Draft EIA Report for Proposed Onshore Oil and Gas Exploration and Appraisal in AA-ONHP-2017/1 Block, Karbi Anglong and Golaghat Districts of Assam & Wokha district of Nagaland District,

Vedanta Limited. (Division Cairn Oil & Gas)

September 2019

Quality information

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Revision History

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01	03.09.2019	Draft EIA Report for Proposed Onshore Oil and Gas Exploration and Appraisal in AA-ONHP-2017/1 Block, Karbi Anglong and Golaghat districts of Assam & Wokha district of Nagaland District		Chetan Zaveri	Executive Director
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Distribution List

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Executive Summary

Introduction

Vedanta Ltd. (Division Cairn Oil & Gas) has been allocated hydro-carbon Block namely AA-ONHP-2017/1 by Government of India under the Revenue Sharing Contract (RSC) for exploration and exploitation of hydrocarbon. A Revenue Sharing Contract (RSC) was signed between the Government of India (GoI) and Vedanta Ltd on 1st October 2018. Vedanta Limited (Division- Cairn Oil and Gas) is currently contributing to more than 20 per cent of India's current crude oil production. Block encloses an area of 715 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 vide letter File No.IA-J-11011/95/2019-IA-II(I) dated 20th April, 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-2017/1. 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-2017/1 block is located in Karbi Anglong and Golaghat districts of Assam & Wokha district of Nagaland. Total area of AA-ONHP-2017/1 block is 715 sq. km. The nearest cities from the block are Dimapur (3 km-in SW direction). National Highways 39 (Within Block) connects the block to other cities like Jorhat and Bokajan.

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. Total 38648 ha, forest area is located within the AA-ONHP-2017/1 block however none of the proposed well location is located within forest land;

Description of the project

The project includes proposed drilling of 20 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 12000 BOPD crude oil and up to 2.4 MMSCFD associated natural gas in AA-ONHP-2017/1 Block located in Karbi Anglong and Golaghat districts of Assam& Wokha district of Nagaland. Block Location on SOI Toposheet is presented below.

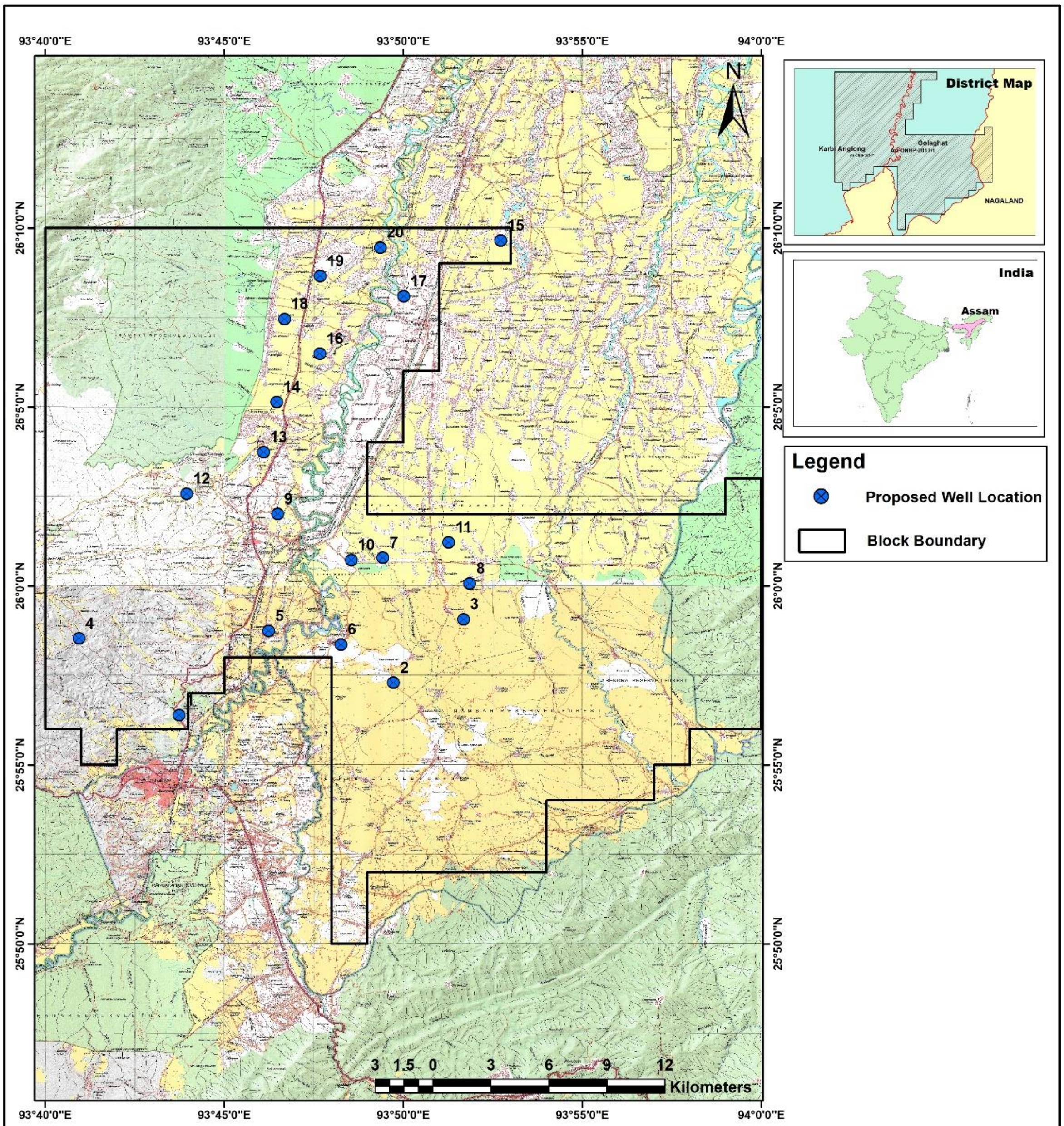


FIGURE NO. 2.2	Project name: EIA Study for Oil and Gas exploration in Block AA-ONHP-20171, Assam.				Title: Map Showing Block Boundary and Well Location on Toposheets
Date: 02/08/2019	Drawn By: Moumita Dey	Checked By: Souvik Basu	Approved By: Avijit Sarkar	Client Name: Vedanta Limited (Cairn Oil and Gas)	Source: Google Earth,Toposheet No:G46J/12 G46J/16, G46P/9, G46P/13(Survey of India)and Esri India.

AECOM

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 earmarked. Site leveling, and excavation works would be carried out for site preparation. Individual sites would be duly fenced to a height of about 2 m using jingled wired fencing or Expm fencing. 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 equipments are 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.

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 12000 BOPD crude oil and up to 2.4 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 m3/day water would be used for mud preparations, 50 m3/day would be required for drilling activities and 30 m3/day freshwater would be used for domestic purposes including drinking, washings and domestic use. 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.

During early production, the installation of typical EPU/QPU unit water requirement for process, domestic consumption, greenbelt and miscellaneous use would be15-18 m^3/day.

Power – For a drill 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 and Radio Room -2x100 KVA (including one as standby).

For each early production unit power requirement would 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 would be used as backup in emergency conditions

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 584 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.
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.
Drill cuttings & spent mud: Approximately 500-1500 Tons/well of drill cuttings from WBM, 250-500 Tons/well of drill cuttings from SBM 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 South Assam Shelf is a part of Assam & Assam-Arakan basin and situated in the Dhansiri valley separated from North Assam shelf by a major E-W trending Jorhat fault. The area represents a part of foreland basin flanked by NE-SW trending Naga Schuppen belt on the East & Southeast and Mikir Massif in the West. The area is sparsely exhibiting intra-cratonic graben filling sediments from Permian age to basaltic flows of Early Cretaceous age. The extensive Late Cretaceous-Oligocene sequence deposited in Passive margin setting witnessed differential erosion at places and overlain by a thick pile of Miocene to Recent sediments deposited in a foreland setting.
Drainage - The River Brahmaputra flowing in east-west direction in the extreme northern parts of the district and its tributaries flowing in northerly direction, control the entire drainage system of the district and plays an important role in the ground water occurrence and control of the district. Important Rivers of the district are Dhansiri and Dayang. These rivers have meandering courses with abandoned channels in the form of bils and ox-bow lakes along their courses

Hydrogeology– The entire Karbi Anglong district can be divided into Consolidated formations comprising oldest granite rock, gneisses etc, semi-consolidated rocks constituting the Tertiary rocks and unconsolidated alluvial sediments. In the consolidated formation, ground water is confined to the top weathered zone and the fractures and fissures of the fresh hard rock.
The Golaghat district is underlain by Quaternary formation followed by Archaean group of rocks. The cumulative thickness of aquifer zones has the tendency to increase towards the north and in the south eastern parts, the thickness reverses considerably. Hydro-geologically, the district is proved to be very potential. Ground water occurs under water table to confined conditions.
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 7.05to 8.44. Turbidity of all the samples varied from 3.1 to 18.0 NTU. The TDS in the water samples varied from 42 mg/l to 318 mg/l. The total alkalinity of the samples varied from 16.0 to 280 mg/l which falls within their corresponding permissible limit of 600 mg/l. Total hardness of the samples varied from 20 to 130 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_2017/1 is located in Lumding city which is located approximately 54 km in south west direction of the block. As per the data, temperature reaches around 42.0oC 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 2.2oC. 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 79.36 µg/m^3 to 84.59 µg/m^3. The monitoring location at AAQ 3, observed the maximum concentration of PM_{10} i.e 84.59 µg/m^3, whereas minimum PM_{10} concentration was observed at AAQ 7, i.e 79.36 µg/m^3. The $PM_{2.5}$, NO_x, SO_2, and NH_3, values were in the range of 41.71 µg/m^3 to 49.73 µg/m^3, 35.52 µg/m3.to 29.45 µg/m3, 8.4 to 7.4 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 alkaline properties in the study area. Soil texture at all locations was observed to be sandy. pH of the soil samples ranged from 4.48 to 8.32. 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-2017/01, located in Karbi Anglong and Golaghat 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. Total 7 transects, 16 quadrats, 5 PBZ locations and 5 primary productivity sampling locations were selected within the block based on topography, land use, habitat and vegetation pattern. For assessment of floral species, quadrats of size 10m x 10m for trees, 5m x 5m for shrubs and 1m x 1m for herbs were plotted and qualitative and quantitative analysis of the same was carried out. Faunal species were assessed by transect method by traversing a known distance and noting observed faunal species along the length. The different habitats observed were forest, wetlands, agricultural fields, tea estates. The floral diversity was high, 45 trees, 15 shrubs, 33 herbs, 14 climbers and 6 aquatic plant. Simpson's and Shannon's index indicate medium to high biodiversity – with respect to the flora. The Shannon's index value varied 2.044 – 3.265, whereas Simpson's index value varied from 0.8273- 0.9619. Among trees, *Tectona grandis*, *Streblus asper, Sterculia viollosa* and *Pongamia pinnata* were found to be the dominant tree species. The phytoplankton diversity of the region is rich; the Shannon's index value ranged from 0.78 -0.954, Simpson's index value ranged from 1.75 - 2.71. Elephant corridors falls within the study area. Primary productivity in the study area varied from 14.687 to 23.4375 gC.m3.hr-1.

Socio- Economic Conditions- A total number of 27 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 964 whereas that of Golaghat and Karbi Anglong district is 964 and 951 respectively. The sex ratio of the villages in the block is more than the sex ratio of Assam, i.e, 958. As per Census 2011, 41 villages had more than 80% ST population, among which 13 had 100% ST population. In contrast, only one village (Samukjan) had more than 80% SC population.

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.
- Consultations to be carried out with land owners for finalizing compensation packages;
- 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 of Drill Site

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 through the use of 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 30-50 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., after testing for hazardous characteristics and analysis. Synthetic base mud would be re-used in further drilling activities.
- 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 shall be made of RCC surrounded by a permanent wall of minimum 5m height (with refractory bricks), to reduce the radiation and glaring effects in the adjoining areas.
- In case of elevated flaring system: this would be designed with proper enclosure height;
- Location of the flare stack to be decided at the design stage taking into consideration nearest habitations, vegetation, public amenities or any sensitive locations
- Flaring of crude oil to be avoided, and crude oil to be effectively separated at the drill site and stored in barrels/tankers for transportation to the nearest terminal for management; and
- No cold venting of natural gas would be resorted instead flaring would be done with combustion efficient elevated flare tip; and
- Location of flare stacks to 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.
- 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 Inland 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.
- Any remaining topsoil that has been stocked during the site clearance would be re-spread over appropriate portions of the site.

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.

1. Introduction

India is largely dependent on import of petroleum goods to meet its requirements and imports about 80% of crude oil demand every year. For the last 3 years including the last financial year of 2018-19, the production figures of crude oil in India is hovering about 35 MTs against a total demand of 212 MTs in the last year. In addition, the demand of petroleum products is poised to grow at an annual average rate of 4.8% till year 2022 (13th 5-year plan).

To enhance indigenous production of oil, Government of India has targeted reducing the country's dependency on import by 10% by the year 2022. As a lead-up to this intent Government of India has awarded Block AA-ONHP-2017/01 in Assam to Vedanta Limited (Division: Cairn Oil & Gas) for exploration of hydrocarbons.

1.1 Background

Revenue Sharing Contract (RSC) for Block AA-ONHP-2017/01 has been signed between Vedanta Limited and MoP&NG, Govt of India on 1st October 2018 for the exploration of hydrocarbons resources. Vedanta Limited (Division Cairn Oil & Gas) proposes to carry out exploration including exploratory and appraisal well drilling and early production of oil and gas in the above mention Block. In case of any discovery, the exploratory and appraisal well(s) would be tested for extended duration by flowing hydrocarbons to ascertain the reservoir parameters, assess the quality and commercial viability for early production.

Vedanta Limited (Division: Cairn Oil & Gas) process to carry out drilling of 20 onshore exploratory and appraisal wells and setting up of early/quick production facility in AA-ONHP-2017/01.

1.2 Objective of the EIA Study

The exploration/development of oil and gas is included under activities specified in Schedule (Activity 1b) of the EIA Notification dated 14th September 2006 and subsequent amendments categorized as "A" category project that requires an Environmental Clearance (EC) from the Ministry of Environment, Forests and Climate Change (MoEF&CC).

AECOM India Pvt Ltd., a NABET-QCI accredited firm has been entrusted with the task of conducting an EIA study and technically assisting Vedanta Limited (Division Cairn Oil & Gas) for obtaining environmental clearance from the MoEF&CC.

The main objectives of the EIA study are as follows:

- Establish the prevailing baseline environmental and socio-economic condition of the AA-ONHP-2017/1 Block and its surroundings along with the compliance needs for environmental approvals to carry out hydrocarbon exploration.
- Assessing environmental and socioeconomic impacts arising out of the proposed drilling activities;
- Recommend appropriate preventive and mitigation measures to eliminate or minimize pollution, environmental & social disturbances during the life-cycle of the project, ensuring compliance with environmental laws and regulations applicable;
- Identifying and proposing alternative actions in terms of technology and practices that may help in abating environmental or socio-economic impacts due to the project;

Integrating mitigative measures with environmental action plans and management systems so that it can be implemented, monitored and suitable corrective action can be taken in case of deviations;

1.3 Project Status

Vedanta Limited (Division Cairn Oil & Gas) had submitted Form-1 of the EIA Notification, along with a draft Terms of Reference (ToR) for scoping to MoEF& CC. MoEF&CC has issued an approved ToR vide file No. IA-J-11011/95/2019-IA-II(I) dated 20th April 2019. The approved ToR is attached as Appendix 1.1.

The baseline monitoring and all primary data collection was conducted for the summer season (March to May) of 2019, as per the requirements of the ToR. Draft EIA report has been prepared for public hearing.

1.4 Brief Details of The Project

AA-ONHP-2017/1 Block is located in Karbi Anglong and Golaghat districts of Assam & Wokha district of Nagaland. Total area of Block is 715 sq. km. Presently Cairn Oil and Gas proposed to carryout drilling of 20 exploratory and appraisal wells with in the Block. Apart from that setting up of Early Production Units (EPUs)/ Quick Production Units (QPUs) for produced well fluid processing and production of up to 12000 BOPD crude oil and associated natural gas 2.4 MMSCFD has also been planned. Total estimated cost of the project is Rs. 584.0 Cr.

1.5 Scope of The Study

The scope of the EIA study considers the impact due to drilling of 20 onshore exploratory and appraisal wells and early/ quick production unit in AA-ONHP-2017/1 on physical, biological and socioeconomic environment of the surrounding areas in compliance to the approved ToR provide by MoEFCC. The scope of the EIA study includes the following:

- To establish the prevailing environmental and socio-economic condition of the study area;
- To assess environmental and socioeconomic impacts arising out of the proposed activities;
- To recommend appropriate preventive and mitigation measures to eliminate or minimize pollution;
- To identify and propose management plans in terms of good practices that may help in abating environmental or socio-economic impacts due to the project.
- To prepare a Disaster Management Plan (DMP) based on Risk Assessment/ studies;

Environmental baseline monitoring has been carried out during March to May 2019 representing summer season and used to identify potential significant impacts.

1.6 Structure of the EIA Report

The overall contents of the EIA report has been prepared as per the generic structure prescribed in the Appendix III of EIA Notification issued by MoEF&CC, Govt. of India on 14th September 2006 and subsequent amendments. The report consists of executive summary followed by eleven chapters, the content of which is briefly described in Table 1.1.

Table 1.1 Content of EIA Report

Sl. No.	Section	Brief Description
	Executive Summary	Executive Summary of EIA report.
1.	Introduction	This section covers project background; scope of the work and overview of the project.
2.	Project Description	Presents a Description of the Existing and proposed project.
3.	Environmental Baseline Study	Baseline Environment Status: The methodology for assessing various baseline environmental components in the study area has been identified in this chapter. The various parameters of present environmental status are identified under different aspects, which include location and regional setting of the area, physical aspects such as land use, land cover and soil quality. Hydrological aspect consists of area drainage, surface water and ground water quality. Meteorological aspect contains all the climatic factors and ambient air quality existing in the study area. Ecological environment describes the flora and fauna of the region. Human aspect includes the demographical features, socio-economic environment and infrastructure facilities of the study area.

Sl. No.	Section	Brief Description
4.	Impact Assessment and Mitigation Measures	Includes impact identification through scoping, assessment of impact, mitigation measures and evaluation of significance of residual impacts.
5.	Alternative Analysis	This section includes alternatives analysis with respect to site and technology
6.	Environmental Monitoring Program	The environmental monitoring would be scheduled during construction and operation phase is provided
7.	Additional studies	A summary of the additional studies/activities conducted as per the requirements of the ToR is given in this chapter. The additional studies conducted are Risk Assessment and Disaster Management Plan. On-site disaster management describing the on-site and off-site emergencies commands and controls have also described in this chapter. Stakeholder assessment as per primary consultation and Public hearing related issues have been also covered in this chapter.
8.	Project Benefits	The benefits that would be accrued from the project in the locality in particular and society in general as well as development would be identified and described in this chapter.
9.	Environmental Management Plan	This section covers introduction and elements of EMP i.e. planning, implementation, checking and management review.
10.	Summary and Conclusion	Presents the overall findings of the EIA study and includes overall justification for implementation of the project and provides explanation of how, adverse effects have been mitigated.
11.	Disclosure of Consultants	Provides brief information about AECOM and professionals who were engaged for completion of this study.

Source: EIA Notification 2006

1.7 Compliance to TOR

An Environment Impact Assessment (EIA) study has been undertaken for the proposed drilling of Exploration and Appraisal (20 Wells) in AA-ONHP-2017/1 Block, Karbi Analog and Golaghat District of Assam and Wokha district of Nagaland. The EIA study has been undertaken in accordance with the Standard ToR issued by MoEF&CC vide File No.IA-J-11011/95/2019-IA-II(I) dated 20th April, 2019.The point wise compliance to ToR is provided in Table 1.2.

Table 1.2 ToR Compliance

Sl. No	Condition	Reference Section
1.	Executive summary of the project	Refer to Executive Summary
2.	Project description, project objectives and project benefits	Refer to Chapter 2, section 2.1 and 2.2-Objectives And Benefits Of Proposed Exploratory, Development And Testing Activities, section 2.3 and 2.4-Well Locations And Environmental Settings, section 2.10- Project Activities And Schedule
3.	Cost of project and period of completion	Refer to Chapter 2, section 2.10- Project Cost and section 2.10 - Project Activities and Schedule
4.	Site details within 1 km of the each proposed well, any habitation, any other installation/activity, flora and fauna, approachability to site, other activities including agriculture/land, satellite imagery for 10 km area.	Refer to Chapter 2, section 2.3 and 2.4-Well Locations and Environmental Settings Refer to Chapter 3, section 3.8-land use/land cover
5.	All the geological details would be mentioned in the Topo sheet of 1:40000	Refer to Chapter 2, Section 2.1 -Block Location & Description

Sl. No	Condition	Reference Section
	scale, superimposing the well locations and other structures of the projects.	
6.	Topography of the project site.	Refer to Chapter 3, section 3.5-Topography
7.	Details of sensitive areas such as National Park, Wildlife sanctuary and any other eco-sensitive area along with map indicating distance	Refer chapter 3, section 3.14-Ecological Environment
8.	Approval for the forest land from the State/Central Govt. under Forest (Conservation) Act, 1980, if applicable.	Forest proposal will be submitted
9.	Recommendation of SCZMA/CRZ clearance as per CRZ Notification dated 6th January, 2011 (if applicable).	Not applicable
10.	Distance from nearby critically/severely polluted area as per Notification, if applicable. Status of moratorium imposed on the area.	Not Applicable
11.	Does proposal involve rehabilitation and resettlement? If yes, details thereof.	No rehabilitation and resettlement would be required as such.
12.	Environmental considerations in the selection of the drilling locations for which environmental clearance is being sought. Present any analysis suggested for minimizing the foot print giving details of drilling and development options considered.	Refer Chapter 5- Analysis of Alternatives
13.	Baseline data collection for air, water and soil for one season leaving the monsoon season in an area of 10 km radius with centre of Oil Field as its centre covering the area of all proposed drilling wells.	Refer Chapter 3, section 3.10-Ambient Air Quality, section 3.11 -Water Environment, section 3.12-Soil Quality
14.	Climatology and Meteorology including wind speed, wind direction, temperature rainfall relative humidity, etc.	Refer Chapter 3, Section 3.9-Climate and Rainfall, section 3.9-Meteorology
15.	Details of Ambient Air Quality monitoring at 8 locations for PM2.5, PM10, SO2, NOx, CO, VOCs, Methane and non-methane HC.	Refer Chapter 3, section 3.10-Ambient Air Quality,
16.	Soil sample analysis (physical and chemical properties) at the areas located at 5 locations.	Refer Chapter 3, section 3.11-Soil Quality
17.	Ground and surface water quality in the vicinity of the proposed wells site.	Refer Chapter 3, section 3.11 -Water Environment,
18.	Measurement of Noise levels within 1 km radius of the proposed wells.	Refer Chapter 3, section 3.10-Ambient Noise Quality
19.	Vegetation and land use; flora/fauna in the Block area with details of endangered species, if any.	Refer Chapter 3, section 3.14-Ecological Environment
20.	Incremental GLC as a result of DG set operation, flaring etc.	Refer Chapter 4 Section 4.8 Air Pollution Impact
21.	Potential environmental impact envisaged during various stages of project activities such as site activation, development, operation/ maintenance and decommissioning.	Refer Chapter 4

Sl. No	Condition	Reference Section
22.	Actual source of water and 'Permission' for the drawl of water from the Competent Authority. Detailed water balance, wastewater generation and discharge.	Refer to Chapter 2, section 2.9-Water Requirement
23.	Noise abatement measures and measures to minimize disturbance due to light and visual intrusions	Refer Chapter 4 Section 4.9 Noise Impact
24.	Details on wastewater generation, treatment and utilization /discharge for produced water/ formation water, cooling waters, other wastewaters, etc. during all project phases.	Refer to Chapter 2, section 2.8.3-Wastewater
25.	Details on solid waste management for drill cuttings, drilling mud and oil sludge, produced sand, radio active materials, other hazardous materials, etc. including its disposal options during all project phases.	Refer to Chapter 2, section 2.8.4-Solid and Hazardous Waste Streams
26.	Disposal of spent oil and lube.	Refer to Chapter 2, section 2.8.4-Solid and Hazardous Waste Streams
27.	Storage of chemicals and diesel at site. Hazardous material usage, storage and accounting	Refer to Chapter 2, section 2.9-Utilities & Resource Requirements
28.	Commitment for the use of water based mud (WBM) only	Refer to Chapter 2, section 2.5-Drilling Activity
29.	Oil spill emergency plans for recovery/ reclamation	Refer Chapter 9, Section 9.5
30.	H2S emissions control	Refer Chapter 7, Section 7.3
31.	Produced oil/gas handling, processing and storage/transportation	Refer Chapter 2, Section 2.6
32.	Details of control of air, water and noise pollution during production phase	Not Applicable
33.	Measures to protect ground water and shallow aquifers from contamination	Refer to Chapter 4, Section 4.11
34.	Whether any burn pits being utilised for well test operations	Refer to Chapter 2, section 2.5-Drilling Activity
35.	Risk assessment and disaster management plan for independent reviews of well-designed construction etc. for prevention of blow out. Blowout preventer installation.	Refer to Chapter 7, Section 7.2
36.	Environmental management plan.	Refer to Chapter 9
37.	Total capital and recurring cost for environmental control measures	Refer to Chapter 9, Section 9.14
38.	Emergency preparedness plan.	Refer to Chapter 7, Section 7.3
39.	Decommissioning and restoration plans	Refer to Chapter 2, section 2.8-Well Decommissioning
40.	Documentary proof of membership of common disposal facilities, if any	Not Applicable
41.	Details of environmental and safety related documentation within the company including documentation and proposed occupational health and safety Surveillance Safety Programme for all personnel at site. This would also	Refer to Chapter 6 - Environmental Monitoring Programme

Sl. No	Condition	Reference Section
	include monitoring programme for the environmental	
42.	A copy of Corporate Environment Policy of the company as per the Ministry's O.M. No. J-11013/ 41/2006-IA.II(I) dated 26thApril, 2011 available on the Ministry's website	Refer to Chapter 9, Section 9.15

Source: ToR issued By MOEF&CC

1.8 Limitations

This EIA study is based on certain scientific principles and professional judgment to certain facts with resultant subjective interpretation. Professional judgment expressed herein is based on the available data and information.

