemical used for the drilling operations (especially daily consumption) would be stored at site.

Mitigation Measures

- The top soil would be stored properly
- Manage spills of contaminants on soil using spill kits;
- Storage of MSW in designated areas within drill sites/production facilities;
- Adopt best practices e.g. use pumps and dispensing nozzle for transfer of fuel, use drip trays etc.

Road and Traffic

Impact

During various phases of projects like construction, drilling, early production and decommissioning various types of vehicle / equipment movement would be involved. The vehicular movement is expected to be more in construction phase due to movement of machinery & manpower.

Mitigation Measures

- Speed limits would be maintained by vehicles involved in transportation of raw material and drilling rig.

- Regular supervision would be done to control vehicular traffic movement along defined traffic routes.
- Entry of vehicles into the drilling site area is prohibited except for material movement.
- Adequate parking would be provided outside the drilling location.

Terrestrial Ecological environment

Impact

The Potential Impacts on the existing floral and faunal diversity may arise due to following activities

1. Vegetation Clearance.
2. Illimitation from Site.
3. Generation of Noise

Mitigation Measures

- The working area would always be kept minimum.
- For felling of trees prior approval from concern Department shall be obtained;
- Appropriate shading of lights to prevent unwanted scattering.
- Plantation of Local tree plantation should be undertaken;
- Fencing would be done on the camp site to avoid any unfortunate encounter with faunal species.

Socio economic environment

Impact

Road infrastructure could be damaged due to heavy traffic movement. Influx of population is anticipated in all stages of the project cycle particularly during exploratory drilling. The drill site would involve the operation of about 50 onsite workers during drilling phase. Interaction between workers with villagers of nearby areas might give rise to various issues like conflict of workers with the local population, nuisance caused by workers due to improper sanitation facilities, etc.

Mitigation

- The shortest distance as far as available / feasible would be considered for access road.
- The village road identified for accessing proposed project footprints, would be strengthened and widened as per requirement.
- Appropriate awareness program on grievance redressal mechanism, would be designed and implemented for local community around proposed project footprints;
- Concerns of local panchayat regarding any impact on their common property resources (like of use of village road, water resource etc.) due to project activities, would be proactively identified and addressed;

Occupational Health & Safety Risks

Impact

The health and safety risks associated with drilling operations may include well kick or blow out, crane failure, fire Hazards and radiation hazard from well logging tool handling and storage.

Mitigation Measures

- Blowout preventers to be provided;
- Flare pit to be placed at a safe distance from the well head and fuel storage areas;
- Fire-fighting measures to be provided.

Operation of Campsites

Impact

It is anticipated that, at any given time, there would be about 80 - 100 personnel working on site including technical staff, drilling crew, security staff etc. who would be accommodated at each campsite associated with drilling. Water for domestic use would be 20-30 m^3/day/well. Each campsite is anticipated to generate 25-30 kg/day/well of domestic waste. Inadequate disposal and handling of waste would pollute the surroundings.

Mitigation Measures

- Safe drinking water to be made.
- Segregation of waste at the source of generation to be put in practice.
- Food waste to be collected and disposed appropriately
- The sewage from each porta-cabin to be connected to a mobile STP.

Demobilization and Abandonment

Impact

If hydrocarbons are not found, a full abandonment plan would be implemented. The impacts from decommissioning of drill sites may include noise generation and soil contamination due to demolition of cutting pits and chemical storage areas.

Mitigation Measures

- All the wastes to be completely removed from the site and sent to designated authorized disposal facilities prior to commencement of demolition work.
- Prior to commencement of any demolition, a planned programme of site clearance would be formulated. All pits, cellars and holes would be removed, and filled to ground level, any oil or otherwise contaminated soil would be removed and disposed properly.
- Roads and other paving would be removed to sufficient depth to allow soil replacement and revegetation.
- If any soil contamination is found, measures to be taken to remove or treat the contaminated soil.

Environment Management and Monitoring Plan

A comprehensive environmental monitoring plan has been developed for the project. Monitoring of ambient air quality, noise levels, soil and groundwater quality to be carried out by MoEF&CC/NABL/Assam SPCB recognized laboratories for pre and post drilling operations to assess the effectiveness of the environment management plan and adopt appropriate corrective measures if it found that those are not functioning properly.

HSE Organization Structure

Vedanta Limited (Division Cairn Oil & gas) has an existing established Health, Safety and Environment (HSE) management system for its operations. The HSE structure comprises of a corporate HSE team based in Gurgaon office and an on-site team.

Vedanta Limited (Division: Cairn Oil and Gas) shall ensure that the contractual documentation emphasizes on the need to comply with all legal requirements and Environment Management and Monitoring Plan (EMMP). Vedanta Limited (Division: Cairn Oil and Gas) shall either directly or through its contractors, to arrange for periodic trainings of the project crew on legal requirements and EMMP. Vedanta Limited (Division: Cairn Oil and Gas) shall undertake regular inspections of the drill and camp sites and document them to ensure compliance to legal requirements and the EMMP.

Proposed CER (Corporate Environmental Responsibilities) Strategy

As per MoEF&CC office memorandum number F. No 22-65/2017-IA-III dated 1st May, 2018, Corporate Environmental Responsibility requirement would be fulfilled as per the prescribed rate.