This report has been developed based on the project related information provided by Vedanta Limited (Division Cairn Oil & Gas) with the assumption that the information gathered is representative for the proposed drilling of 20 onshore exploratory and appraisal wells and early production in Karbi Anglong and Golaghat districts of Assam & Wokha district of Nagaland. If information to the contrary is discovered, the findings in this EIA may need would be modified accordingly. The impact assessment for the Project is based on the project configuration as described in Section 2 on Project Description.

2. Description of the Project

The proposed project includes drilling of 20 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 12000 BOPD crude oil and up to 2.4 MMSCFD associated natural gas in AA-ONHP-2017/1 Block located in Karbi Anglong and Golaghat districts of Assam& Wokha district of Nagaland.

Vedanta Limited (Division: Cairn Oil & Gas) proposes to carry out drilling of 20 exploratory and appraisal well within Block area for the period of 10-12 years. 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. Moreover, in case of commercially viable discovery (s) of hydrocarbons in the Block and having established the size of the hydrocarbon field (s), field would be immediately brought into early production of crude oil and associated gas using some of the successful exploratory/ appraisal wells by setting up of temporary and mobile Early Production Units (EPUs)/ QPUs (Quick Production Units) for the processing of produced well fluids. Any associated gas would be used for captive power generation.

2.1 Objectives of Proposed Project

Specific objectives of the proposed drilling activities are summarized below:

- To develop and produce hydrocarbons safely
- To augment National Production of oil and gas

2.2 Benefits of the Proposed Project

The project (in case of commercially viable discovery of oil and gas) would ultimately cater to fulfil the energy requirement of India. The dependency of India on other countries would be lessened to an extent. Additionally, the project would benefit people living in neighbouring villages in relation to direct & indirect employment associated with various project activities and would boost the local economy. The benefits of the project are listed below;

- Provision of direct and indirect royalty to Assam Government and more cess to Govt. of India
- Provision of direct and indirect employment opportunity to local people
- Increase in business opportunity for the local people
- Energy security for the country

2.3 Block Location & Description

Location of Block

AA-ONHP-2017/1 block is located in Karbi Anglong and Golaghat districts of Assam & Wokha district of Nagaland. Total area of Block is 715 sq. km. The coordinates of the block are presented in Figure 1.

. The regional setting of the AA- ONHP-2017/1 Block is shown in Figure 2. The geographic location of the Block is included within overlaid on the Survey of India's Topo- Sheet No. G46J/12, G46J/16, G46P/9, G46P/13. The block location map superimposed on Toposheet and satellite imagery is shown in Figure 3 and Figure 4 respectively.

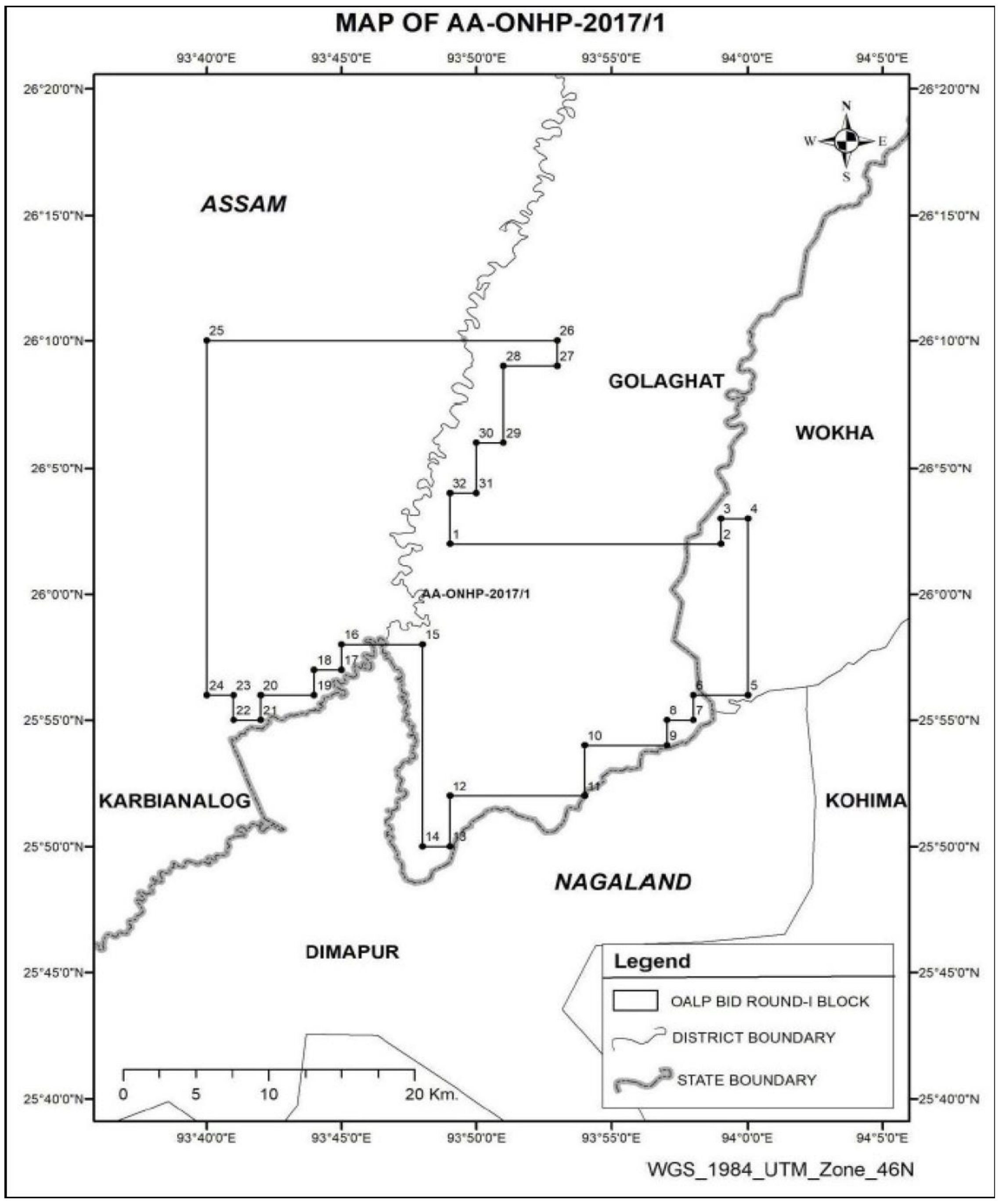


Figure 1. Block Boundary pillar Coordinates of AA-ONHP-2017/1

Boundary /Pillar Points	Longitude (East)	Latitude (North)
1	93°59'	26°2'
2	93°59'	26°2'
3	93°59'	26°3'
4	94°0'	26°3'
5	94°0'	26°56'
6	93°58'	26°56'
7	93°58'	26°55
8	93°57'	26°55'
9	93°57'	26°54'
10	93°54'	25°54'
11	93°54'	25°52'
12	93°49'	25°52'
13	93°49'	25°50'
14	93°48'	25°50'
15	93°48'	25°58'
16	93°45'	25°58'
17	93°45'	25°57'
18	93°44'	25°57'
19	93°44'	25°56'
20	93°42'	25°56'
21	93°42'	25°55'
22	93°41'	25°55'
23	93°41'	25°56'
24	93°40'	25°56'
25	93°40'	26°10'
26	93°53'	26°10'
27	93°53'	26°9'
28	93°51'	26°9'
29	93°51'	26°6'
30	93°50'	26°6'
31	93°50'	26°4'
32	93°49'	26°4'

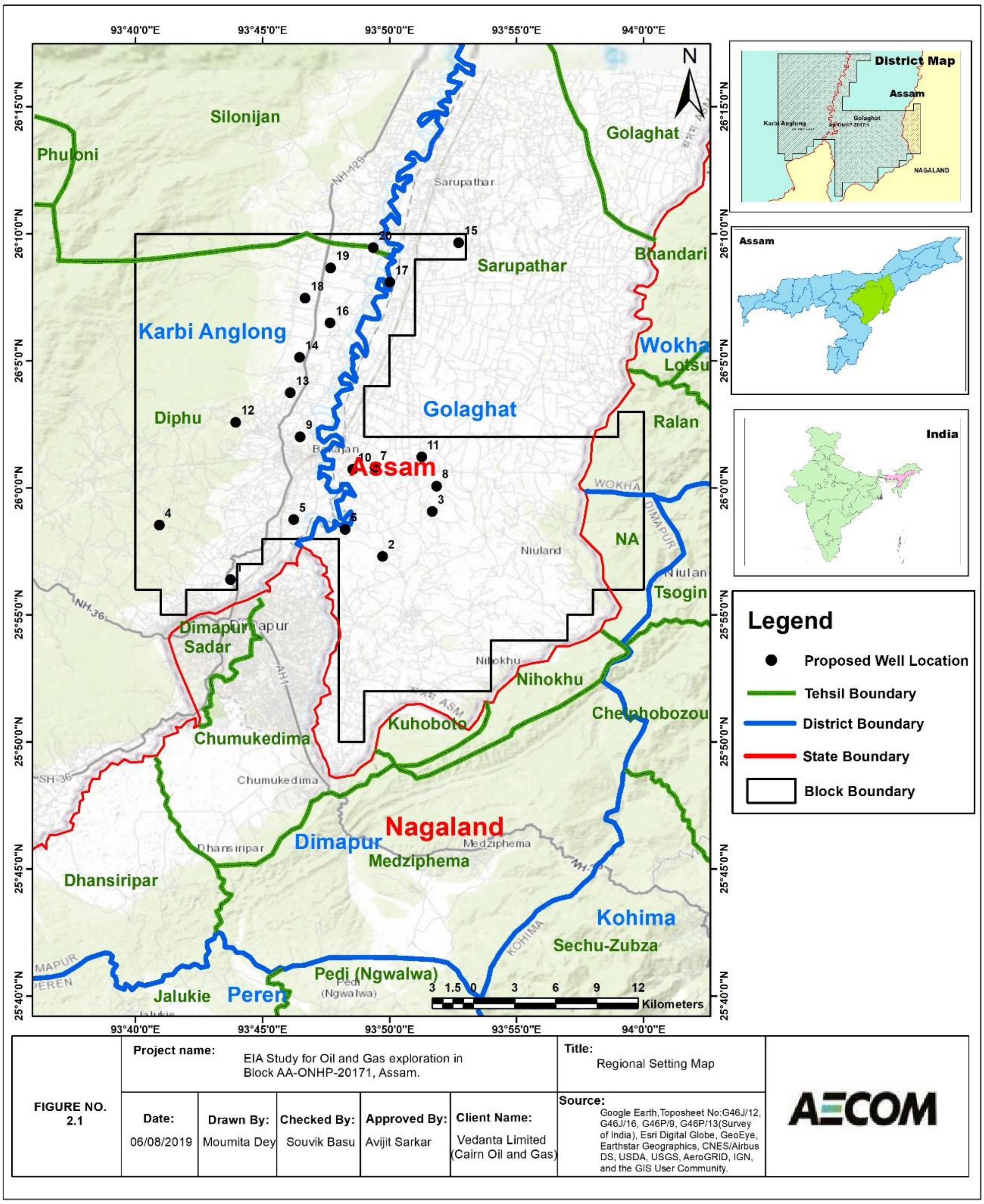


Figure 2. Regional Settings of AA-ONHP-2017/1

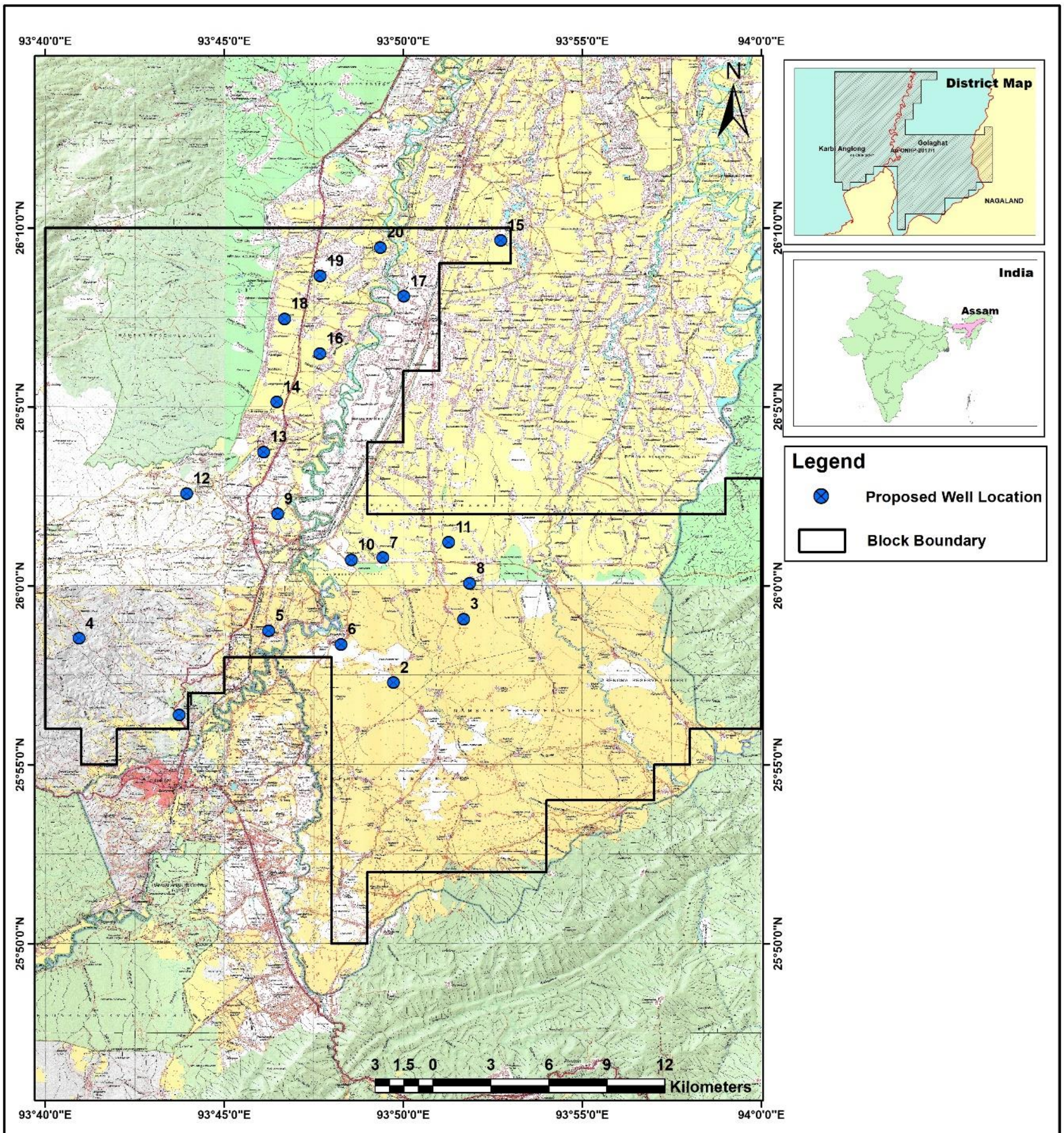


FIGURE NO. 2.2	Project name: EIA Study for Oil and Gas exploration in Block AA-ONHP-20171, Assam.					Title: Map Showing Block Boundary and Well Location on Toposheets	
	Date: 02/08/2019	Drawn By: Moumita Dey	Checked By: Souvik Basu	Approved By: Avijit Sarkar	Client Name: Vedanta Limited (Cairn Oil and Gas)	Source: Google Earth,Toposheet No:G46J/12 G46J/16, G46P/9, G46P/13(Survey of India)and Esri India.	AECOM

Figure 3. Block Boundary of AA-ONHP-2017/1 Block on SOI Toposheet

Figure 4. Block boundary AA-ONHP-2017/1 Block on Satellite Imagery(Google Earth)

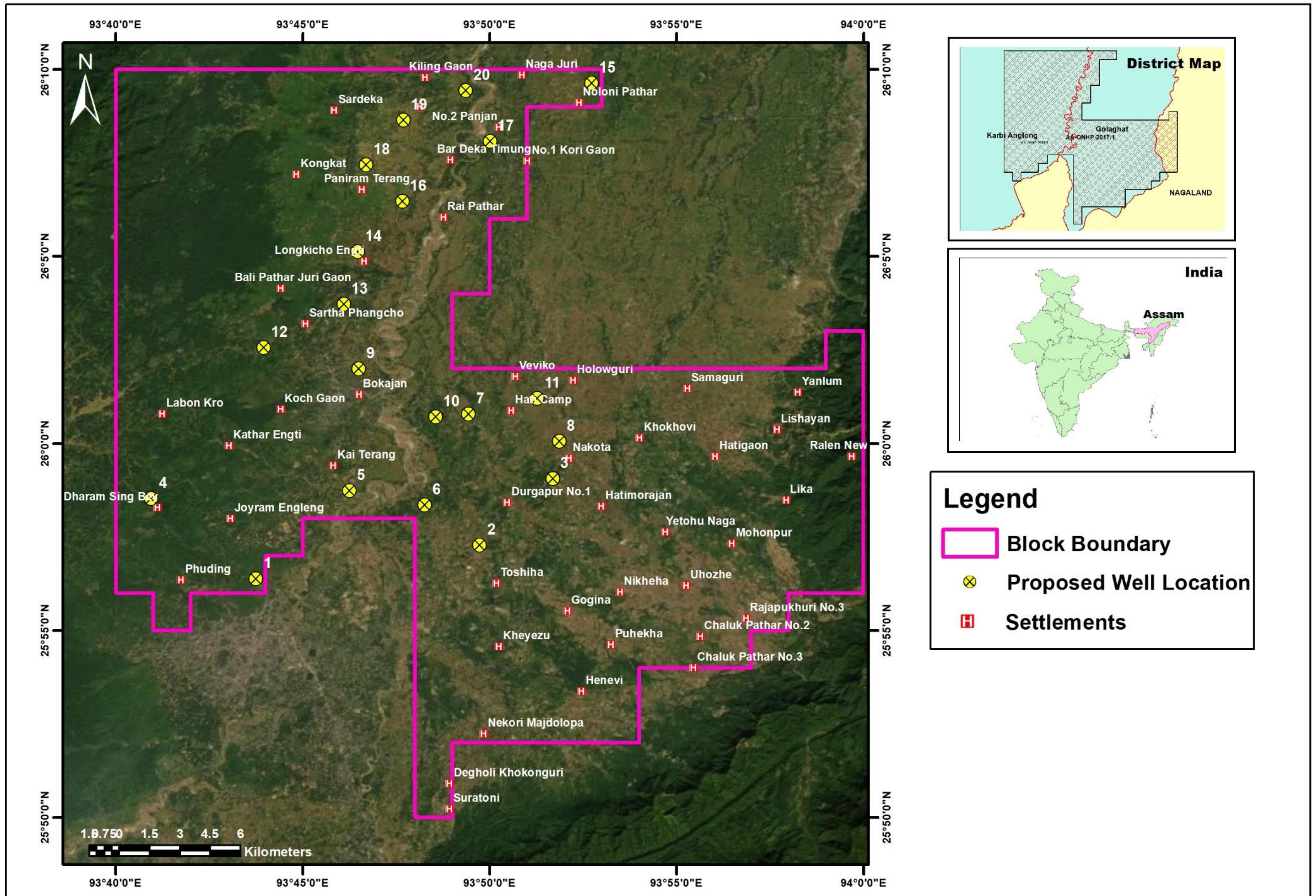


FIGURE NO.	Project name: EIA Study for Oil and Gas exploration in Block AA-ONHP-2017/1, Assam.					Title: Map Showing the Block Boundary and Proposed Well Location on Satellite Imagery	AECOM
	Date: 02/08/2019	Drawn By: Moumita Dey	Checked By: Souvik Basu	Approved By: Avijit Sarkar	Client Name: Vedanta Limited (Cairn Oil and Gas)	Source: Google Earth,Toposheet No:G46J/12, G46J/16, G46P/9, G46P/13(Survey of India), Esri Digital Globe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community.	

Block Accessibility

Roads

The project location falls in two districts of Assam state, Karbi Anglong and Golaghat. Diphu is the head quarter of the Karbi Anglong district. The district headquarters are located at Golaghat. Golaghat is one of the largest subdivisions of Assam and plays a significant role in the tea industry of Assam. Dimapur (Nagaland) is the nearest airport and 3 km from the block. National Highways 39 (Within Block) connects the block to other cities like Jorhat and Bokajan.

Railway

Railway lines connecting Guwahati to Dibrugarh runs within the block boundary. Dimapur and Bokajan Railway station located within Block.

Airport

Dimapur airport is the nearest air connectivity located 3 km (SW) from the Block boundary.

Accessibility map of Block AA-ONHP-2017/1 is presented Figure 5

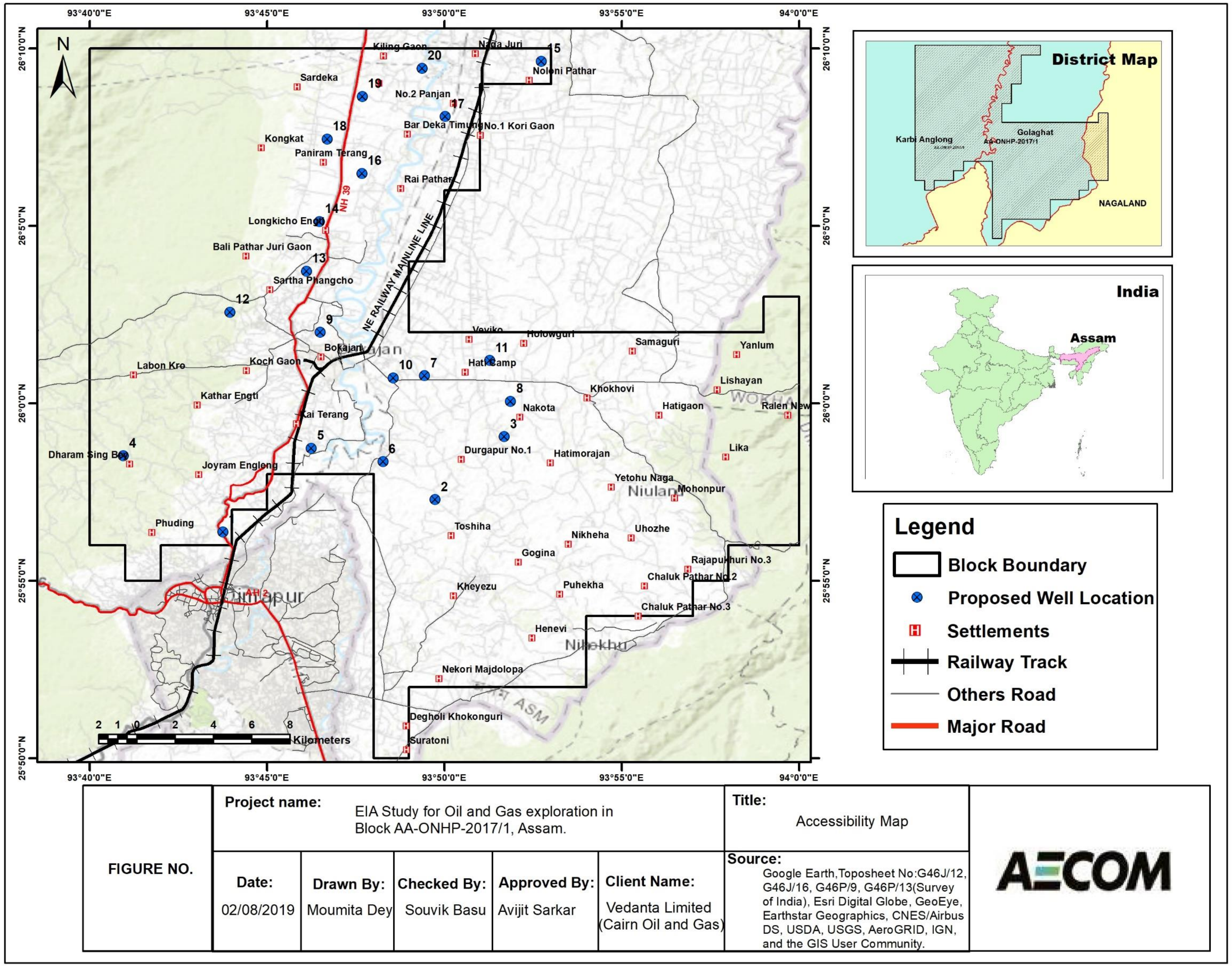


Figure 5. Accessibility Map of AAONHP-2017/1 Block

2.4 Environmental Settings

AA-ONHP-2017/1 Block

- Dhansiri River, Dayang River, Rengma River, Yampar nadi and Zubza river are flowing within the block;
- Total 38648 ha, forest area is located within the AA-ONHP-2017/1 block however none of the proposed well location is located within forest land;
- There is no wildlife sanctuary and national park located within the 15 kilometres of the block boundary;
- Land use classes with the Block comprise of fellow land and agriculture land;
- Cement industry present in the 2.21 km east from well no 27 .

Location of Wells

Vedanta Limited. (Division Cairn Oil & Gas) proposes to drill 20 exploration & appraisal wells within the present block boundary of AA-ONHP-2017/1. The proposed well sites were selected based primarily on the geological consideration but the environmental considerations viz. location of sensitive ecological habitats, settlements, schools/ hospitals, water bodies etc. have also been considered. Care had been taken to locate the wells distantly from these receptors. In case, well site selection in proximity to sensitive receptors could not be avoided (due to presence of geological formations), requisite clearance/permission would be obtained required. Proper environmental and safety measures would be adopted to minimize footprints on these receptors. Proposed well coordinates are provided in
Table 2.1

Table 2.1 Details of Proposed Well Location

Well no.	Coordinates	Present Land Use	Village	Administrative Village Name	Tehsil	District
1	25°56'35.11"N 93°43'45.83"E	Fallow land	Joyram Engleng		Silonjan	Golaghat
2	25°57'17.040"N, 93°49'43.980"E	Agricultural land	Kiyetho	Ambari	Sarupathar	Golaghat
3	25°59'3.454"N 93°51'41.232"E	Homested plantation	Sunito	Da-Gaon No.3	Sarupathar	Golaghat
4	25°58'38.82"N 93°41'3.45"E	Agricultural land	Sarthe Killing		Diphu	Karbi Anglong
5	25°58'43.96"N 93°46'14.57"E	Agricultural land	Christian Basti		Diphu	Karbi Anglong
6	25°58'21.200"N, 93°48'15.770"E	Agricultural land	Khaghaboto	Kai Terang	Diphu	Karbi Anglong
7	26° 0'46.710"N, 93°49'26.130"E	Agricultural land	M.V.chungajaan	Chungazan Hazari Gaon	Sarupathar	Golaghat
8	26° 0'3.330"N 93°51'51.513"E	Agricultural land	Kachari Gaon	Madhapur	Sarupathar	Golaghat
9	26° 1'59.81"N 93°46'29.71"E	Agricultural land	Sukhajan		Diphu	Karbi Anaglong
10	26° 0'42.820"N, 93°48'33.250"E	Agricultural land	M.V.chungajaan	Bokajan	Diphu	Karbi Anglong
11	26° 1'12.252"N 93°51'16.208"E	Agricultural land	Naokhuti	Netezu	Sarupathar	Golaghat
12	26° 2'24.39"N 93°43'52.73"E	Agricultural land	Sukhanjan		Diphu	Karbi Anglong
13	26° 3'43.52"N 93°46'6.20"E	Agricultural land	Sariajan		Diphu	Karbi Anglong
14	26° 5'7.39"N 93°46'28.18"E	Agricultural land	Sariajan		Diphu	Karbi Anglong
15	26° 9'38.27"N 93°52'43.48"E	Agricultural land	Dighalganja NC		Sarupathar	Golaghat

16	26° 6'28.63"N 93°47'40.31"E	Agricultural Land	Dilaojan	Diphu	Karbi Anglong
17	26° 8'4.62"N 93°50'0.89"E	Agricultural land	No.1 Kori Gaon	Sarupathar	Golaghat
18	26° 7'26.87"N 93°46'41.36"E	Agricultural land	Dihingia	Siloni jan	Karbi Anglong
19	26°8'38.65"N 93°47'41.20"E	Agricultural land	Rongagara	Siloni jan	Karbi Anglong
20	26° 9'26.45"N 93°49'21.87"E	Agricultural land	Jabarajan	Siloni jan	Karbi Anglong

Environmental settings around 2.5 km radius [1]area of each well site was carried out during field survey and the same has been checked with toposheet and satellite imagery.

Presently all the of proposed well locations are located in agricultural land. Settlements/houses was observed in vicinity of well locations. Villages roads are also located close to well locations. Well profile including environmental setting and environmental settings map of each well is given in Appendix 2.3.

[1] As per project plan well site may shift 2 kilometer around the prosed well site based on seismic data and geological formation. Considering the fact 2.5 km radius of the proposed well site is considered as the area of influence of the particular well.

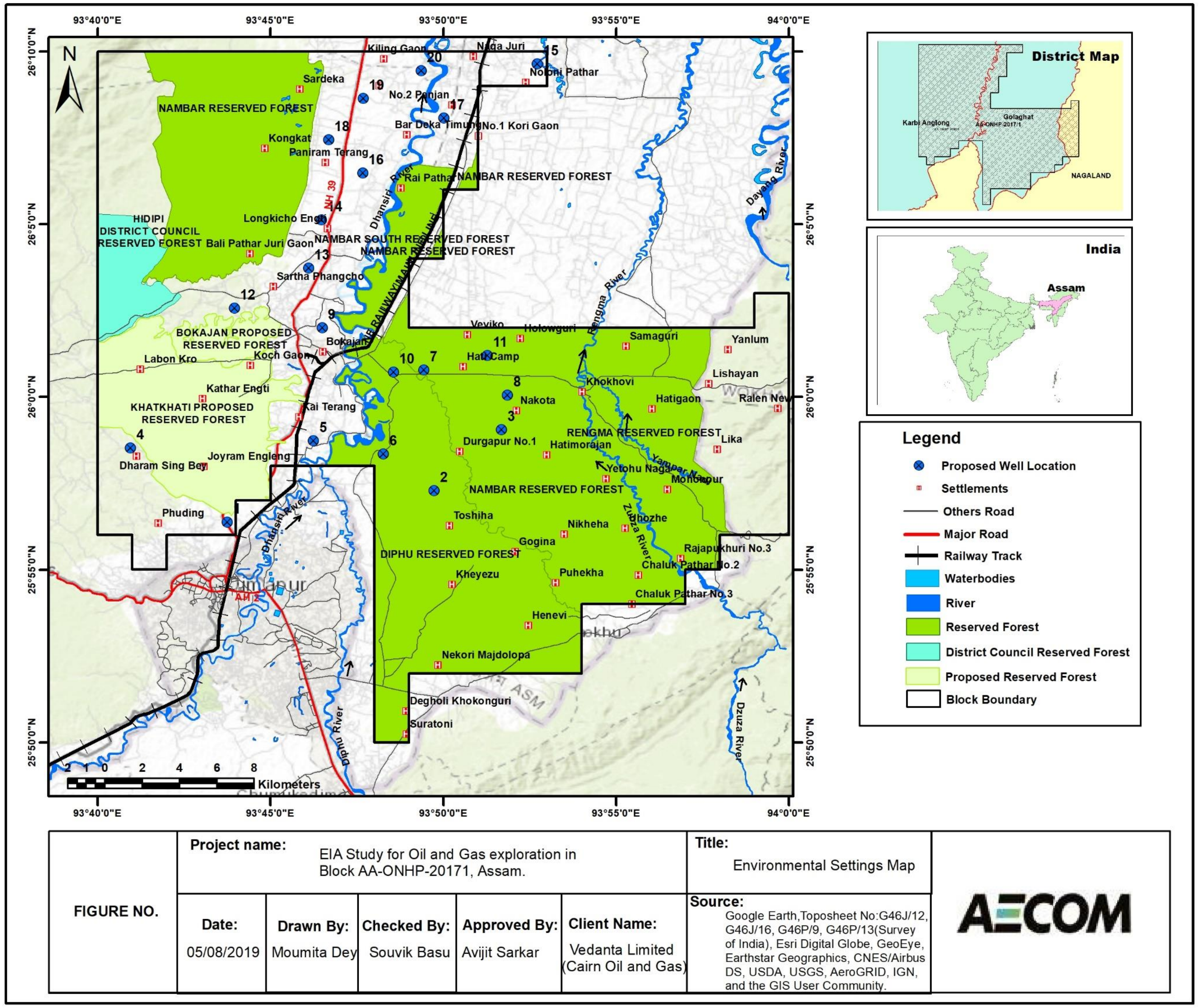


Figure 6. Environmental Settings Map of the Block

2.5 Well Drilling Process

The lifecycle of project activities for the proposed project has been divided into distinct steps and each is described in detail in the subsequent sections and would take approximately three months to complete drilling and testing activity at each well site. Vedanta Limited (Division Cairn Oil and Gas) has planned to carry out the proposed project activities in the AA-ONHP-2017/1 Block over a period of 10-12 years.

The project lifecycle has been classified into three phases:

Pre-drilling activity

- Site selection
- Land procurement
- Site Preparation
- Site access road and drill site construction
- Pre-drilling activities, mobilization and Rigging up

Drilling activity

- Drilling of wells
- Testing of wells

Early Production- When, exploratory drilling is successful

- Drilling of Appraisal wells to quantify the hydrocarbon reserves
- Setting up of Early Production Units (EPUs)/Quick Production Units (QPUs)

Well decommissioning

- Well abandonment
- Site closure and decommissioning
- Site Restoration

Pre-drilling Activity

The pre-drilling phase would involve the following activities:

Site Selection

The exploration history of the area exhibits the potential presence of the oil and gas in the region. The seismic data interpretation of the seismic survey would decide the exact locations of the drilling well. The proposed exploratory well site have been identified based on the study and interpretation of the stratigraphy and seismic data. Within the identified location the actual well drilling site have been selected based on the following factors:

- Located at a safe distance from public road.
- Ensure natural drainage channels are avoided or drainage channels rerouted to ensure
- Unhindered flow of rain / flood water. Where necessary adequate erosion control measures would be provided

Land Procurement

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. 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.

Site Preparation

Site preparation would involve all activities required to facilitate the operation of the drilling rig Site preparation would be involve all activities required to facilitate the operation of the drilling rig and associated equipment and machineries. At the initial stage, the drilling site would be elevated to about 2.0 m from the existing ground level with minimal clearance of existing ground vegetation. The existing trees would be retained to the extent possible. All efforts would be made during the design of the drill pad to prevent felling of any mature trees.

The loose top soil would be removed by using mechanical means like bulldozer and saved at a nearby place (away from the water channels) for later use during site restoration. Levelling and compaction would be done with the help of graders and mechanical rollers. The land filling materials and rubbles would be required for the purpose for site preparation in sufficient amount. Subsequently, the proposed well site & campsite would be duly fenced using chain link and barbed wires.

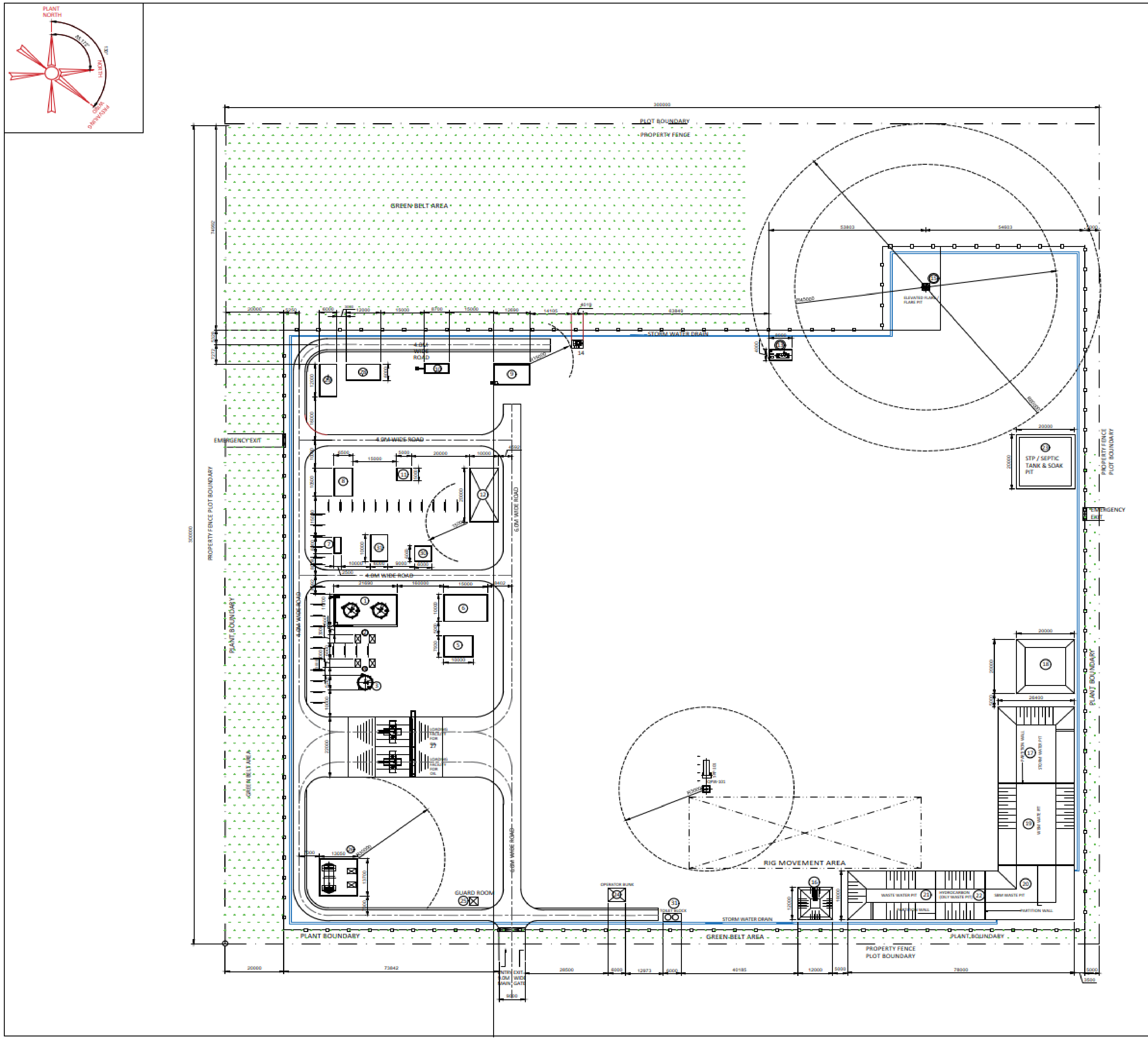
Platforms for drill pad and all other heavy equipment systems or machinery, cast in-situ Reinforced Cement Concrete (RCC) would be used for the construction of foundation system. The rig foundation would be of 20m X 20m in size and would have an elevation of 0.6 m. For making the foundations of main rig structure, cast in-situ bored under- reamed piles of specified lengths would also be used. The elevated structures would have proper garland drains for storm water with sufficient gradient, made of brick masonry, to take care of surface runoff water.

Pit of an impervious HDPE liner would be provided as part of the site development for collection and storage of drilling waste in the form of spent drilling mud and cuttings etc.

A Campsite, elevated to the height as that of the drilling site (approx.2.0 m), would be set up adjoining the well site. Local earth and rubble would be used as the fill material. Proper surface gradients and brick masonry drains would take care of the run-off water, where as separate septic tanks and soak pits would be provided along with the labour camp for disposal of domestic waste water.

Though the rig and related equipment's would be directly brought to site, spares, mud preparing chemicals and other materials would be stored at a warehouse near to the site and would be sent to the site from that intermediate storage area. The rig equipment would however be transported directly to the drilling site during mobilization and would be de-mobilized directly from the site. The materials would be intermittently supplied from warehouse to the drilling site, during the operations - with some stock at the drilling site itself.

A typical layout of drill site with QPU is presented in Figure 7 **Error! Reference source not found.** and typical drill s ite without QPU is presented in Figure 8.



EQUIPMENT LIST			
SL NO.	EQUIPMENT	QTY.	DIMENSION
1	OIL STORAGE TANK	2	5.2 DIA
2	OIL TRANSFER PUMPS	2	-
3	WATER STORAGE TANK	1	5.2 DIA
4	WATER TRANSFER PUMPS	2	-
5	INSTRUMENT AIR PACKAGE	1	10x7.93
6	CHEMICAL INJECTION PACKAGE	1	15x10
7	ELECTROSTATIC COALESCER SEPARATOR	1	6x2.5
8	HEATER TREATER SKID	1	10.5x6.5
9	DIESEL STORAGE TANK & PUMP	1	12.96x7.95
10	DIESEL GENERATOR	1	8.7x3.5
11	FUEL GAS SYSTEM	1	10x10
12	GEG PACKAGE	1	20x20
13	FLARE KO DRUM & PUMPS	1+2	8x4
14	CLOSED DRAIN SYSTEM & PUMPS	1+2	4x4
15	ELEVATED FLARE / FLARE PIT	1	2.6x2.6
16	FRESH WATER PIT	1	12x12
17	STORM WATER PIT	1	30x20
18	MUD PIT	1	20x20
19	WBM WASTE PIT	1	27.7x26.4
20	SBM WASTE PIT	1	29.4x26.4
21	WASTE WATER PIT	1	30x18
22	HYDROCARBON (OILY WASTE PIT)	1	18x16.5
23	STP / SEPTIC TANK & SOAK PIT	1	20x20
24	OPERATOR ROOM	1	6x5
25	GUARD ROOM	1	3x3
26	FIRE FIGHTING FACILITY & FIRE PUMPS	1+2	13.7x13
27	LOADING FACILITY AREA	1	-
28	SUB-STATION	1	12x6
29	CONTROL ROOM	1	6x6
30	WELL TEST SEPARATOR	1	6x6
31	PRODUCED WATER TREATMENT SKID	1	10x6
32	TOILET BLOCK	1	-

Figure 7. TYPICAL LAYOUT OF DRILLING PAD WITH QPU

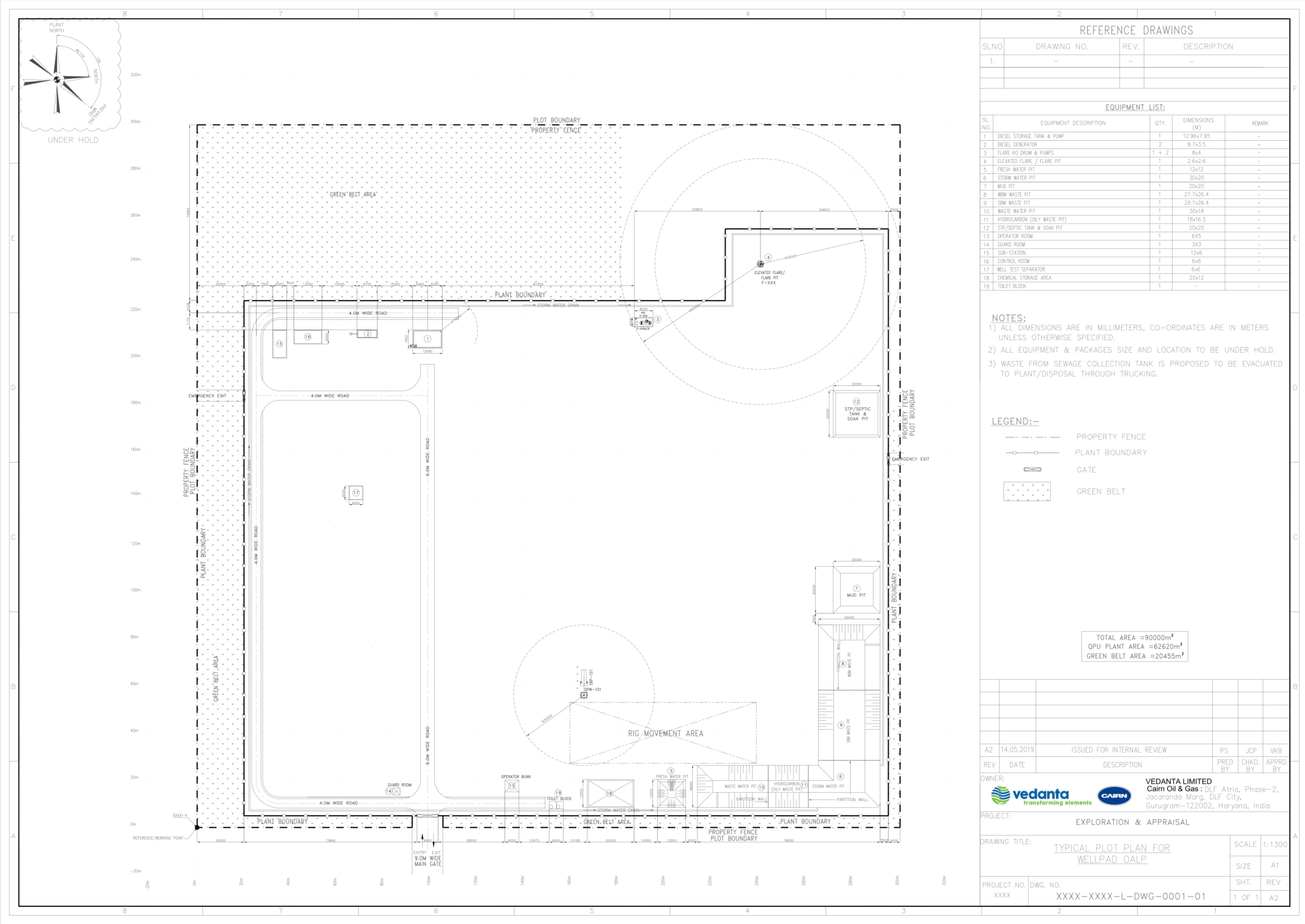


Figure 8. Schematic Diagram of A typical Well Pad

Drilling Activity

The proposed drilling would be carried out by using a standard land rig or a "Mobile Land Rig" with standard water-based drilling fluid treatment system. This rig would be suitable for deep drilling up to the desired depth of 6000 meters (TVDSS) as planned for the project. Additionally, there would be other ancillary facilities like Drilling mud system, ETP, Cuttings separation, Drill Cementing equipment etc. and utilities to supply power (DG sets), water, fuel (HSD) to the drilling process and would be set up as a part of the Project. The details of the drilling rig is given in Table 2.2. The typical configuration of a Drilling Rig is shown in the Figure 9.

Table 2.2 Specification of a Drilling Rig

Type of Rig	Electrical Rig
Power generator type & nos.	AC – SCR Type. (03 Nos.)
Details of solids handling systems on rig	Shale Shakers - 1200 GPM Capacity Desander – 1200 GPM Capacity Desilter – 1200 GPM Capacity

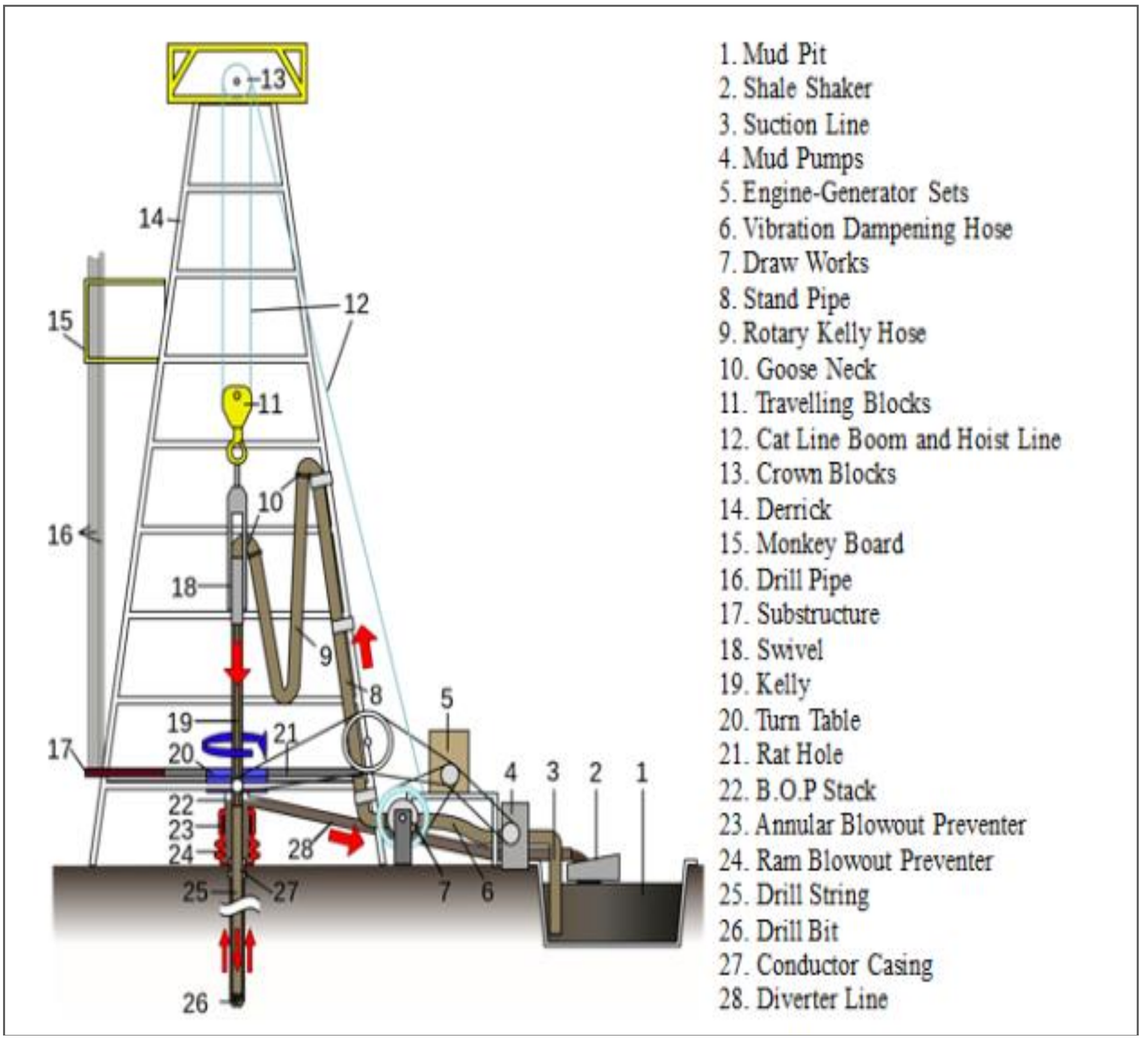


Figure 9. Typical Drilling Rig Configuration

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. A typical model of onshore drilling process is presented in Figure 10

Figure 10. Typical Model Onshore Drilling Process

Mud System and Cuttings

returns at the drill pipe–casing annulus up to surface back into the circulation system after separation of drill cuttings /solids through solids control equipment. The primary function of drilling fluid is to ensure that the rock cuttings generated by the drill bit are continuously removed from the wellbore. The mud must be designed such that it can carry the cuttings to surface while circulating, suspend the cuttings while not circulating and drop the cuttings out of suspension at the surface. The drilled solids are removed at the surface by mechanical devices such as shale shakers, de-sanders and de-silters. The hydrostatic pressure exerted by the mud column prevents influx of formation fluids into the wellbore. The instability caused by the pressure differential between the borehole and the pore pressure can be overcome by increasing the mud weight. Hydration of the clays can be overcome by using non-aqueous based muds, or partially addressed by treating the mud with chemicals which would reduce the ability of the water in the mud to hydrate the clays in the formation. Water based mud would be used for initial, shallower sections where massive shales are not encountered. The deeper and difficult to drill formations would be drilled using synthetic base mud (SBM). Synthetic base mud unlike oil-based mud (OBM) is biodegradable but can be re-used. At the end of drilling a well almost the entire amount of the SBM is collected for re-use in next drilling operation. SBM systems promote good hole cleaning and cuttings suspension properties. They also suppress gas hydrate formation and exhibit improved conditions for well bore stability compared to most WBM. WBM typically consists of water, bentonite, polymers and barite. Other chemical additives viz. glycols and salts may be used in conjunction to mitigate potential problems related to hydrate formation. The mud would be used would be continuously tested for its density, viscosity, yield point, water loss, pH value etc. The mud would be prepared onsite (drill location) using centrifugal pumps, hoppers and treatment tanks.

During drilling activity, cuttings would be generated due to crushing action of the drill bit. These cuttings would be removed by pumping drilling fluid into the well via triplex mud pumps. The mud used during such operation would flush out formation cuttings from the well hole. Cuttings would be then separated from drilling mud using solids-control equipment. This would comprise a stepped system of processes consisting of linear motion vibrating screens called shale shakers, hydro-cyclones (including de-sanders and de-silters), and centrifuges to mechanically separate cuttings from the mud.

Flow chart for drilling mud & solid discharge is shown in Figure 11 and a typical view of drill cutting separation & Treatment system is shown in Figure 11

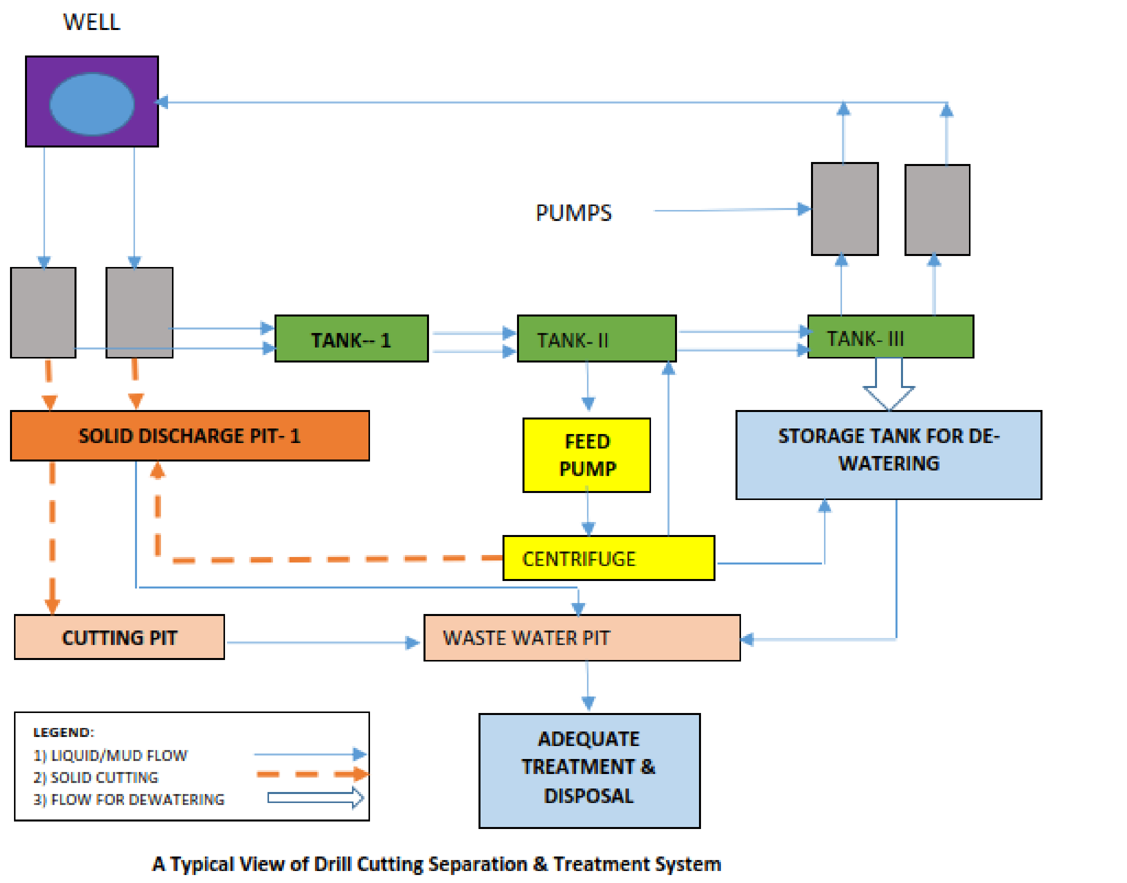


Figure 11. A Typical View of Drill Cuttings Separation & Treatment System

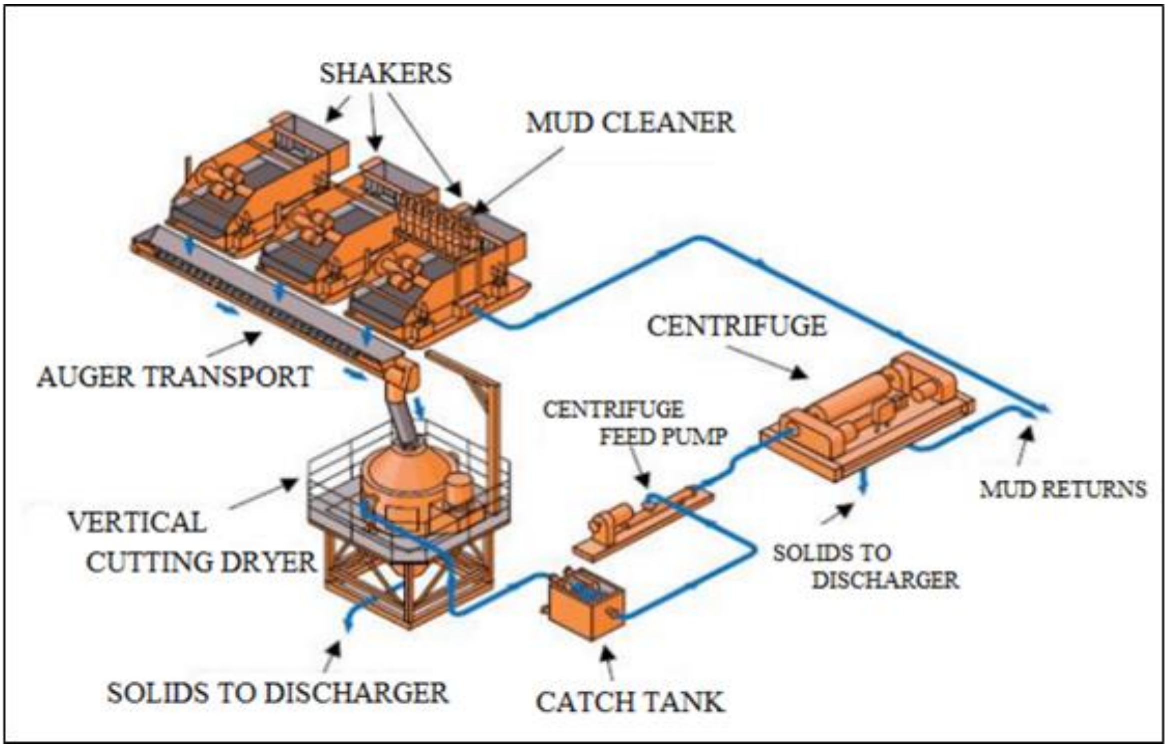


Figure 12. Typical view of Drill Cuttings Separation & Treatment System

Cementing

Cementing is a necessary aspect of exploratory drilling oil and gas wells. Cement is used to fulfil the following works:

- Secure/support casing strings
- Isolate zones for production purposes

Well Evaluation

During the drilling operations for different zones, logging operations would be undertaken to get information on the potential type and quantities of hydrocarbons present in the target formations. Technicians employed by a specialist logging Service Company do well logging by different well logging techniques including electric, sonic and radioactive techniques. Logging instruments (sensors) are attached to the bottom of a wire line and lowered to the bottom of the well and they are then slowly brought back. No emissions to the environment or any environmental harm is associated with wire line logging operations. The radioactive source required for well logging operations would be kept in specially designed container.

A drill-stem test would be frequently performed to evaluate the formation or zone from which the gas show was observed. A drill-stem test enables the exploration company to obtain a sample of the fluids and gases contained in the formation or interval being tested as well as pressure information, which is determined by special gauges within the test tool. The test tool contains a valve which may be opened and closed to allow formation fluids to enter the test tool and drill string. If there is sufficient fluid and pressure within the zone being tested, the formation fluid may rise to the surface and flow into special test tanks used for that purpose. If gas is present, it is burned at the surface as a flare.

Hydraulic Fracturing – for Tight Rock Reservoirs of Hydrocarbons

Hydraulic fracturing is used in tight rock reservoirs with low permeability, such as shale (i.e, the conductivity or ability of hydrocarbons to flow in the formation is low because of the small pore size in the rock). The goal of hydraulic fracturing in tight reservoir (shale) formations is to enable a well to produce the resource or to increase the rate at which a well is able to produce the resource. Hydraulic fracturing may be conducted in wells with low permeability formation and low pressure. Wells requiring hydraulic fracturing and numbers of stages of hydraulic fracturing per well would depend on seismic data acquired & interpreted and data acquired during the drilling phase of the project.

Hydraulic fracturing is a common technique used to stimulate the production of oil and natural gas by creating fractures or cracks that extend from the well hole into the rock formations. This is accomplished by injecting fluid, which is usually a mixture of water and high viscosity fluid additives, under extremely high pressure. The pressure of the water would then exceed the strength of the rock, causing fractures to enlarge. After the fractures take place, a “propping agent” known as proppant (which is usually sand) is injected into the fractures to keep them from closing. This allows the hydrocarbon to move more efficiently from the rock to the well. A single well may require up to 15,000 m^3 of water which may vary depending on the fracking requirements. For the hydraulic fracturing in a well, proppant mass of 150,000 – 200,000 lbs per stage and fluid volume of 2500 bbls – 4000 bbls per stage would be required.

Fracturing effluent generated would be discharged in the HDPE lined pits at the drilling well sites. The effluent would be treated for disposal and reuse to the extent possible

Well kick situation & Control measures

While drilling, if the formation pressure exceeds the hydrostatic pressure exerted by the drilling fluid, formation fluids break out in to the well bore. This is called kick. Primary means of well control is to have sufficient over-balance over formation pressure. For some reason if an unexpected over-pressurized formation is encountered while drilling and if the well control situation arises, rig is equipped with equipment to control this situation. This set of equipment is called “Blowout Preventers (BOP)”. Blow Out Preventer consists of, “Annular Preventer”, which can generally close on any size or shape of tubular in the well bore and closes the annular space between drill string and casing. Another type of blowout preventer is a “Ram Preventer”. Ram preventers are of two types i.e., Pipe Rams and Shear Rams. Pipe rams also close the annulus between drill string and casing, but they have a fixed size. As such a specific pipe rams can be closed on a specific size of pipe. Shear rams are generally the last choice of preventer would be operated as they shear drill string and shut off the well bore. After determining the existing formation pressure and other geological complexities from the seismic data, appropriate BOP would be used as per standard oil field guideline for the same.

All these preventers would be stacked in a sequence and such assembly of preventers is termed as BOP stack. A typical BOP stack is illustrated in figure 13. Blowout prevention equipment would be installed, tested and operated according to the well control procedures of Vedanta Limited (Division: Cairn Oil & Gas).

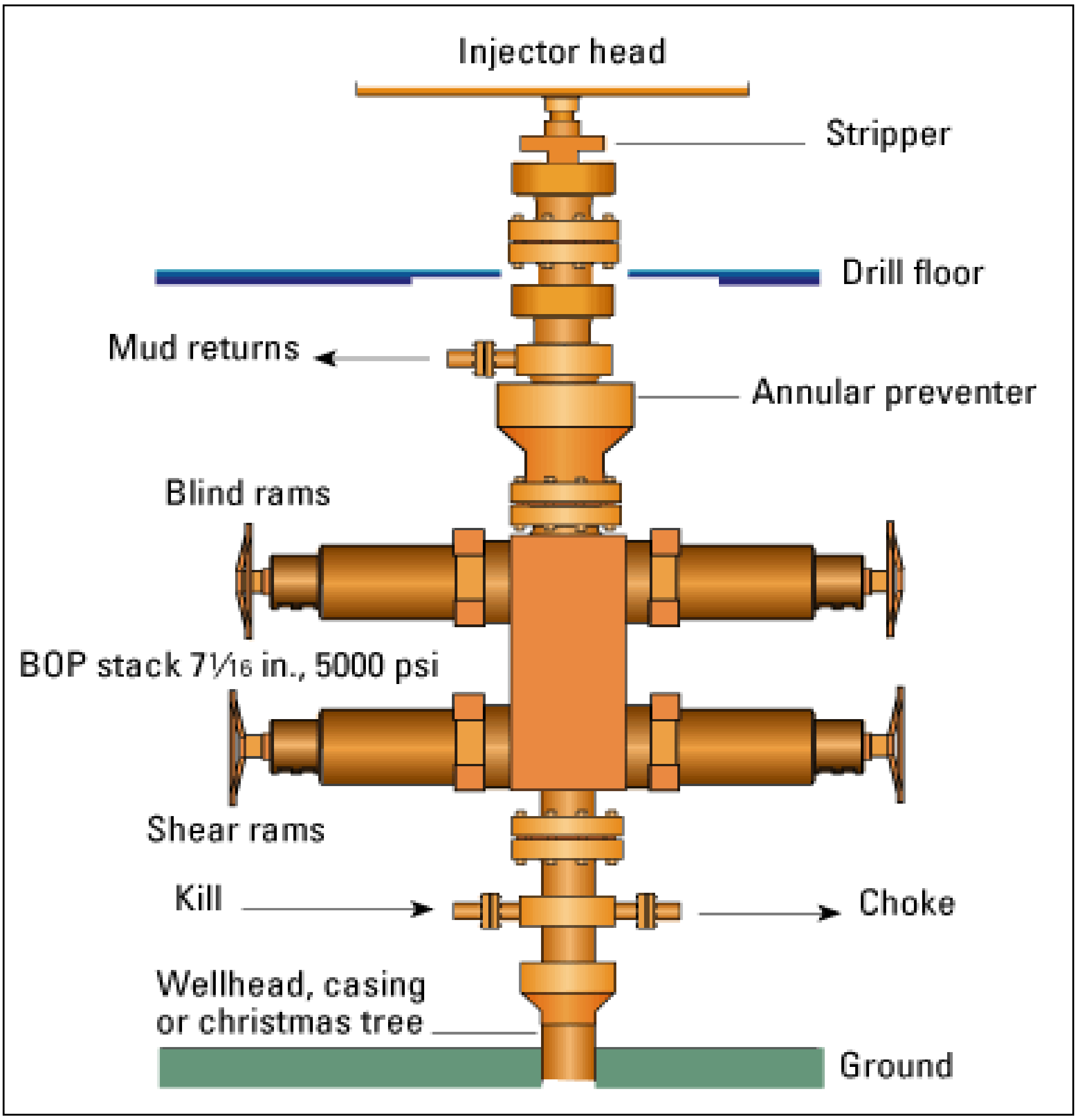


Figure 13. Blow Out Preventer

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. During the well testing, crude oil, natural gas and produced water could be generated and would be treated and disposed appropriately. Hydrocarbons would be flared. Efficient test flare burner would be used to minimize incomplete combustion. As an alternative option, if feasible, crude oil/ slop oil would be transferred to nearby refinery (terminals/depots) for processing or would be sent to authorized recyclers

2.6 Early Production

When, exploratory drilling is successful, more wells (termed as Appraisal wells) would be drilled to determine the size and the extent of the field. Wells drilled to quantify the hydrocarbon reserves found are called as 'appraisal' wells. The appraisal activity would be carried out with an aim to evaluate the size and nature of the reservoir, to determine the number of confirming or appraisal wells required, and whether any further seismic survey is necessary. The technical procedures and activities in appraisal drilling would be the same as those employed for exploration wells. A number of wells may be drilled from a single well pad/ drill site. 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, in order to reduce the land requirement.

Drilling of Appraisal wells

When, exploratory drilling is successful, more wells (termed as Appraisal wells) would be drilled to determine the size and the extent of the field. Wells drilled to quantify the hydrocarbon reserves found are called as 'appraisal' wells. The appraisal activity would be carried out with an aim to evaluate the size and nature of the reservoir, to determine the number of confirming or appraisal wells required, and whether any further seismic survey is necessary. The technical procedures and activities in appraisal drilling would be the same as those employed for exploration wells. A number of wells may be drilled from a single well pad/ drill site. 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, in order to reduce the land requirement.

Early Production Units (EPUs)/ Quick Production units (QPUs):

Early Production Units (EPUs) or Quick Production Units (QPUs) would be installed for the processing of produced well fluid. A EPU/ QPU would be a packaged/ modular mobile unit and would mainly consists of a heater-treater separator or a production heater followed with a three phase separator, electrostatic coalescer, oil storage tanks, oil tanker loading system, produced water separation and disposal system, power generation (GEG or DG), test separator skid, utility systems such as fuel gas, flare, Inst. Air package, diesel storage, firefighting equipment, etc. A QPF would be designed for a capacity of 2,000 BLPD (Barrels of liquid per Day) with water cut variation from 0 – 50 vol%.

Produced well fluid from one or more successful exploratory/ appraisal wells would be gathered & sent to heater-treater separator skid for primary separation & heating purpose. Gathered produced fluid would be heated & degassed in heater-treater separator skid operating at ~2.5 – 3 Barg and ~70 – 80^{0}C and separated in to gas, oil and water streams. The separated produced (associated) gas would be either routed to fuel gas system or to flare depending on the quantity and richness of produced (associated) gas. In case of sufficient quantity of produced gas, a part of the produced gas would be used for power generation using gas engine generator (GEG), for firing in heater-treater separator skid and for blanketing & purging purpose. The surplus gas post internal consumption (if any) would be routed to flare for safe atmospheric discharge.

Separated oil from heater-treater separator skid would be sent to electrostatic coalescer separator (if needed, based on oil properties) to separate the residual water and achieve BS&W specifications. The treated crude oil from electrostatic coalescer separator would be sent to oil storage tanks. From oil storage tanks, oil would be pumped & loaded in to road tanker using the tanker loading facility for evacuation of crude oil to the nearby available facilities like terminals/ depots of consumers.

Separated produced water (PW) from heater-treater separator skid would be sent to degasser vessel operating at low pressure. The evolved HC gases from degasser vessel would be routed to flare for safe disposal and the degassed water sent to PW treatment package.

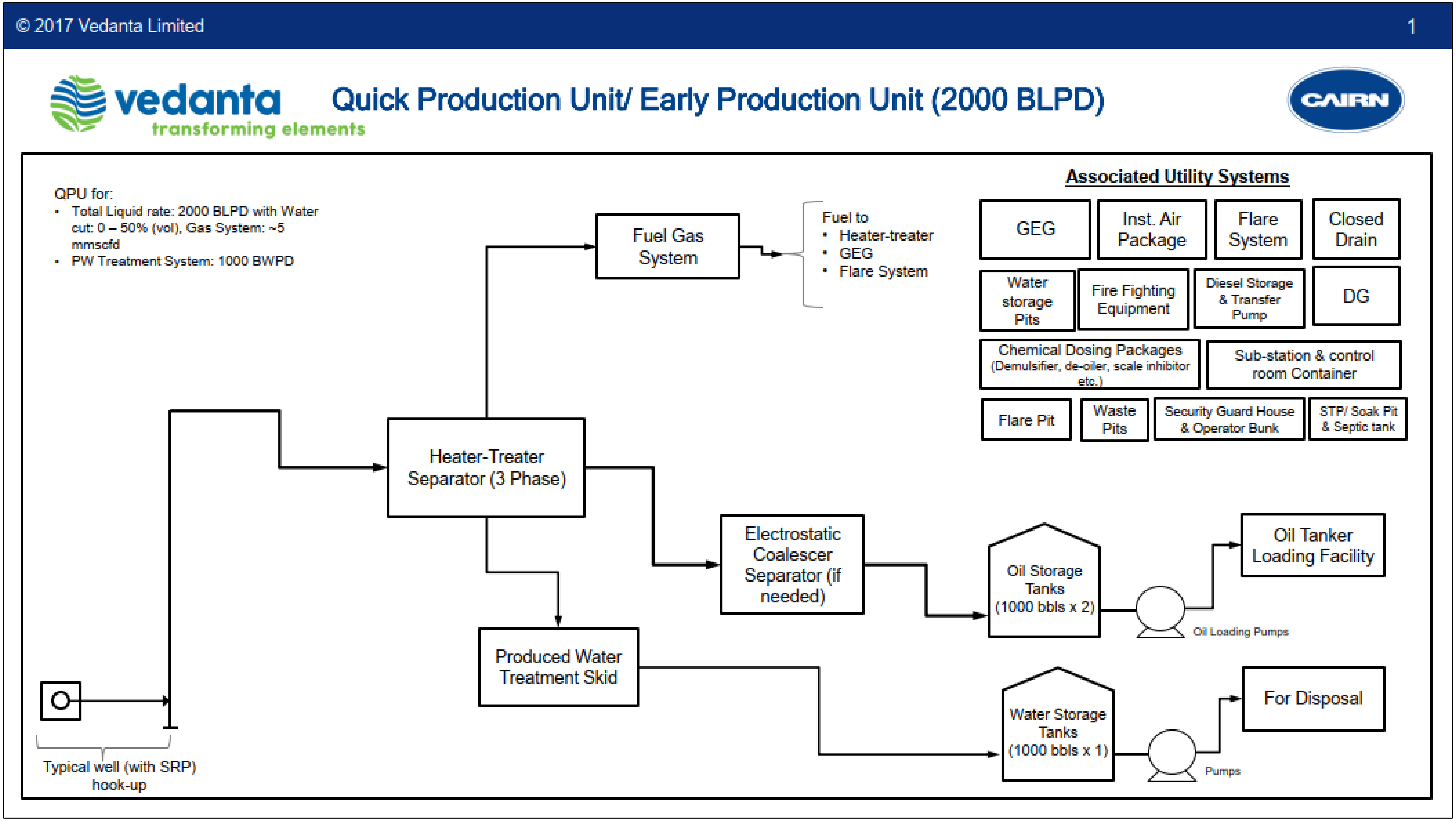
The PW treatment package would consists of a compact flotation unit or other equivalent gas floatation based de-oiling (oil removal) system and a filtration system. The treated water from PW treated skid would be stored in PW storage tanks. The produced water would be treated to achieve MoEF/ CPCB/ SPCB specifications (discharge standards) and would be disposed off. The treated effluent (i.e. produced water) would be disposed-off using either a nearby down hole disposal well (by reinjection in abandoned well) or other available and suitable onshore disposal medium or solar/ mechanical evaporators depending on the quantity and feasibility.

The power requirement would be met through either state electricity grid and/ or installation of Diesel/ Gas Engine Generator(s) using produced gas. If produced gas is sufficient quantity, then power generation using produced gas would be preferred.

Along with above processing facility, a well test separator skid would be installed at pad. It would be used for well testing purpose. Well under testing would be routed to test separator skid. The separated gas, oil & water would be sent back to inlet of heater-treater separator skid for further processing. Quick production set-up would have following utility systems & infrastructure for supporting the operations.

- Wells with selected artificial lift and flow lines
- Fuel gas system consisting of filters & a super-heater
- Instrument Air package or Instrument as system

- Chemical dosing packages i.e. corrosion inhibitor, de-mulsifier & scale inhibitor etc.
- Elevated flare system or enclosed ground flare or ground flare
- Closed drain system, storm water drain system
- Fresh water storage
- Diesel storage
- Power generation (GEG and / or DG)
- Firefighting equipment
- Domestic sewage treatment facility (STP or septic tank & soak pit system);



Source: Vedanta Limited (division Cairn Oil & Gas)

2.7 Completion of Drilling

On completion of activities, the well would be either plugged and suspended (if the well evaluations indicate commercial quantities of hydrocarbons) or would be killed and permanently abandoned. In the event of a decision to suspend the well, it would be filled with a brine solution containing very small quantities of inhibitors to protect the well. The well would be sealed with cement plugs and some of the wellhead equipment (Blind Flange) would be left on the surface (Cellar). If the well is abandoned it would be sealed with a series of cement plugs, all the wellhead equipment would be removed, by leaving the surface clear of any debris and the site would be restored.

2.8 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. This would involve the dismantling of the rig, all associated equipment and the residential camp, and transporting it out of the project area. It is expected that demobilization would take approximately 20-25 days and would involve the trucking away of materials, equipment and other materials from the site to bring it back to its original condition. It is estimated that about 50 truckloads would be transported out of site during this period. If no indication of any commercially viable amount of oil or gas is encountered either before or after testing, the well would be declared dry and accordingly would be plugged of and abandoned, and the site would be restored in line with regulations and good industry practice.

2.9 Utilities & Resource Requirements, Associated Facilities

Liquid Mud Plant (LMP)

The Liquid Mud Plant (LMP) would be located at suitable locations of the fields to prepare drilling mud for the drilling operations. It is estimated around 3 – 5 LMP's would be set-up at any a given point of time for the proposed drilling operations. All the tanks, equipment's, civil works, pumps, mud laboratory with testing equipment along with the mud waste disposal pits would be constructed within a single location.

The entire LMP area would be provided with containment area and with facilities for fork lift movement and transportation of solid waste skips. The area would be designed to facilitate tanks for SBM mixing/ storage, tanks of base oil storage and another tanks for brine mixing/storage. These tanks are interconnected with piping and manifold with mixing hoppers, pumps connections, centrifuges connection with complete mud conditioning set-up, loading-unloading piping/hoses connections.

The Mud Plant area would be surrounded with a containment boundary wall. All the liquid transferred from the LMP to the drilling site would be through road tankers. For power supply requirement DG sets would be required with one operational and one standby.

The LMP would have water storage tanks, bunk houses for operating office and site laboratory, dry chemical storage area in paved surface, truck loading and unloading area with parking facility, cranes & forklifts maintenance and parking facility, septic tank with soak pits, DG area, diesel storage area and power distribution panel & facility.

Accommodation & Camp Site

Drilling camp sites would be set-up within the vicinity of the drilling sites to allow for easy movement of the crew between the camp and the drilling sites. The camp site would generally comprise of transportable container cabins (portable cabin) of 20 feet and 40 feet size to provide accommodation to operational crew. Each cabin would house 2 to 4 persons. A typical view of Vedanta Limited. (Division Cairn Oil & Gas)'s camp site has been presented in **Figure 14** below. Toilet facilities would be built as part of the accommodation unit. The sewage lines from the units would be connected through a pipeline system to a septic tank and soak pit system. Additionally, there would be dedicated cabins to serve as kitchen, cold storage, dining area, recreation area, laundry etc.

Figure 14. Typical View of Camp Site

Approach and Internal Roads

The approach road to drill sites would be constructed and/or existing roads would be strengthened for movement of construction machinery, drilling rig, material supply vehicles, passenger vehicles etc. depending on the location of drill site. In general, it is intended to make the maximum use of the existing road infrastructure.

Water Storage Pit

The water storage pit contains the water used for preparing drilling fluid and domestic purpose. Provision for additional water storage would be kept in case multi-stage fracturing is planned.

Chemical Storage Area

The chemicals to be used in preparing mud would be stored on a paved platform with kerb walls and protected against weather by an impervious covering. All the storage areas would be identified with labelling and sign boards. Material Safety Data Sheets (MSDS) shall be maintained for all chemicals that are stored and handled at the drill site. The storage area would be provided with adequate number of fire extinguishers.

Spent Drilling Fluid Disposal Pits

All wastewater from the drilling operations would be collected in the drilling fluid storage pit. The wastewater in this storage pits would be recycled and reused during drilling phase. The residual wastewater would be sent to solar evaporation pit for treatment. The pits would be lined with HDPE sheet and the overlaps welded together with the edges bought over the rim and tucked into the cement mortar / bund soil.

Drill Cutting Disposal (impervious lined) Pit

While recycling the mud, the drill cutting would be separated through shale shaker, which would be disposed off to cutting disposal pit. It would be HDPE lined to avoid contamination of land and groundwater. The pit would be soil bunded lined to prevent any overflow to the surroundings.

Flare Pit (well testing)

To conduct ground flaring, all the sites would have a flaring pit with adequate burner. The flare pit would be made up of RCC / brick lining and are located preferably 90 degrees to the predominant wind direction. The location of the pit also depends on the entry to the site from the adjacent road side, processing units or tanks.

Flare Stack

A flare system consists of the flare stack or boom and pipes which collect the gases to be flared. The flare tip at the end of the stack or boom is designed to assist entrainment of air into the flare to improve burn efficiency. Seals installed in the stack prevent flashback of the flame, and a vessel at the base of the stack removes and conserves any liquids from the gas passing to the flare.

- For effective flaring document “Oil & Gas drilling and extraction industry” June 2006 would be followed.
- Standard flare design - An efficient test flare burner head equipped with a combustion enhancement system would be selected to minimize incomplete combustion, black smoke, and hydrocarbon fallout. Volumes of hydrocarbons flared would be recorded.
- Location and height of the flare stack based on maximum ground level concentration criteria & maximum radiation intensity exposure criteria
- Flare stack- Minimum physical height of stack would be 30 m from ground level. Only in those situations and or locations where elevated flares are not technical feasible, then ground flaring may be resorted to, such as when there is a crop cultivation / vegetation in the vicinity of the well pad or / and where flared gas volume is <0.5 MMSCFD (due to this low volume, sometimes elevated flare gets extinguished in presence of wind)

Diesel Storage Tank

The fuel (diesel) would be received in bulk quantity through tankers and would be stored in above ground steel diesel tanks. The tank area is generally provided with secondary containment of adequate capacity to control any accidental leaks.

Waste Storage

Hazardous wastes generated from drilling activities such as used oil from pumps and machinery, empty chemical and fuel barrels, contaminated oil rags and soil etc would be collected and stored in a designated storage area. The storage area would have paved flooring, containment bund and roof. Waste oil from pumps and machinery would be collected and stored in used oil barrels and would be kept in a designated storage area. The contaminated soil and cotton rags would be disposed of at approved secured Land fill as per the legal provision. Used oil would be disposed off through recyclers/ re-processors registered with the Central Pollution Control Board and authorized by State Pollution Control Board.

Storm Water Drainage System

Adequate drain would be provided all around the drilling site to prevent runoff of any oil containing waste water into the nearby natural drainage area. The storm water drain shall be provided with oil trap and the collected water shall be sent to storm water pit.

Sewage Treatment Plant (STP)

Mobile Modular STP of capacity 30 m3/day for treatment of sewage and sullage Water generated within the well pad limits. Each well site and camp site would have toilets which would be provided with septic tanks and soak pit arrangement. To cater to about people that would stay in the camps site, adequately sized septic tanks and soak pits would be provided.

Raw Material Requirement

Maximum care would be taken for resource optimization, wherever possible with an aim of

- Resource Conservation
- Elimination of Waste Streams
- Minimizing Waste
- Reuse/recycle of Wastes
- 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 in further drilling activities

Raw Material Required for Drilling

During drilling activities, materials like HSD, Steel (in the form of casings & tubulars) and chemicals like barite, oil well cement and bentonite would be required. Other production equipment like tubular (Casing and tubings), wellhead assembly, packer etc, and chemicals for mud and cementing required for the drilling operations and shall be procured by the company from within the country and from abroad before the commencement of operations.

Water based mud would be used for initial, shallower sections where massive shales are not encountered. The deeper and difficult to drill formations would be drilled using synthetic base mud (SBM). Synthetic based mud can be re-used. WBM typically consists of water, bentonite, polymers and barite. Other chemical additives viz. glycols and salts may be used in conjunction to mitigate potential problems related to hydrate formation.

- Requirement WBM (approx.) 800-1000 m3/well
- Requirement SBM (approx.) 600-800 m3/well

The role of the mud in pressure control is especially important. If the drill bit penetrates a formation containing oil, gas or water under pressure these fluids are prevented from flowing into the borehole by ensuring that the drilling mud is of sufficient density to the natural formation pressures. The density of the mud can be increased by the addition of barite weighting material. Bentonite is employed to improve the theological properties and enable the drill cuttings to be transported from the hole while drilling and also be suspended in the fluid while the drill bit is being changed. The barite used in the drilling mud would be as per American Petroleum Institute (API) standard specifications.

Power Requirement

Drilling Operations

The power requirement in the drilling site and the campsites would be provided through diesel generator (DG) sets. The rated capacity of the DG sets required for onshore drilling site is provided in the **Error! Reference source not found.**.

Table 2.3 Details of DG Sets of Onshore Drilling Activity

S. No.	Location	DG Capacity
1.	Camp site	2x350 KVA (Including one as standby)
2.	Drilling site	3x1000 KVA (Including one as standby) or 2x1850 KVA (1 Working + 1 Standby) Depending on the rig capcity & availability during E&A drilling phase
3.	Radio Room	2X 100 KVA (Including one as standby)
Each Early Production Unit		
1	Gas Engine Generator (GEG)	1 MW output
2	DG for Emergency purpose	1 x 500 KVA

Source: Vedanta Limited (Division: Cairn Oil & Gas)

Water Requirement

Drilling

Water consumption during drilling and testing of wells would be 102 m^3 per day per well. Total 72 m^3 per day fresh water would be required for drilling activities and 30 m^3 per day freshwater would be used for domestic purposes including drinking, washings and domestic use. Wells would be drilled either water-based mud or synthetic based mud. The water requirement in drilling rig is mainly meant for preparation of drilling mud apart from washing 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 of unavailability of water from approved sources, required water would be extracted after obtaining permission from CGWA/State Govt.

Quick production unit/Early production unit

Approximately, 20 m^3 per day water would be required for domestic use in each QPU/EPU.
The water requirement per well is shown in Table 2.4. Water balance diagram is presented in figure 15.

Table 2.4 Water Requirement

Description	Quantity(m3)/day
Total Water Requirement for Drilling each well drilling	72

Description	Quantity(m3)/day
Total water Requirement for Domestic Use/well	30
Total Water requirement during early production stage for each unit	15-18

Source: Vedanta Limited (Division: Cairn Oil & Gas)

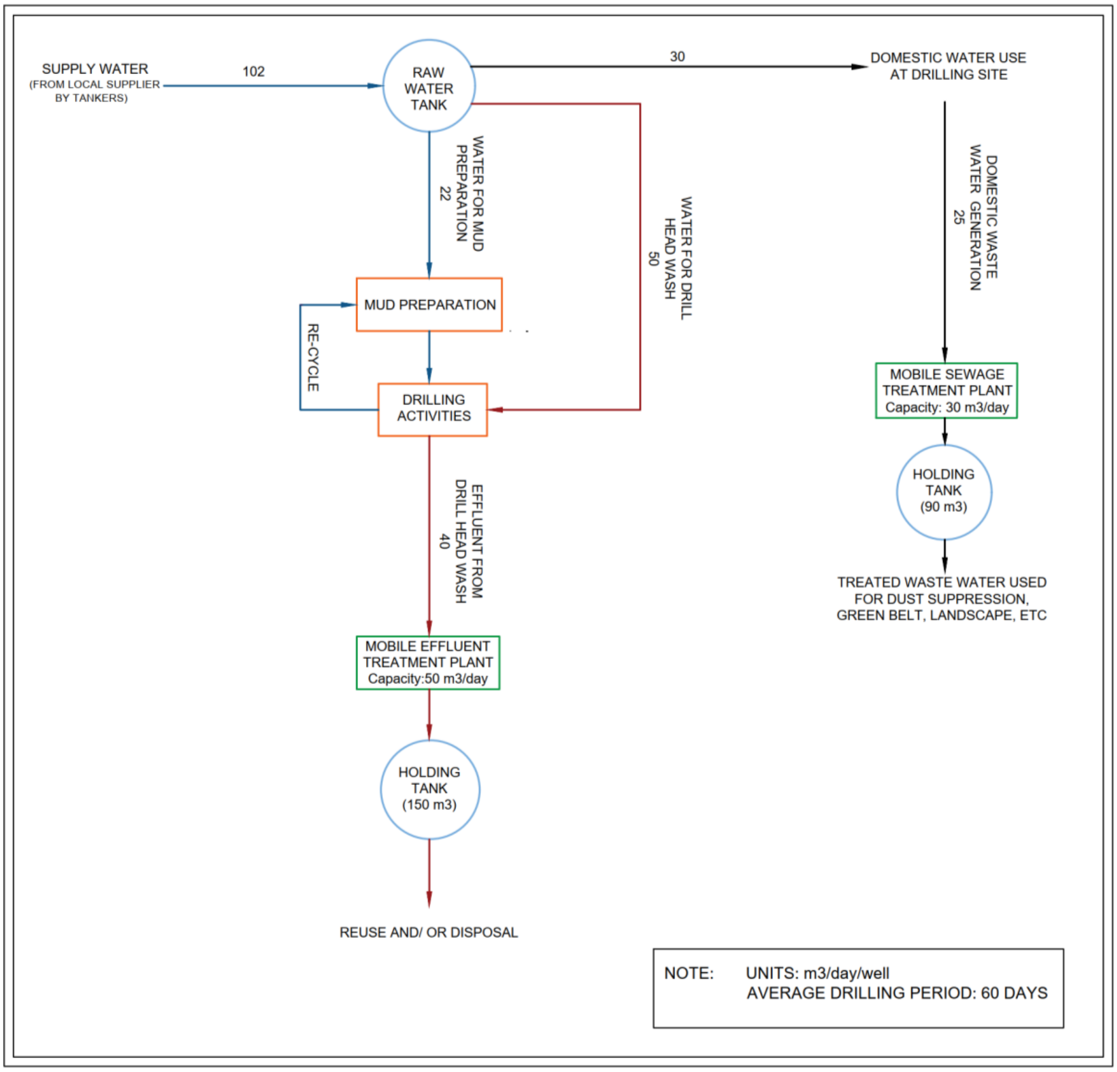


Figure 15. Water Balance for Drilling Phase of the Oil and Gas Exploration

Fuel Consumption

Fuel consumed during the drilling phase would mainly be diesel (HSD) used for various equipment and vehicles operating to transport goods and supplies to site.

During the drilling phase of High-Speed Diesel would be required. Fuel would be supplied onsite by local supplier through mobile tankers. Out of this, a major part approximately 85% would be consumed by the rig (also include the DG sets) and about 15% would be required for the campsite.

Manpower / Employment

Most of the workforce would be from local/nearby area. During the site preparation for drilling, approximately 30-35 workmen would be employed per drill site. During the drilling phase, about 50 workmen per shift would be working on site. This would include technical experts, who would be responsible for various drilling related activities and some technical manpower. 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.

Drilling Hazards

Loss of well control / blow-out, fire, explosion and oil spills are the major potential hazards associated with drilling for oil and gas. Effective response plans to foreseeable emergencies would be developed by Cairn Oil and Gas and communicated to the project teams. The quantitative risk assessment to be carried out as part of this EIA would also contribute towards identification of hazards, risks and formulating management plans for emergency response, blowout, oil spills.

Pollution Sources and Characterization

The various types of pollution from the proposed exploratory drilling operations are:

- Noise and Vibration;
- Air Emission;
- Liquid waste and
- Solid and Hazardous waste generation

Exhaust gases from DG sets, noise from the drilling operations, wastewater, drilling wastes are the major types of the pollutants generated during the proposed drilling operations which is a temporary activity lasting for maximum of 4- 5 months at each of the well locations.

Noise and Vibrations

Noise would be generated during various phases of the project, site preparation, drilling and decommissioning of wells. The major noise generating operations from the proposed activity are drilling operations, diesel generators, mud circulation pumps and movement of vehicles. Noise during the site preparatory phase would primarily be contributed by heavy construction machinery operating on site and vehicular sources. The noise generation work however is transient and limited to the drilling period only. The diesel generators would be provided with acoustic enclosures to comply with the regulatory requirements. Average noise emission ranges for different types of machineries and vehicles is shown in **Error! Reference source not found.** and **Error! Reference source not fo und.** respectively.

As drilling activity is continuous, part of the noise associated with functioning of the rig and ancillaries would be generated throughout day and night.

Table 2.5 Typical Noise Emissions from Construction Machinery

Equipment	Sound Level at Operator (in decibels)	
	Average	Range
	Earth Moving Equipment	
Front End Loader	88.0	85-91
Back Hoe	86.5	79-89
Bull Dozer	96.0	89-103
Roller	90.0	79-93
Truck	96.0	89-103
	Material Handling Equipment	
Concrete Mixer	<85.0	-
Crane/Hydra	<85.0	-
Derrick	100	97-102

Source: British Columbia, "Construction Noise," Workers Compensation Board of BC

Table 2.6 Drilling Rig and Equipment Noise Level

Equipment	Equivalent Noise Level in db (A)	
	Average	Range
Drilling Rig	96.9	88.0-103.0
Mud Pumps	76.9	73.3 -80.5
Diesel Generators	72.7	71.8-73.7
Shale Shakers	76.6	-

Air Emissions

Exhaust emissions are expected from diesel generators to be used for the operation of drilling activities. Emissions are also expected from flaring of gases during testing/extended testing of exploratory and appraisal wells. Vehicular emissions are likely to occur during the transportation of materials, equipment and workforce. The principal air pollutants would comprise of Suspended Particulate Matter (SPM), Sulphur and Nitrogen oxides (SO_2 and NO_2) and other hydrocarbons (HC).

Additionally, the flaring and burning of oil during the testing of the well would also lead to the release of some pollutants including un-burnt hydrocarbons to the atmosphere. Some fugitive emissions of dust and air pollutants from vehicular exhaust would also happen during the project lifecycle, mostly during the operation and decommissioning activities. Additionally, there would be re-entrainment of dust from the approach road leading to the site mainly during the dry season.

The following pollution prevention and control measures would be adopted-

- Air emission specifications would be considered during all equipment selection and procurement.
- The associated gas stream would be routed to an efficient flare system.

Liquid Waste

The drilling operation would generate wastewater in the form of wash water due to washing of equipment, string and cuttings etc. The only other source of wastewater generated from drilling operation is sewage from sanitation facilities. Around 15 to 25 m3/day/well of wastewater would be generated, which would be treated in modular Sewage Treatment Plant (STP) and the treated water would be used for dust suppression, green belt, etc. It is expected that wastewater in the form of Drill cutting washing + Rig washing+ cooling etc shall be generated at an average rate of around 30 to 40 m3/day/well during the drilling operations from a single well. Waste water would be discharged in HDPE lined evaporation pit for disposal. The wash water would contain variable quantities of mineral salts, solids, suspended and dissolved hydrocarbons, and other organic and inorganic components in very minor quantities. The drilling wash wastewater would be treated prior to discharge to comply with the regulatory standards. Treated effluent (PW) would be disposed off on the suitable onshore disposal medium or solar/mech. evaporators depending on feasibility. The quantity of wastewater generation and anticipated disposal methods is given in **Error! Reference source not found.**.

Table 2.7 Waste Water Generated During Drilling and their Disposal

Wastewater	Quantity	Disposal
Drilling wash wastewater	30-40 m3/day/well	The wastewater would be adequately treated in an Effluent Treatment Plant (ETP) to ensure conformance to the CPCB onshore oil and gas extraction industry effluent standards or disposal through solar evaporation.
Domestic Wastewater	15-25 m3/day/well	The domestic wastewater would be treated in mobile Sewage Treatment Plant and the treated water would be used for dust suppression, green belt, etc.

During Early Production

Solid and Hazardous Waste

The different solid and hazardous waste water generated during project and their mode of disposal has been presented in **Error! Reference source not found.**.

Table 2.8 Waste Water Generated during and Mode of Disposal

Waste Type	Quantity	Mode of Disposal
Domestic Waste	25 – 30 kg per day/well	Would be stored in compost pits on daily basis.
Drill Cuttings associated with WBM	250-750 tons/ well	Cuttings would be washed and contained in cuttings disposal area (HDPE lined collection pit) provided per the requirement of HWMHTM, 2016 Rules
Drill Cuttings associated with SBM	500-1500 tons/well	Cuttings would be washed and contained in cuttings disposal area (HDPE lined collection pit) provided per the requirement of HWMHTM, 2016 Rules
Spent/Residual Drilling Mud	250-500 tons/ well	The mud would be disposed as per Hazardous Waste Rules, 2016
Sludge containing oil & other drilling wastes	250-500 tons/ well	The oil contaminated sludge would dispose as per Hazardous Waste Rules, 2016
Used oil	1-2 tons/wel	Used oil would be sent CPCB authorized recyclers.
Non-combustible waste containing metallic residues	1000-1200 kg/well	To be analysed for the trace/heavy metals content before disposing suitably
Left over chemicals and materials, scrap metal	250 - 500 kg/well	Scrap metal and recoverable material to the salvages before dispose of balance material through the registered vendors
Cement, grit, blasting and painting wastes	500 - 600 kg/well	To be disposed of their registered vendors on periodic basis.

Pollution Prevention Control Measures at Design Stage

Vedanta Limited. (Division Cairn Oil & Gas) would include necessary pollution prevention control measures in the well pad designing stage. Basic provision for pollution prevention control measures would be as follows:

- Liquid Mud Plant - The Mud Plant area would be surrounded with a containment boundary wall. All the liquid transferred from the LMP to the drilling site would be through road tankers.
- Chemical Storage Area -The chemicals to be used in preparing mud would be stored on a paved platform with kerb walls and protected against weather by an impervious covering. The storage area would be provided with adequate number of fire extinguishers.
- Spent Drilling Fluid Disposal Pits - Spent drilling fluid would be recycled and reused during drilling phase. The residual wastewater would be sent to solar evaporation pit for natural solar drying. The pits would be lined with HDPE sheet and the overlaps welded together with the edges bought over the rim and tucked into the cement mortar / bund soil.
- Drill Cutting Disposal -Drill Cuttings would be disposed of in lined pitsto avoid contamination of land and groundwater. The pit would be soil bunded and HDPE lined to prevent any overflow to the surroundings.
- Flare Pit (well testing) - To conduct ground flaring, all the sites would have a flaring pit with adequate burner. The flare pit would be made up of RCC / brick lining and are located preferably 90 degrees to the wind direction.
- Diesel Storage Tank - The tank area would be provided with secondary containment (dykewalls)of adequate capacity to control any accidental leaks.
- Waste/ Lubricating Oil Storage - The storage area would have paved flooring, containment bund and roof. Waste oil from pumps and machinery would be collected and stored in used oil barrels and shall be kept in a designated storage area.

- Storm Water Drainage System - A garland drain would be provided all around the drilling site to prevent runoff of any oil containing waste into the nearby area. The storm water drain shall be provided with oil trap and the collected water shall be sent to storm water pit.
- Spill Containment System - Containment systems and oil traps would be provided to trap any spillage of oil at the drilling site. All potential sources of spillage would be equipped with drip pans in order to contain spills.
- Mobile STP - Each well site and camp site would have toilets which would be provided with modular STP for treatment of sewage generated within the well facility.

2.10 Project Cost

Vedanta Limited (Division Cairn Oil and Gas) has planned to carry out the proposed project activities in the AA-ONHP-2017/1 Block over a period of 10-12 years. The estimated project cost is Rs. 584.0 Crore.

3. Description of the Environment

3.1 Introduction

This chapter describes the existing baseline environmental settings in study area including AA-ONHP-2017/1 Block and its immediate surroundings. This includes the physical environment comprising air, water and land components, the biological environment, and socio-economic environment. Attributes of the physical environment like air, water, soil quality and noise level in the surrounding area have been assessed primarily through monitoring and analysis of samples collected from field. Baseline monitoring has been carried out during Summer season, 2019 (March to May 2019). Information about topography, geology, hydrology prevailing natural hazards risks like floods, earthquakes etc. have been collected from different available literatures and information from various government departments. Primary surveys were carried out to understand and record the biological environment prevailing in the area and the same was verified against published information and literatures. The socio-economic environment has been studied through consultations with various stakeholders in the villages within the AA-ONHP-2017/1 Block. Additionally, socio-economic data have been obtained from the Census of India 2011 reports.

3.2 Study area

The study area for determination of environmental, biological and social baseline is the entire AA-ONHP-2017/1 Block and 10km radius area from the Block boundary. The Block AA-ONHP-2017/1 is located in Karbi Anglong and Golaghat district of Assam and Wortha District of Nagaland. Although, no activity is planned in Nagaland district. The entire study area is covered by SoI Toposheet no G46J/12, G46J/16, G46P/9, G46P/13.

3.3 Physiography and Geology

Physiography

As already mentioned, the study area is located at the intersection of KarbiAnglong, Golaghat districts of Assam and Workha District of Nagaland. The physiography of this area is undulating land with elevation of about 100m above MSL. The area falls in the eastern part of KarbiAnglong district which is in the plain areas of the district while in Golaghat district the study area falls in the southern part, which has undulating features. The slope of the area is towards north-east and is gradual.

Geology

The South Assam Shelf is a part of Assam & Assam-Arakan basin and situated in the Dhansiri valley separated from North Assam shelf by a major E-W trending Jorhat fault. The area represents a part of foreland basin flanked by NE-SW trending Naga Schuppen belt on the East & Southeast and Mikir Massif in the West. The area is sparsely exhibiting intra-cratonic graben filling sediments from Permian age to basaltic flows of Early Cretaceous age. The extensive Late Cretaceous-Oligocene sequence deposited in Passive margin setting witnessed differential erosion at places and overlain by a thick pile of Miocene to Recent sediments deposited in a foreland setting. The total sedimentary thickness in the area is of the order of 3500 m. Reservoirs in different stratigraphic levels starting from fractured Basement to Sylhet, Kopili, Barail, Bokabil, Tipam and Namsang have been charged in different parts of the basin depending on entrapment and are required to be probed for hydrocarbons.

3.4 Hydrogeology

Karbi Anglong District

As mentioned earlier, the entire Karbi Anglong district can be divided into Consolidated formations comprising oldest granite rock, gneisses etc, semi-consolidated rocks constituting the Tertiary rocks and unconsolidated alluvial sediments. In the consolidated formation, ground water is confined to the top weathered zone and the fractures and fissures of the fresh hard rock. The thickness of the weathered zone depends on compactness and topography of rock types and other climatic effects. The depth of water level varies from 4 to 6 m in low terraced zone and 8 to 10 m in high terraced zones. In small valleys within denudational hills, the static water level is 5 to 7 m bgl with water level fluctuation ranging from 2 to 3 m. The depth of the weathered materials generally is from 10 – 20 m. About 13 nos. borewells were drilled in hard rock and yield of the boreholes are limited. The depth to water level varies from 1 m to as much as 14 m or more up to 28 m bgl. Based on the tube well data drilled by CGWB the sub-surface aquifer geometry is described as follows. The shallow aquifer constitutes mixture of sand, clay with little gravel. Its thickness varies from 15 to 30 m. Ground water occurs under water table to semi-confined conditions. The deeper aquifers consist of fine to coarse sand and gravel with intercalation of clay bands. 3 to 6 aquifer zones are demarcated within stipulated depth. Auto flow conditions are observed in Ongaon and Nathgaon areas in Howraghat block with piezometric head within 0.5 m to 1.5 m agl with auto flow discharge of 30 to 60 lpm. Auto flow condition is also observed around Bokajan area with fluctuation of piezometric head from 0.3 to 0.5 m in Bokajan, Howraghat and Rongkhong blocks respectively.

Golaghat District

The district is underlain by Quaternary formation followed by Archaean group of rocks. The cumulative thickness of aquifer zones has the tendency to increase towards the north and in the southeastern parts, the thickness reverses considerably. Hydro-geologically, the district is proved to be very potential. Ground water occurs under water table to confined conditions. Depth to water level in major parts of the district varies from 2 to 5 m. In the extreme southern and south-western parts close to hills, the water level is found to be deeper and generally rests within 5 to 7 m. The movement of ground water is from south to north. The water level trend shows that there is gradual rising of water level in the district. Central Ground Water Board has so far constructed fourteen exploratory tube wells in the district. Hydrogeological information collected from these wells indicates that three to nine prolific aquifer system exist in the district. Deep tube wells constructed down to maximum depth of 250 m give variable discharge from 26 to 216 m3 /hr for draw down within 13 m. Transmissivity and permeability value varies from 415 to 500 m2 /d and 7 to 82 m/day respectively.

Hydrogeological Map for Golaghat and Karbi Analog are given in Figure 16 and 17 respectively

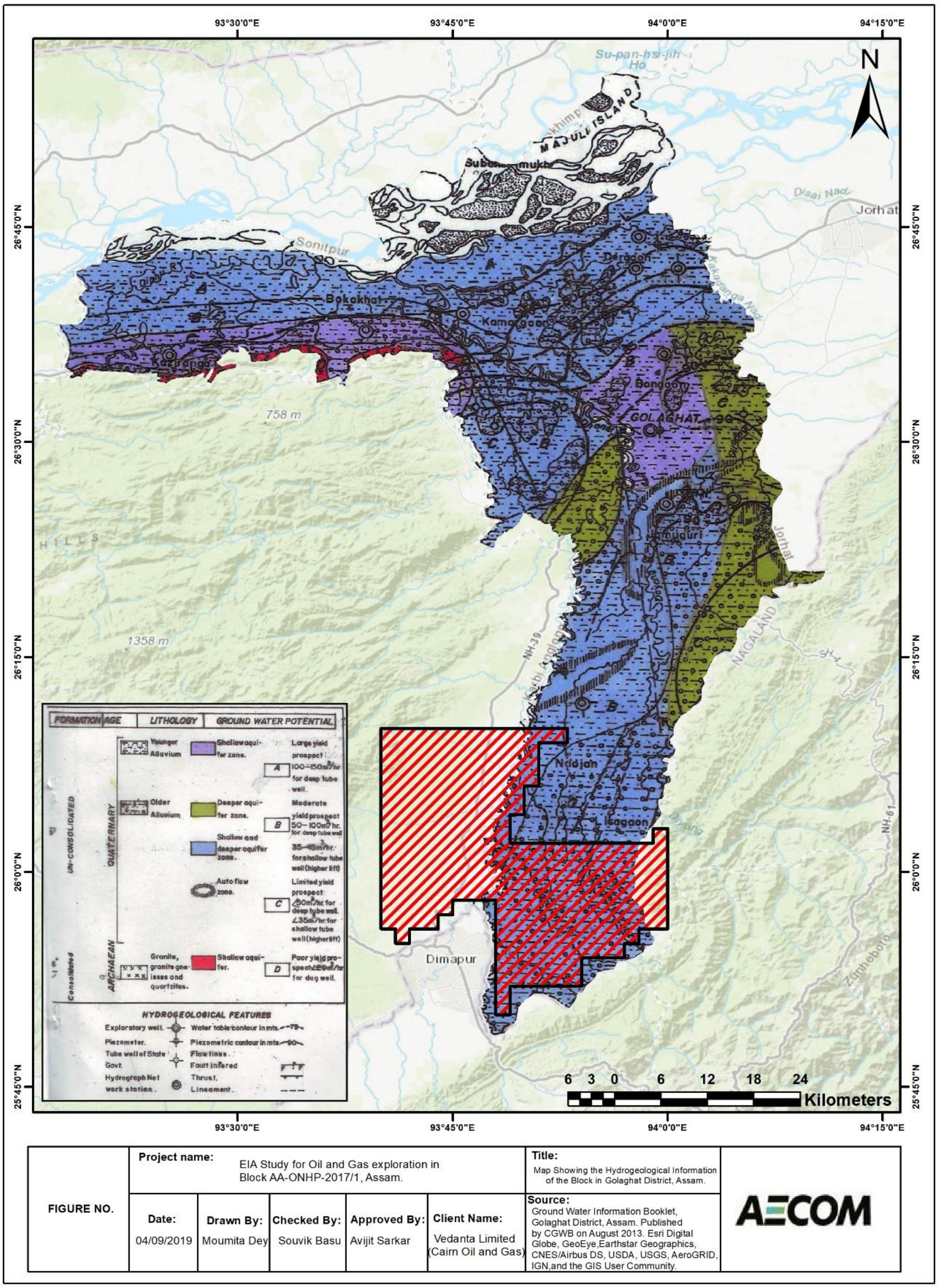


Figure 16: Hydrogeological Map, Golaghat District

Source: http://cgwb.gov.in/District_Profile/Assam/Golaghat.pdf

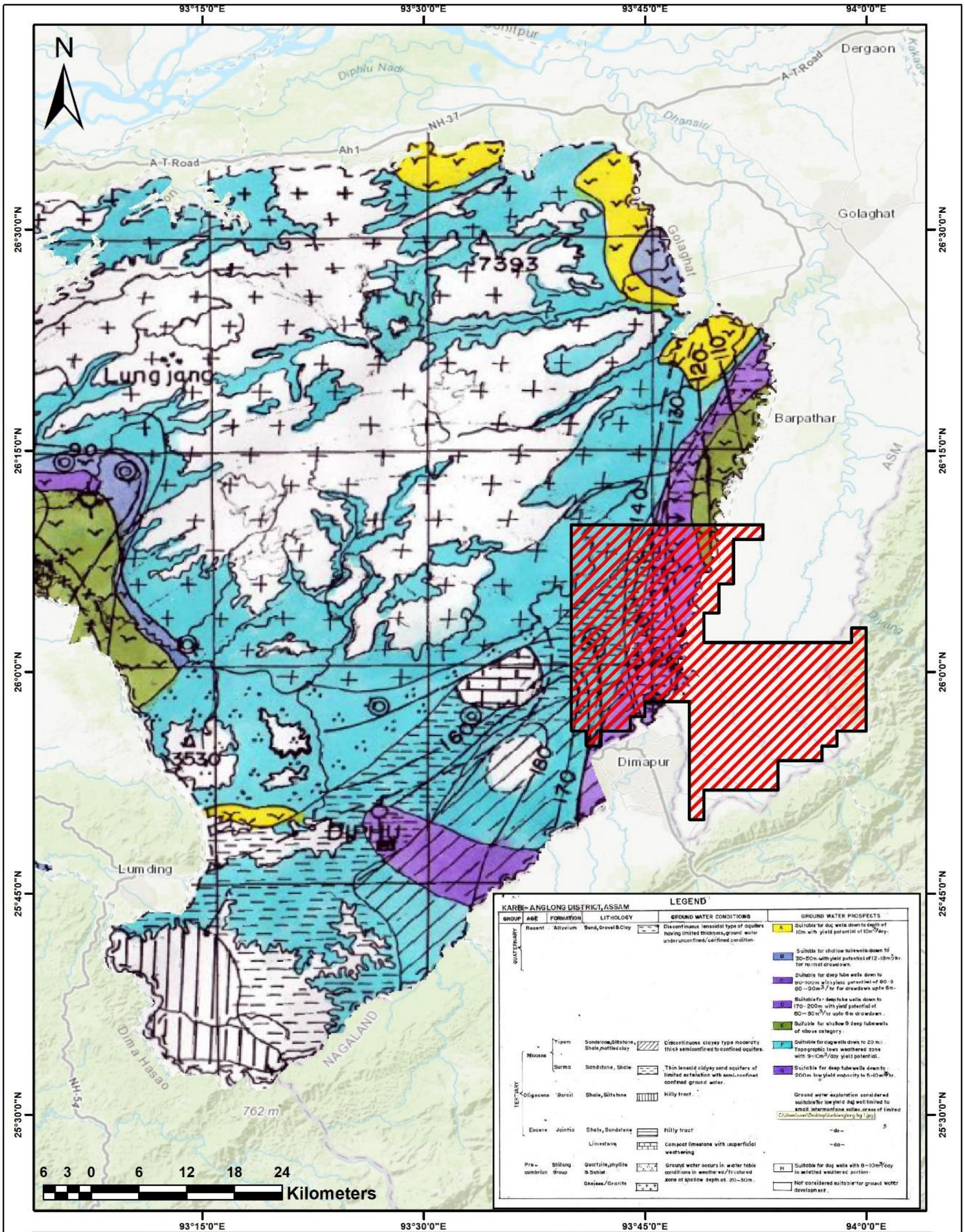


FIGURE NO.	Project name: EIA Study for Oil and Gas exploration in Block AA-ONHP-2017/1, Assam.				Title: Map Showing the Hydrogeological Information of the Block in KarbiAnglong District, Assam.	AECOM
	Date: 04/09/2019	Drawn By: Moumita Dey	Checked By: Souvik Basu	Approved By: Avijit Sarkar	Client Name: Vedanta Limited (Cairn Oil and Gas)	Source: Ground Water Information Booklet, KarbiAnglong District, Assam. Published by CGWB on August 2013. Esri Digital Globe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community.

Figure 17: Hydrogeological Map, Karbi Analnog District

Source: http://cgwb.gov.in/District_Profile/Assam/Karbi%20Anglong.pdf

3.5 Topography

The general topography is plain with undulating terrains in south, south east (**Figure 18**). Dhansiri River flows through the block in north south direction of the block and Bakala Nadi flows in the western side, nearest distance is 406 meters from the proposed block boundary. In general, the elevation of the block ranges between 429-584m above mean sea level.

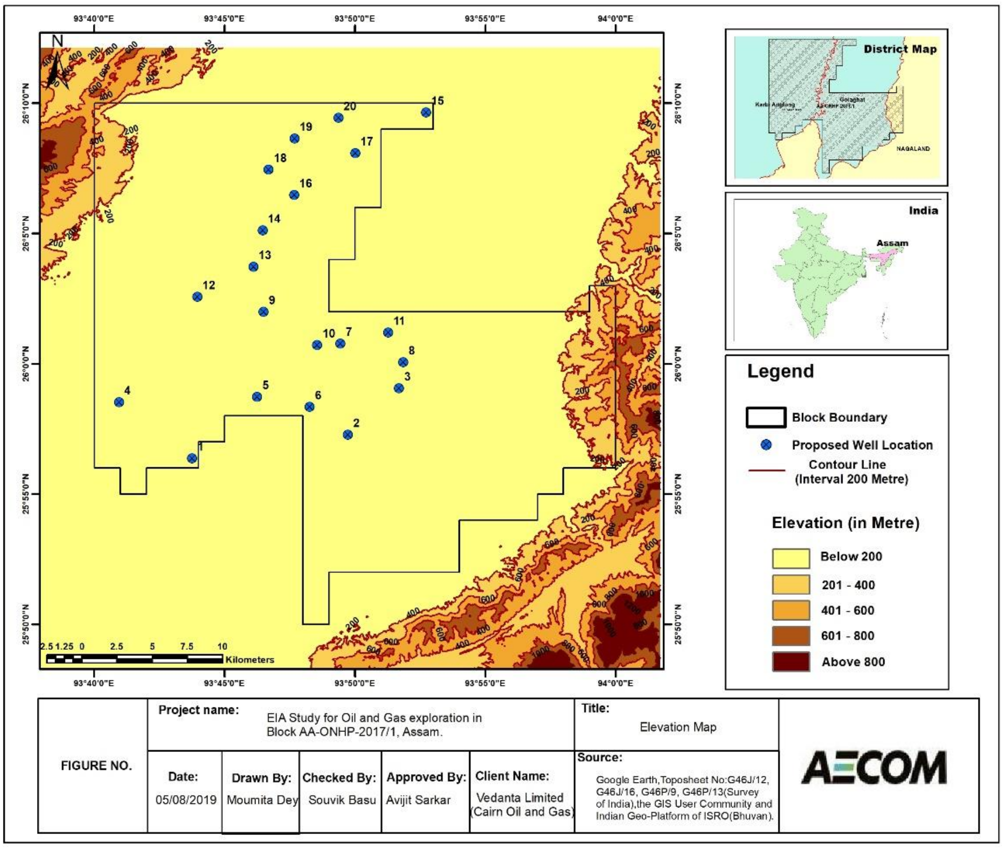


Figure 18. Elevation Map of the Block AA-ONHP-2017/1.

3.6 Drainage

The River Brahmaputra flowing in east-west direction in the extreme northern parts of the district and its tributaries flowing in northerly direction, control the entire drainage system of the district and plays an important role in the ground water occurrence and control of the district. Important Rivers of the district are Dhansiri and Dayang. These rivers have meandering courses with abandoned channels in the form of bils and ox-bow lakes along their courses. The drainage map for Block AA-ONHP-2017/1 is given Figure 19.

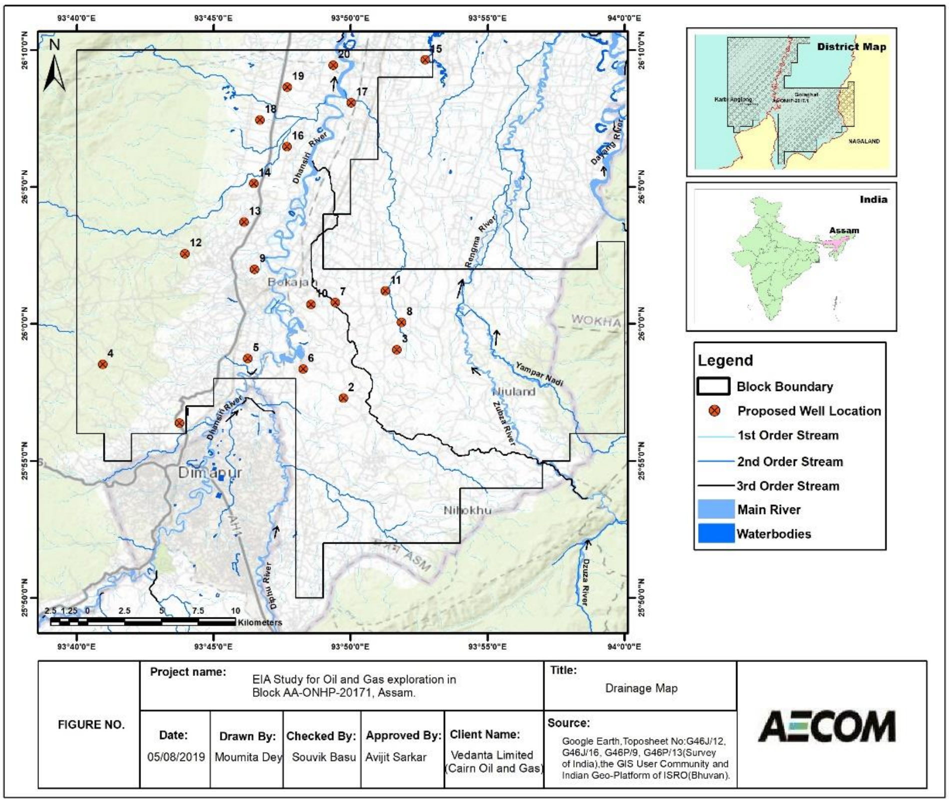


Figure 19. **Drainage Map of the Block AA-ONHP-2017/1**

3.7 Vulnerability of the Site

A natural disaster during the life cycle of the project can have a significant effect on the functioning of the project in addition to affecting the local environment in the area and stressing the availability of resources for the project. Such disasters also sometimes create difficulties in access through disruption of transportation links.

Seismicity

The study area is located in Zone V as shown in the Bureau of Indian Standards (BIS) 2000 seismic zone map is given in Figure-20. Zone V is defined as region which might encounter earthquakes of maximum intensity.

The region has experienced a large number of earthquakes of tectonic origin. The risk probabilities of earthquake are less over the entire Brahmaputra valley. Two major earthquakes of magnitude 8.7 (occurred in 1897) and 8.6 (in 1950) causing large scale damage to life and properties in this region. The details of the earthquakes are given in Table-3.1. and the seismeic zone map.

Table 3.1 SIGNIFICANT EARTHQUAKES IN ASSAM

Date of Earthquake	Location of Epicentre	Remarks
12th June 1897	Near Rangjoli, Assam	Magnitude M 8.7. This was one of the most powerful earthquakes in the Indian sub-continent. The quake wreaked havoc across the present states of Assam and Meghalaya. 1500 people were killed and hundreds more hurt.
15th Aug 1950	Indo-China Border Region	Magnitude M 8.6. This "Independence Day" earthquake was the 6th largest earthquake of the 20th century. Though it hit in a mountainous region along India's international border with China, 1500 people were killed and the drainage of the region was greatly affected

Source: Amateur Seismic Centre www.asc-india.org

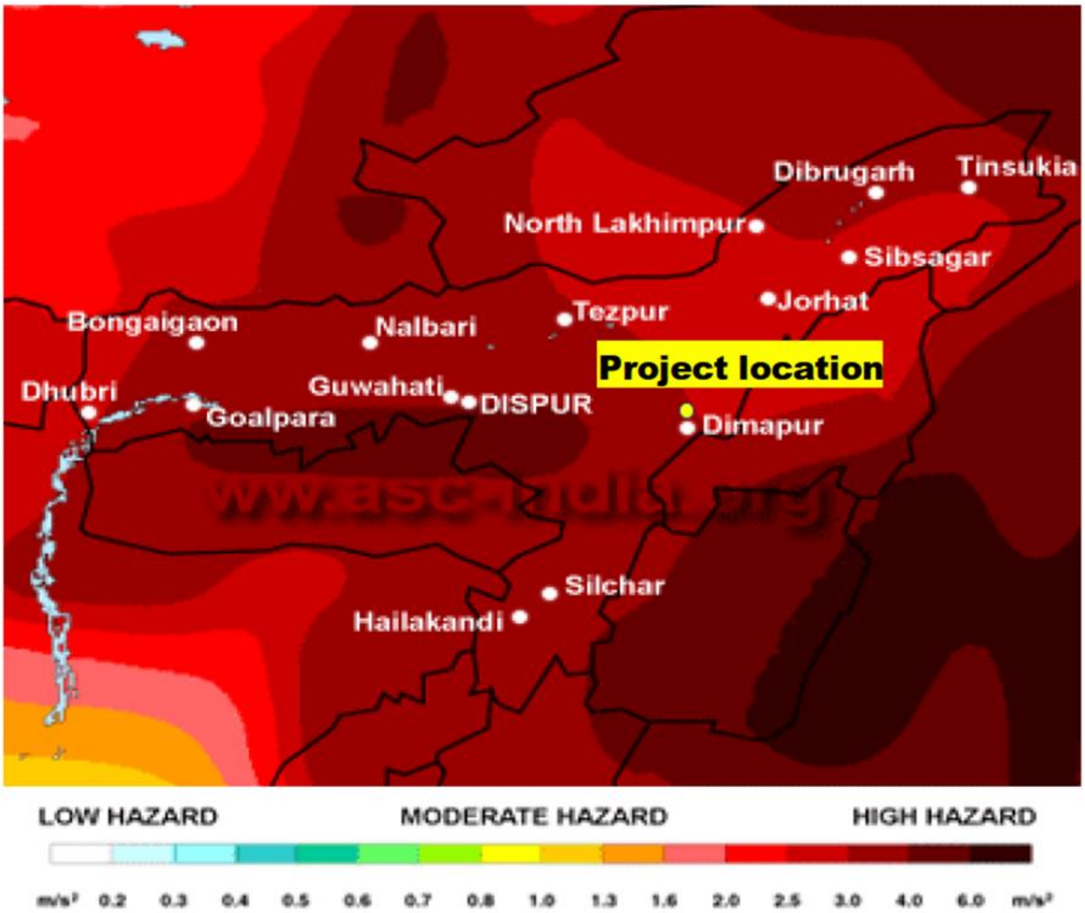


Figure 20. Seismic Zone & Flood Zone Map of Assam

Source: Disaster Management, Relief & Civil defence Department, Govt. of Assam

Floods

One of the most serious problems of Assam is the occurrence of frequent and widespread floods. The Brahmaputra and the Barak are the two main rivers, which causes major problem during the monsoon period every year in the form of floods thereby resulting in bank erosion and drainage congestion. Large areas are inundated by floods causing heavy loss in terms of life and property; and also cause extensive damage to standing crops thereby affecting local livelihood. The flood history of Assam is given in Table 3.2.

Table 3.2 Flood History in Assam

Year	Affected Area (Lakh ha)	Affected Population (Lakh)	Total Damage (in Crores INR)
1990	0.488	1.692	74.56
1991	0.997	5.307	191.15
1992	0.213	0.974	26.56
1993	1.348	5.261	0.215
1994	0.053	0.177	0.20
1998	0.972	4.698	700.00
2000	1.000	3.900	244.06
2001	0.200	0.540	11.14

Year	Affected Area (Lakh ha)	Affected Population (Lakh)	Total Damage (in Crores INR)
2002	1.960	6.960	210.95
2004	All of the 27 districts, worst affected districts, Karimganj, Cachar, Nagaon and Golpara	122.0	NA

Source: Disaster Management, Relief & Civil defence Department, Govt. of Assam

It was revealed from the Disaster Management Plan of Golaghat District (2011) that the entire district is Flood prone. Flood mainly occurs from May to September. The Flood Hazard Maps of Golaghat District (1998-2007) prepared by National Remote Sensing Agency (NRSA) showed that Flood primarily occurs in areas abutting the courses of Brahmaputra and Dhansiri Rivers.

3.8 Land use/Land Cover

Land use Pattern in the Study Area

It is observed that, major land use pattern of Block AA-ONHP-2017/1 is Agricultural Land which is covering 282.86 sq km area of the study area. Besides agricultural land, other land uses which are observed in the study area are Forest land(233.34 sq km), Marshy land (28.54sq km) and Plantations (54.7sq km) Land. The detail of land use pattern in the study area is given in **Table 3.3** and in Figure 21. Pie chart of the Land use map of the AA-ONHP-2017/1 Block is presented in Figure 22

Table 3.3 Land use Pattern in the study area

Sl. No.	Land Use Pattern	Area (in Km^2)
1	RIVER	8.199155
2	WATER BODY	0.429784
3	FOREST LAND	233.346342
4	BUILT UP	47.013378
5	INDUSTRY	0.119952
6	BRICK KLIN INDUSTRY	2.443384
7	TEA GARDEN	56.589011
8	PLANTATIONS	54.701588
9	MARSHY LAND	28.544361
10	AGRICULTURAL LAND	282.868457

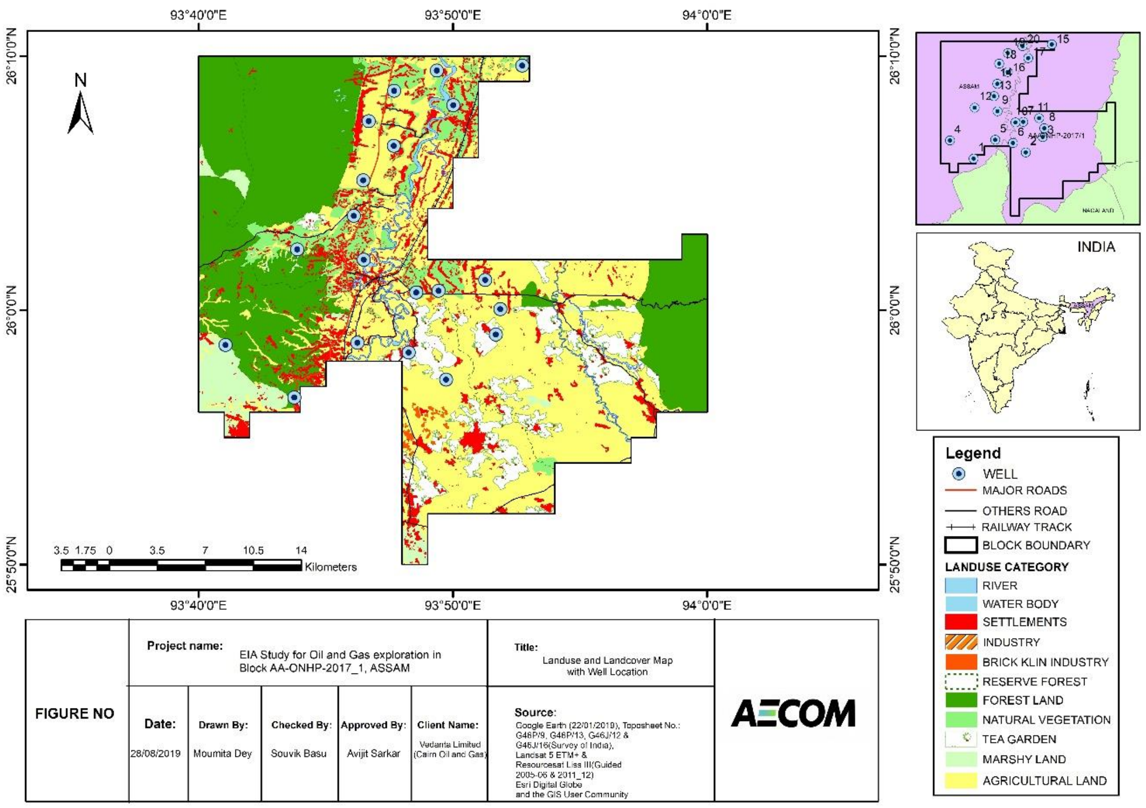


Figure 21 : Land Use Land Cover Profile of the Study Area.

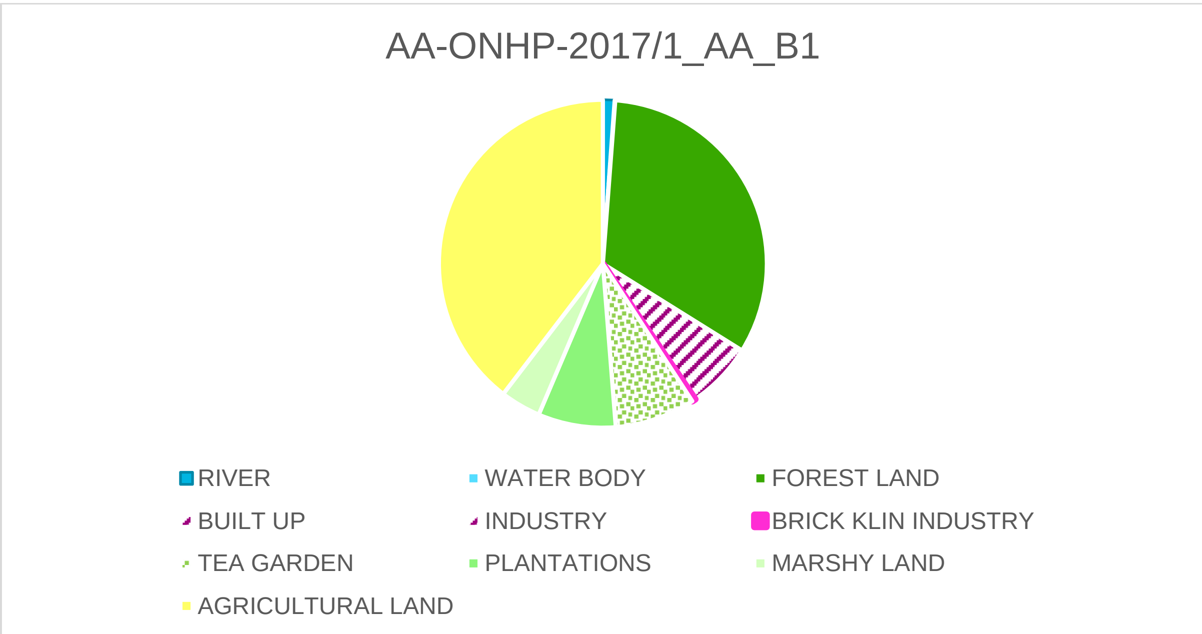


Figure 22. Pie chart for Land use of Block 1

3.9 Climate & Meteorology

Temperature

As per climatological table of 1971-2000 of Indian Meteorological Department (IMD) nearest weather station to AA-ONHP_2017/1 is located in Lumding city which is located approximately 54 km in south west direction of the block. As per the data, temperature reaches around 42.0°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 2.2°C.

Relative Humidity

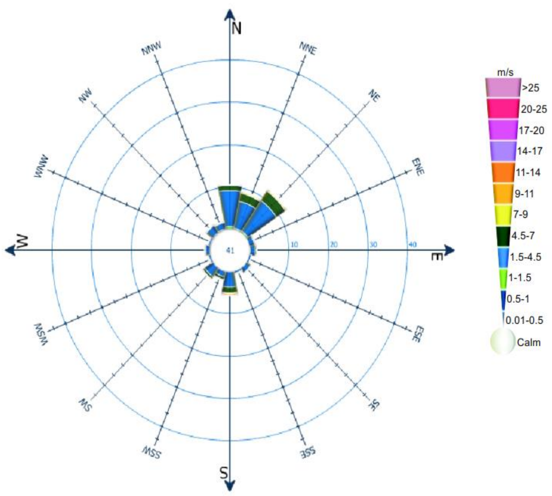
As per the Climatological Normal (1981-2010), mean relative humidity in winter, at day time was recorded as 87%, whereas the mean night time relative humidity was 85%. In summer mean day time relative humidity accounted as 87%.

Rainfall

Lumding has annual mean rainfall of 1239.2 mm throughout the year. Highest rainfall recorded in monsoon.

Wind Speed and Wind Direction

As per the Atlas of Windrose (1971-2000) by Indian Meteorological Department, highest monthly mean wind speed is 3.2 m/s and lowest monthly mean wind speed is 1.8 m/s in November. Predominant wind direction is NNE direction.



DIR. (Degrees)	SPEED OF 10-MN MEAN WIND meters per second												
	0.0 - 0.5	0.5 - 1.0	1.0 - 1.5	1.5 - 4.5	4.5 - 7.0	7.0 - 9.0	9.0 - 11.0	11.0 - 14.0	14.0 - 17.0	17.0 - 20.0	20.0 - 25.0	>=25.0	total
348-11	0.0	0.0	0.6	8.5	1.3	0.0	0.0						10.4
11-33			0.3	6.5	2.0	0.4	0.1						9.3
33-56			0.5	8.7	2.7	0.3	0.1	0.0					12.3
56-78			0.0	1.3	0.2	0.0							1.5
78-101			0.1	1.3	0.3	0.0							1.7
101-123			0.0	0.6	0.0								0.6
123-146			0.1	1.3	0.1								1.5
146-168			0.0	0.5	0.2								0.7
168-191		0.0	0.1	3.7	1.4	0.3	0.3	0.0					5.8
191-213			0.1	1.3	0.7	0.1	0.1						2.3
213-236			0.1	2.5	0.6	0.1	0.0						3.3
236-258				0.5	0.2	0.0		0.0					0.7
258-281			0.0	1.0	0.3	0.0				0.0			1.3
281-303			0.1	0.5	0.1	0.0	0.0						0.7
303-326			0.1	2.0	0.2	0.1							2.4
326-348			0.1	1.5	0.2	0.0							1.8
Total	0.0	0.0	2.2	41.7	10.5	1.3	0.6	0.0	0.0	0.0	0.0	0.0	56.5
Calm:	43.5	Total data used:10948 Total missing data: 5563											

Source: Windrose Atlas (1971-2000) by Indian Meteorological Department

Figure 23. Windrose of Jorhat

Note: Windrose for Lumding district is not present in IMD Atlas.

Table 3.4 Climatology profile of Lumding

Seasons	Temperature (°C)		Relative humidity		Rainfall (mm)
	Maximum	Minimum	Day time	Night time	
Winter	89.3	22.7	83	77	158.9
Summer	108.8	43.2	89	86	331.7

Monsoon	109.0	65.0	90	86	1062
Post Monsoon	101.0	50.0	82	75	303

Source: IMD Meteorological table

Micrometeorological Parameters

Block Micrometeorological parameters have been observed to assess the local climatic condition of the study area. Micrometeorological setup was installed at Bokajan Village. The micro met monitoring stations have been installed at a height of about 10 m above the ground level, ensuring that there are no obstructions to the free flow of winds. A three-monthly (March to May 2019) monitoring was conducted, and the prevailing meteorological conditions are discussed below (Table 3.5).

Meteorological profile of this region characterised by medium temperature with high humidity, with a medium lesser amount of rainfall. Temperature of this region varies from, 16.9°C to 36.3°C. Relative humidity accounts for 78. 2%, on an average throughout the monitoring period. Average wind speed was measured as 3.18 metre/second throughout the study period with predominant wind direction from NE to SW.

Table 3.5 Climatological profile of the Study Area

Station name	Temperature(°C)		Relative humidity	Rainfall	Wind speed	Wind direction
	Max	Min	(Average)	(mm)	(mph)	
Bokajan	36.3	16.9	78.8	60.62mm	3.18	NE to SW

Source: MET station installed at Bokajan

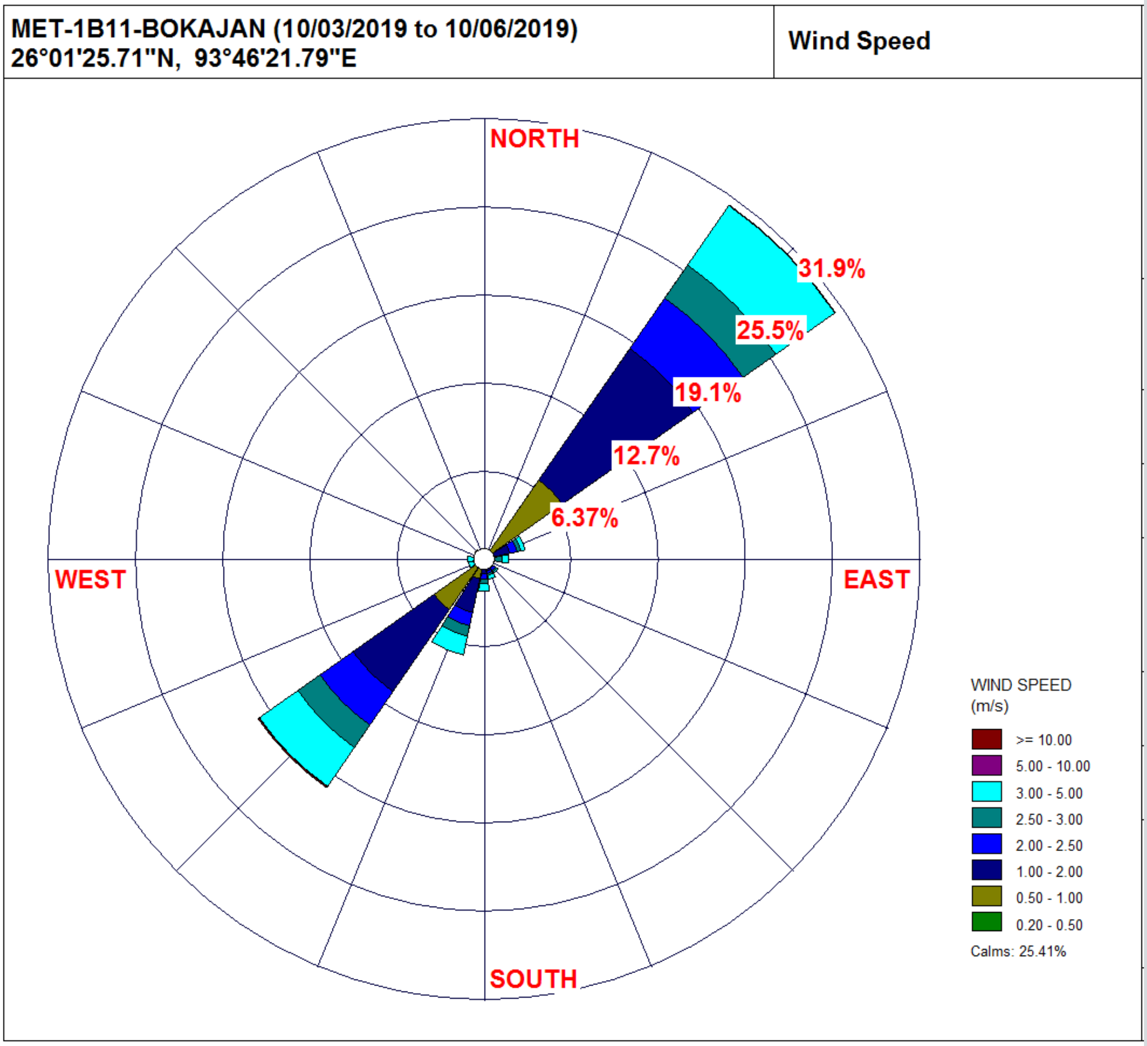


Figure 24. Windrose of Bokajan MET station.

Source: MET station installed at Bokajan

Ambient Air Quality

The baseline status of the ambient air quality was assessed through a scientifically designed ambient air quality-monitoring network. The design of monitoring network in the air quality study was based on (i)meteorological conditions on synoptic basis; (ii) topography of the study area; (iii) representatives of regional background air quality for obtaining baseline status; (iv) representatives of likely impact areas and (v) location of sensitive receptors in the study area, (vi) settlement area and (vi) accessibility and availability of infrastructure. Criteria used for designing the network have been principally governed by pre-dominant wind directions obtained from the wind rose pattern for the summer season and the accessibility of the selected sites.

Ambient air quality monitoring was conducted for following parameters:(i) Particulate Matter (PM10 & PM 2.5), (ii) Sulphur Dioxide (SO_2), (iii) Nitrogen Dioxide (NO_2), (iv) Carbon monoxide (CO),Ozone(O_3), Benzene(C_6H_6), Benzo alpha pyrene (BaP), Lead(Pb) ,Arsenic(As), Nickel(Ni) , Ammonia(NH_3) ,Hydrocarbons(HC)- both methane and non-methane , Volatile Organic Compounds (VoC). Ambient air quality monitoring was conducted at AA-ONHP-2017/1 Block in representative locations during pre-monsoon season i.e. March to May 2019.

There are 8 locations have been selected in the study area for ambient air quality monitoring. The air monitoring activity was conducted as per the approved CPCB guidelines. The monitoring locations have been selected after considering the upwind, downwind and cross wind direction of the proposed well location within the study area.

AAQ Monitoring Locations

The ambient air quality monitoring was carried out at eight (8) locations in and around the study area. The monitoring locations have been selected taking into considerations factors such as predominant up & down wind directions and cross wind direction of the proposed well location, locations of the sensitive receptors in the Block area, and, any existing air pollution sources also taken into consideration during selection of monitoring location.

The detail ambient air quality monitoring results is given in Appendix 3-2. The location of the 8 air monitoring locations is given in Table 3-6

Table 3.6 Ambient Air Quality Monitoring Stations

Location Code	Location	Coordinate	Direction	Justification
AAQ1	Nepali Basti, Balipathar	25°51'41.80"N, 93°48'22.52"E	1.39 km SW from Well no 2	Predominant downwind of Well 2
AAQ2	Romon Ringtigaon	25°52'5.17"N 93°51'57.04"E	0.81 km SSW from Well no 1	Predominant downwind of Well 1
AAQ3	Satsang Village	25°57'59.62"N 93°50'11.87"E	2.5km NW from Well no 13	Predominant downwind of Well 13
AAQ4	Goutam Basti	25°54'27.75"N 93°56'4.79"E	2.0 km SW from Well no 8	Predominant downwind of Well 8
AAQ5	Ekrani Basti	26° 3'52.87"N 93°46'30.81"E	0.70 km ENE from well no 35	2nd Predominant downwind of Well 35
AAQ6	Santigaon	25°58'6.49"N 93°42'48.39"E	2.0km NW from well no 11	Upwind of Well 11
AAQ7	Panchlamardgaon	26° 0'35.78"N 93°54'29.95"E	1.62 km SSW from Well no 30	Predominant downwind of Well 30
AAQ8	Gharialdubi	26° 9'41.93"N 93°46'33.52"E	1.5km NNW from Well no 45	Near Nambar Reserved Forest

Source: Primary baseline Survey of Air Quality, (March – May 2019)

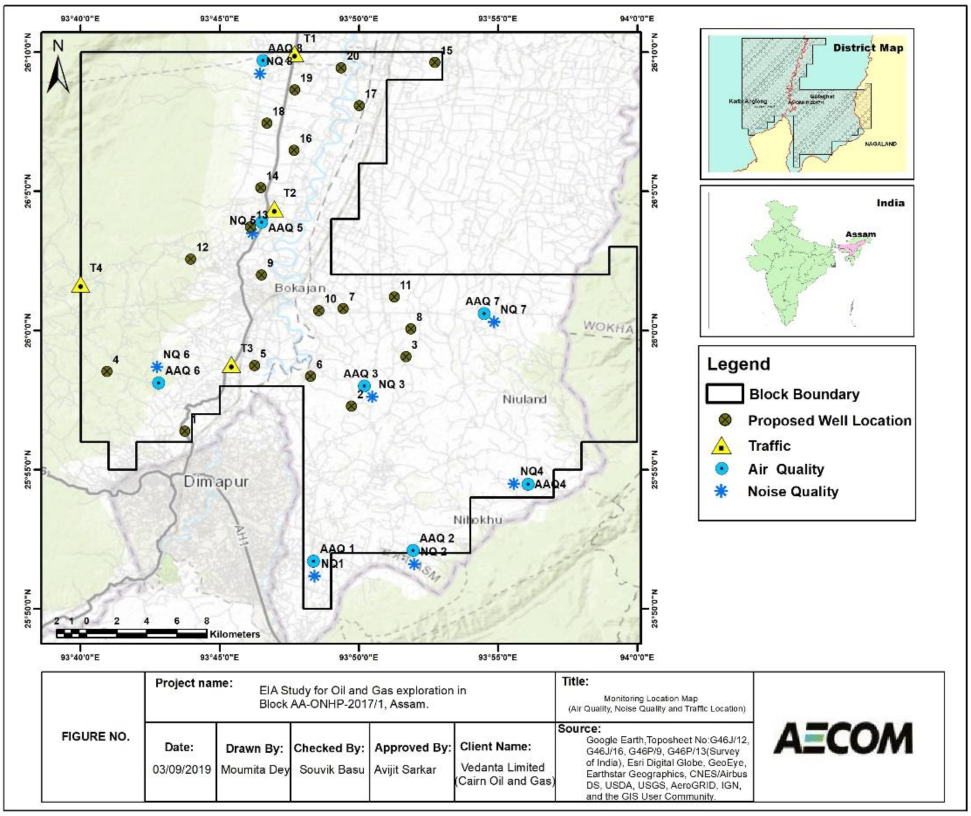


Figure 25. Ambient Air Quality, Noise quality and Traffic Monitoring Stations in Block AA-ONHP-2017/01

AAQ monitoring Results

Ambient air quality monitoring was conducted for twice a week 24 hourly for three months at eight (8) locations for each parameter as listed above in table below. Analysis of ambient air quality monitoring results for March to May'19 is presented in **Table 3-7.**

Table 3.7 Ambient Air Quality monitoring result of Block AA-ONHP-2017/1

Parameter	Results	AAQ-1	AAQ-2	AAQ-3	AAQ-4	AAQ-5	AAQ-6	AAQ-7	AAQ-8
PM10 (µg/m3)	NAAQS	100	100	100	100	100	100	100	100
	Max	81.3	83.7	87.3	82	80.8	81.8	80	80.4
	Min	34.2	31.2	42.2	37.5	34.2	37.5	34.5	37.2
	Average	62.6	63.5	65.0	65.3	62.8	62.4	63.5	63.0
	98th Percentile	79.92	82.09	84.59	80.95	80.30	81.06	79.36	79.94
PM2.5 (µg/m3)	NAAQS	60	60	60	60	60	60	60	60
	Max	51.7	41.8	52.6	48.3	43.3	49.7	44.6	51.8
	Min	14.5	14.5	22.9	18.6	16.6	18.5	20.6	24.6
	Average	31.9	32.7	33.7	33.8	30.9	32.5	32.0	33.5
	98th Percentile	47.37	41.71	51.96	47.06	42.47	49.24	43.54	49.73
SO2 (µg/m3)	NAAQS	80	80	80	80	80	80	80	80
	Max	8.1	7.5	7.6	7.7	8.5	8.2	8.2	7.9
	Min	6.2	6.2	6.2	6	6	6.1	6.2	6.1
	Average	6.9	6.8	7.0	6.7	7.0	6.8	7.1	6.9
	98th Percentile	8	7.45	7.6	7.59	8.38	8.00	8.2	7.79
NO2 (µg/m3)	NAAQS	80	80	80	80	80	80	80	80
	Max	33.9	31.2	33.9	33.1	36.3	34.1	35.7	29.5
	Min	16.5	15.2	16.3	15.2	13.5	12.5	12.2	15.2
	Average	22.7	22.6	24.7	23.7	23.9	22.6	23.7	22.8
	98th Percentile	31.32	30.97	33.02	32.64	35.59	33.73	33.58	29.45
CO (mg/m3)	NAAQS	4	4	4	4	4	4	4	4
	Max	0.64	0.58	0.69	0.75	0.77	0.78	0.77	0.65
	Min	0.15	0.19	0.16	0.19	0.16	0.19	0.16	0.19
	Average	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
	98th Percentile	0.63	0.57	0.67	0.75	0.72	0.77	0.69	0.63
NH3 (µg/m3)	NAAQS	400	400	400	400	400	400	400	400
	Max	26.3	19.6	23.3	20.4	26.6	20.2	35.7	24.2
	Min	10.2	10.6	11.4	14.4	11.3	11.2	12.2	11.7
	Average	16.7	15.4	15.8	17.2	18.3	15.7	23.7	17.1
	98th Percentile	26.1	19.45	22.42	20.19	25.69	19.88	33.58	24.00
C6H6 (µg/m3)	NAAQS	5	5	5	5	5	5	5	5
	Max	<4.2	<4.2	<4.2	<4.2	<4.2	<4.2	<4.2	<4.2

Parameter	Results	AAQ-1	AAQ-2	AAQ-3	AAQ-4	AAQ-5	AAQ-6	AAQ-7	AAQ-8
	Min	<4.2	<4.2	<4.2	<4.2	<4.2	<4.2	<4.2	<4.2
	Average	<4.2	<4.2	<4.2	<4.2	<4.2	<4.2	<4.2	<4.2
	98th Percentile	<4.2	<4.2	<4.2	<4.2	<4.2	<4.2	<4.2	<4.2
BAP (ng/m3)	NAAQS	1	1	1	1	1	1	1	1
	Max	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Min	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Average	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	98th Percentile	<0.5	<0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
O3 (µg/m3)	NAAQS	180	180	180	180	180	180	180	180
	Max	24.5	25.4	26.6	24.9	25.3	26.5	26.9	26.3
	Min	21.4	20.5	21.2	20.7	21.5	20.9	20.8	20.9
	Average	22.8	22.9	23.6	23.2	23.5	23.0	23.2	22.3
	98th Percentile	24.47	25.25	26.36	24.9	25.27	26.37	26.69	25.89
Pb (µg/m3)	NAAQS	1	1	1	1	1	1	1	1
	Max	0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Min	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Average	0.0	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	98th Percentile	0.049	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Ni (ng/m3)	NAAQS	20	20	20	20	20	20	20	20
	Max	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
	Min	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
	Average	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
	98th Percentile	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
As (ng/m3)	NAAQS	6	6	6	6	6	6	6	6
	Max	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	Min	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	Average	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	98th Percentile	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
HC as Methane (µg/m3)	NAAQS	-	-	-	-	-	-	-	-
	Max	2.79	2.51	2.83	2.94	2.78	2.83	2.78	2.94
	Min	0.81	0.93	1.1	1.23	0.82	1.2	1.04	1.04
	Average	1.6	1.7	1.9	1.8	1.8	1.9	1.9	1.8
	98th Percentile	2.78	2.46	2.74	2.87	2.65	2.68	2.74	2.68
HC as Non-Methane (µg/m3)	NAAQS	-	-	-	-	-	-	-	-
	Max	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1

Parameter	Results	AAQ-1	AAQ-2	AAQ-3	AAQ-4	AAQ-5	AAQ-6	AAQ-7	AAQ-8
	Min	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Average	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	98th Percentile	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1

Note: NAAQS = National Ambient Air Quality Standards; BDL = Below Detection Limit; NA = Not Available

DL = Detection Limit; DL for C6H6 = 2.0 µg/m3, DL for BAP = 0.5 µg/m3, DL for O3 = 10.0 µg/m3, DL for Pb = 0.01 µg/m3, DL for As = 0.5 ng/m3, DL for HC as Methane = 2.5 µg/m3, DL for HC as Non-Methane = 2.5 µg/m3,

Particulate Matter (PM_{10})

PM_{10} concentration in the study area varied from 79.36 µg/m^3 to 84.59 µg/m^3. The monitoring location at AAQ 3, observed the maximum concentration of PM_{10} i.e 84.59 µg/m^3, whereas minimum PM_{10} concentration was observed at AAQ 7, i.e 79.36 µg/m^3. Graphical presentation of concentration of PM_{10} values is given Figure 26

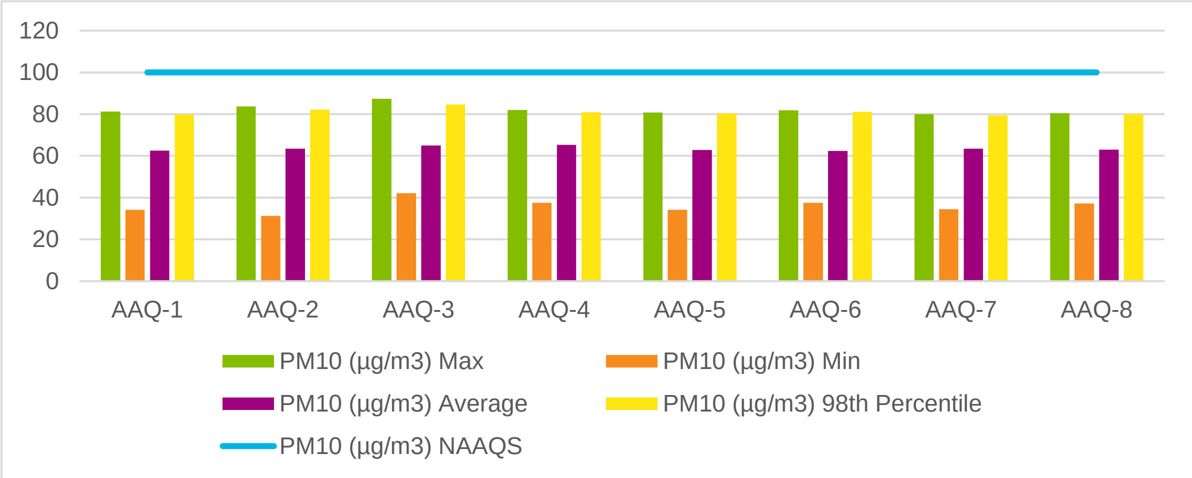


Figure 26. PM 10 Values at the Monitoring Locations.

Particulate Matter (PM2.5)

$PM_{2.5}$ concentration in the study area varied from 41.71 µg/m^3 to 49.73 µg/m^3. The highest PM 2.5 concentration was observed at monitoring location AAQ8 which is 49.73 µg/m3 and the lowest concentration of PM 2.5 is located at monitoring location AAQ 8 which is 41.71 µg/m3. Graphical presentation of concentration of PM2.5 values is given Figure 27.

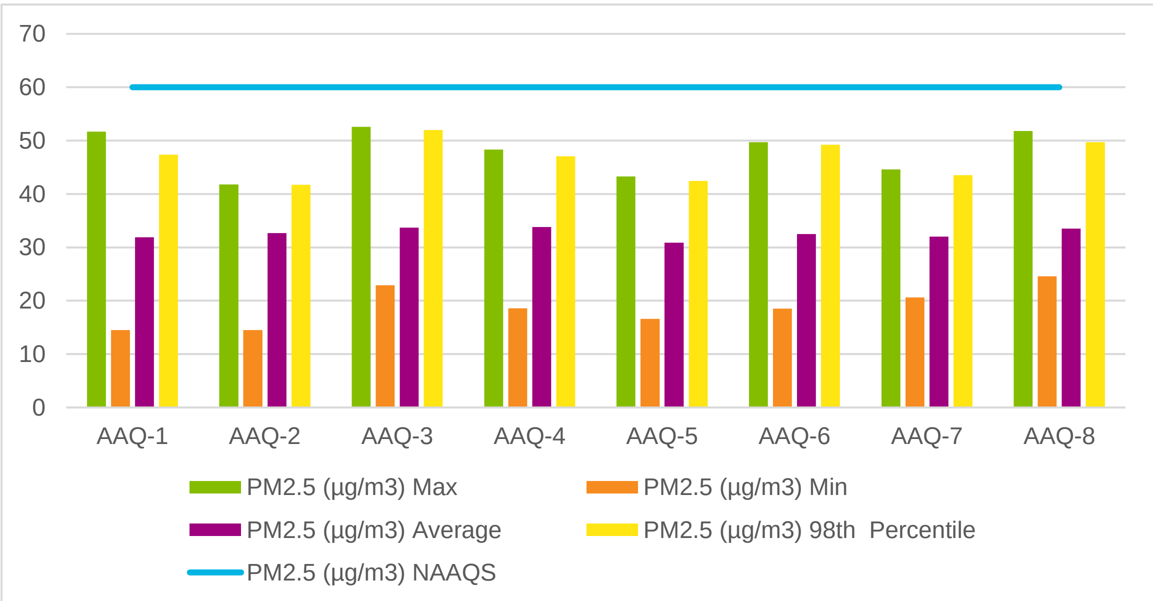


Figure 27. PM2.5 Values at the Monitoring Locations.

Nitrogen Di-Oxide (NO2)

NO_2 concentration in the study area varied from 35.52 µg/m3.to 29.45 µg/m3 98th percentile value. The highest NO2 concentration was observed at monitoring location AAQ5 which is 35.52 µg/m3 and the lowest concentration of NO_2 was recorded at monitoring location AAQ 8 which is 29.45 µg/m3. Graphical presentation of concentration of NO_2 values is given figure 28.

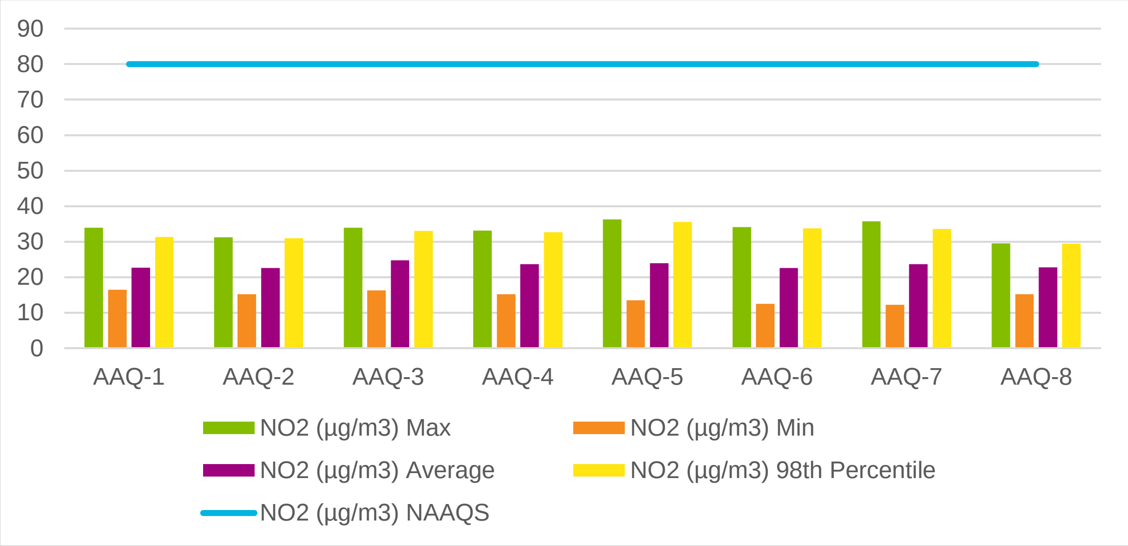


Figure 28. NO_2 Values at the Monitoring Locations

Sulphur Di-Oxide (SO_2)

SO_2 concentration in the study area varied from 8.4 to 7.4 to µg/m3. The highest SO_2 concentration was observed at monitoring location AAQ 5 which is 8.4 µg/m3 and the lowest concentration of SO_2 was recorded at monitoring location AAQ 2 which is 7.4µg/m3. Graphical presentation of concentration of SO_2 values is given Figure 29

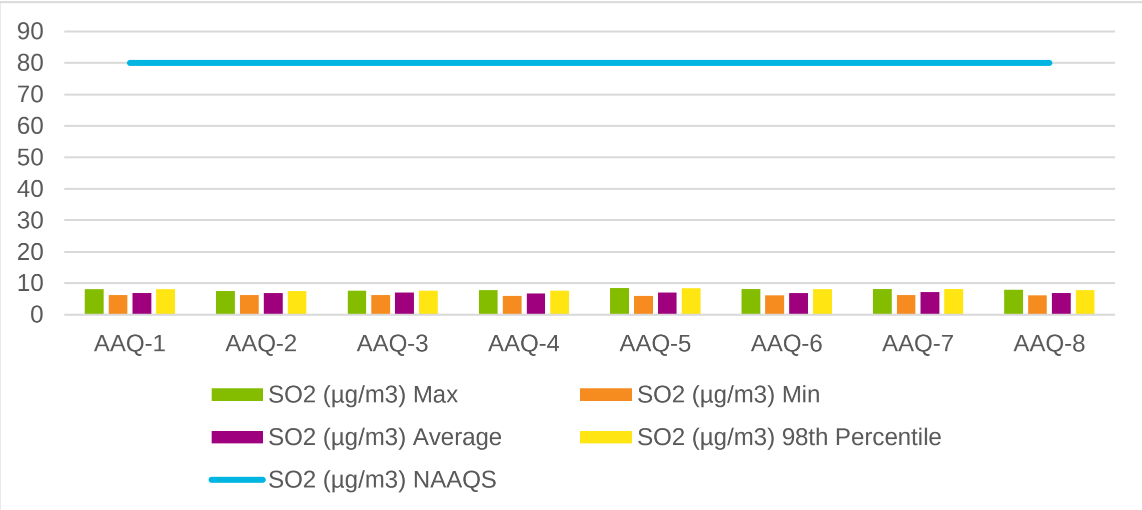


Figure 29. SO2 Values at the Monitoring Locations

Other Parameters

The concentrations for CO ranged from 0.57 to 0.77 mg/m^3. The concentrations for NH_3 ranged from 19.88 to 33.58 µg/m^3. The average concentration for Ni ranged <5.0 ng/m^3. The seasonal average concentrations for O_3 ranged from 24.47 to 26.69 µg/m^3.

Concentration of other parameters i.e. C_6H_6 (µg/m^3), BAP (ng/m^3), Pb (µg/m^3), As (ng/m3), HC as Methane (µg/m^3), and HC as Non-Methane (µg/m^3) have been observed would be below detectable limit at all locations. Currently there are no ambient air quality standards for HCs (as methane & as non-methane).

The photograph of ambient air quality sampling is shown below.

Photographs 1: AAQ station at AAQ1

Photographs 2: AAQ station at AAQ2

Photographs 3: AAQ station at AAQ7

Photographs 4: AAQ station at AAQ8

3.10 Ambient Noise Quality

Monitoring of noise levels around the study area has been carried out to assess the existing noise levels generated due to the existing operations on human settlements. Noise standards have been designed for different types of land use i.e. residential, commercial industrial areas and silence zones as per 'The Noise Pollution (Regulation and Control) Rules, 2000, Notified by Ministry of Environment and Forests, New Delhi, February 14, 2000'.

The ambient noise monitoring was carried out at eight (8) locations during baseline monitoring activity (March to May 2019). The details of the noise monitoring locations are given in Table 3.7. Sound pressure level (SPL) measurements in dB (A) have been recorded for every hour continuously for 24 hours at 15 minutes interval for the monitoring stations and equivalent noise levels in the form of Leq day and Leq night was computed. The day noise levels have been monitored during 6.00 am to 10.00 pm and night levels during 10.00 pm to 6.00 am at all the locations. The results obtained have been compared with the standard specified in Schedule III, Rule 3 of Environmental Protection Rules.

Table 3.8 Ambient Noise Monitoring Locations

Location Code	Monitoring Location	Coordinates	Direction
NQ1	Nepali Basti ,Balipathar	26°7'34.57"N, 93°49'31.19"E	11.0 km N from Well no 2
NQ2	Romon Ringtigaon	26°09'32.13"N 93°46'54.90"E	11.1 km SSE from Well no 2
NQ3	Satsang Village	26°03'57.42"N 93°46'54.90"E	1.31 km SE from Well no 2
NQ4	Goutam Basti	25°57'50.58"N, 93°42'41.03"E	10.5 km ENE from Well no 2
NQ5	Ekrani Basti	26°02'08.64"N 93°46'20.62"E	0.5 km S from Well no 13
NQ6	Santigaon	25°57'08.21"N 93°44'45.54"E	2.67 km SE from Well no 4
NQ7	Panchlamardgaon	26°00'38.68"N 93°49'56.95"E	8.13 km NE from Well no 8

Location Code	Monitoring Location	Coordinates	Direction
NQ 8	Gharialdubi	25°59'58.75"N 93°46'23.34"E	2.10 km WNW from Well no 19

Map showing Monitoring Locations for Noise in the study area is presented in Figure 30.The details of ambient noise monitoring result is given in **Appendix 3-3.** The graphical representation of noise level is present in Figure 30

The summarized results of noise levels are given in Table 39. The noise levels are compared with Ambient Air Quality Standards in respect of Noise as per The Noise Pollution (Regulation and Control) Rules, 2000 stipulated for daytime and night time for residential land use

Table 3.9 Noise level in the Study Area

Location code	Leq Day Time (dBA)	Leq Night Time (dBA)	Applicable Daytime Standards	Applicable Night-time Standards
NQ1	52.95	44.6	55	45
NQ2	51.8	44.1	55	45
NQ3	53.9	44.7	55	45
NQ4	53.8	45.0	55	45
NQ5	54.8	45.4	55	45
NQ6	56.4	44.7	55	45
NQ7	51.0	43.0	55	45
NQ 8	56.1	45.0	55	45

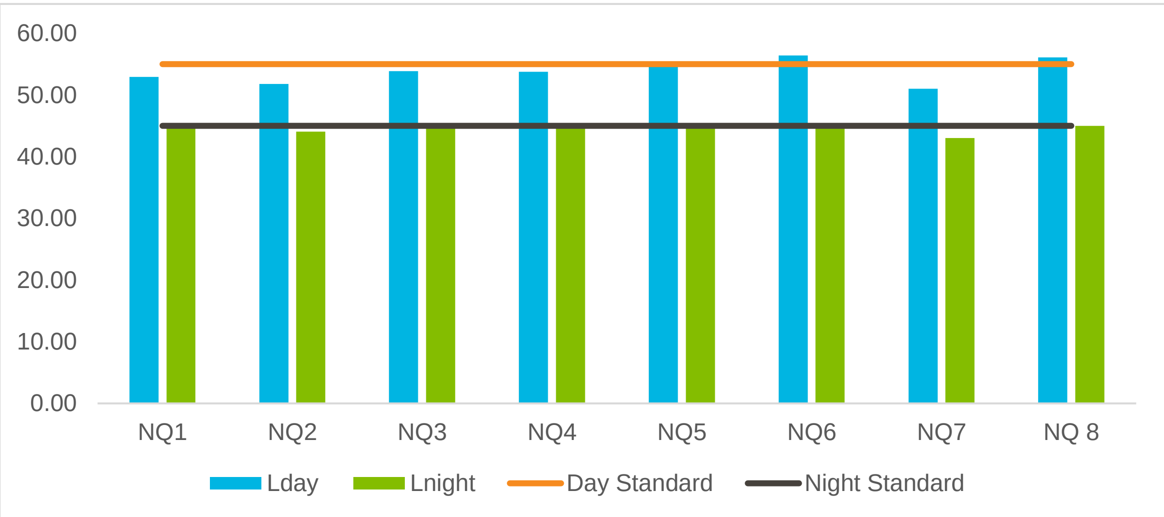


Figure 30. Day and Night Time Equivalent Noise Levels.

Leq for day time was found would be exceeding Ambient Air Quality Standards in respect of Noise for day time as 55dB(A) for residential area at all locations except NQ6 and NQ8 due to vehicular movement at night time. Leq for night time was found would be in the limit of Ambient noise Quality Standards, for night time as 45dB(A) for residential area at all locations,

Photographs 1: NQ station at NQ8	Photographs 2 : NQ Station at NQ2

Photographs 3: NQ station at NQ4	Photographs 4: NQ at NQ6

3.11 Water Environment

Water quality assessment of different parameters of ground water resources within Block area has been carried out for assessing the ground water quality. Eight (8) ground water samples covering entire Block area have been examined for physico-chemical, heavy metals and bacteriological parameters.

Analyses of the ground water samples have been carried out as per established standard methods and procedures prescribed by CPCB, IS 3025 Codes and APHA 22nd edition, 2012. **Appendix 3-4 and Appendix 3-5** gives ground water quality monitoring results.

Ground Water Quality

Primary monitoring of ground water quality was considered important to understand the probable impacts of the proposed project activities on the sub surface aquifers. Potential pollution of subsurface and unconfined aquifers may occur due to improper casing and cementing of well leading to infiltration or seeping of drilling chemicals or mud into nearby aquifer. Contamination of aquifers may also occur from disposal of drilling waste and mud in an open/unpaved pit. Map showing ground water sampling locations in the study area is presented in Figure 31

Groundwater Sampling Locations

For the purpose of baseline assessment, total 8 locations have been identified for groundwater samples covering the study area and have been examined for physico-chemical, heavy metals and bacteriological parameters to assess the current status of water quality in the study area during the monitoring period. The groundwater quality is likely would be variable within the Block due to spatial heterogeneity in the aquifer. These locations are spatially distributed all across the Block and its surrounding areas. The sampling locations have been selected to capture both shallow as well as deeper part of aquifer. All ground water samples have been collected from bore wells/tube well.

Table 3.10 Ground Water Sampling Locations

Location Code	Location Name	Coordinate	Source
GW 1	Nihato Basti	25°52'17.00"N 93°48'41.20"E	OPEN WELL
GW 2	Near Durgapur	26°0'36.80"N 93°49'23.90"E	TUBE WELL
GW 3	Near Milanpur	26°0'38.50"N 93°50'33.50"E	TUBE WELL
GW 4	Nuland Village	25°56'20.20"N 93°57'36.90"E	OPEN WELL
GW 5	Near Kathalguri	26°03'52.41"N 93°47'28.35"E	TUBE WELL
GW 6	Khalkhati Pakaphil	25°57'06.40"N 93°45'17.50"E	TUBE WELL
GW 7	Hinoto Village	25°59'12.70"N 93°54'50.00"E	TUBE WELL
GW 8	Jabrajan	26°10'21.20"N 93°46'45.60"E	OPEN WELL

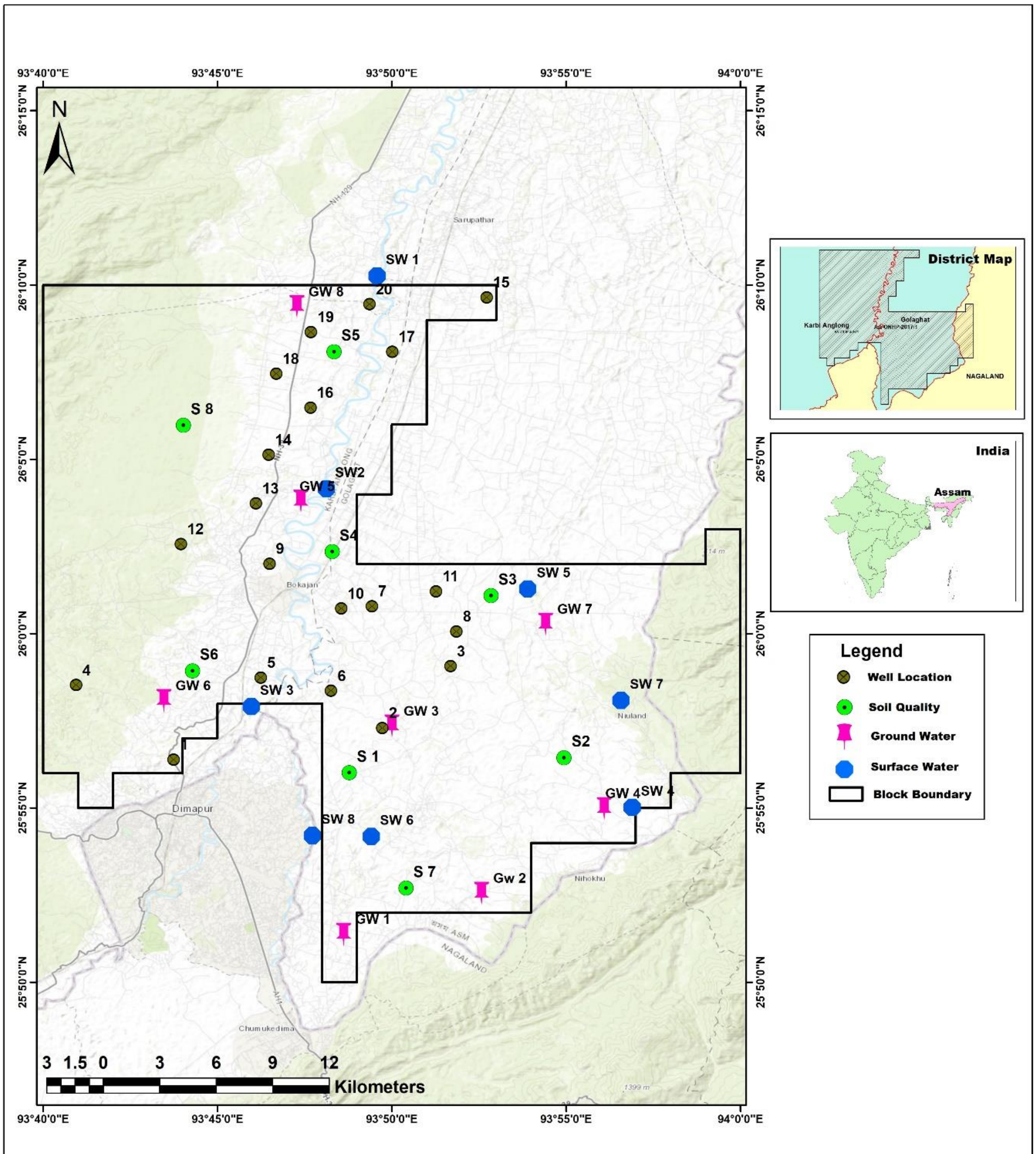


FIGURE NO.	Project name: EIA Study for Oil and Gas exploration in Block AA-ONHP-20171, Assam.				Title: Map Showing Ground Water, Surface water and Soil.	AECOM
	Date: 03/09/2019	Drawn By: Moumita Dey	Checked By: Souvik Basu	Approved By: Avijit Sarkar	Client Name: Vedanta Limited (Cairn Oil and Gas)	Source: Google Earth, Toposheet No:G46J/12, G46J/16, G46P/9, G46P/13(Survey of India), Esri Digital Globe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community.

Figure 31. Ground water, surface water and Soil quality monitoring Locations in Block AA-ONHP-2017/1.

Table 3.11 . Ground Water Quality Monitoring Result

S.N.	Parameters	Unit	GW1/B1	GW2/B1	GW3/B1	GW4/B1	GW5/B1	GW6/B1	GW7/B1	GW8/B1	Desirable limit	Permissible limit
1	Colour	Hazen	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	5	15
2	Odour	-	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Agreeable	Agreeable
3	Taste	None	Not Done	Not Done	Not Done	Not Done	Not Done	Not Done	Not Done	Not Done	-	-
4	Temperature	Deg C	25	25	25	25	25	25	25	25	-	-
5	pH	-	7.05 at 25 deg C	7.39 at 25 deg C	8.44 at 25 deg C	7.86 at 25 deg C	7.65 at 25 deg C	8.24 at 25 deg C	7.89 at 25 degC	7.34 at 25 deg C	6.5-8.5	6.5-8.5
6	Turbidity	NTU	11	4.8	3.5	4.4	18	3.8	3.1	3.7	1	5
7	Total Dissolved Solids	mg/l	168	186	318	110	170.2	290	42	120	500	2000
8	Electrical Conductivity	µS/Cm	243	286	513	167	257	467	64	181	-	-
9	Salinity	None	0.14 in respect to KCl equivalent salinity 35	0.16 In respect to KCl equivalent salinity 35	0.29 In respect to KCl equivalent salinity 35	0.09 In respect to KCl equivalent salinity 35	0.15 In respect to KCl equivalent salinity 35	0.27 In respect to KCl euivalent salinity 35	0.04 In respect to KCl equivalent salinity 35	0.10 In respect to KCl equivalent salinity 35	-	-
10	Dissloved oxygen	mg/l	5.4	5.4	5.4	5.3	5.0	5.2	5.4	5.1	-	-
(II)	General Parameters											
11	Aluminium(Al)	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.03	0.2
12	Anionic Detergent (as MBAS)	mg/l	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.2	0.01

S.N.	Parameters	Unit	GW1/B1	GW2/B1	GW3/B1	GW4/B1	GW5/B1	GW6/B1	GW7/B1	GW8/B1	Desirable limit	Permissible limit
13	Barium (Ba)	mg/l	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.7	
14	Calcium(Ca)	mg/l	20	16	16	16	28.0	32	4.80	20.0	75	200
15	Chloramines (as Cl2)	mg/l	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	4	
16	Chloride	mg/l	20	10	10	15	10	20	10	15	250	1000
17	Copper(Cu)	mg/l	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.05	1.5
18	Fluoride as F	mg/l	0.23	0.24	0.30	0.28	0.29	0.31	0.26	0.28	1	1.5
19	Free Residual Chlorine	mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	0.1
20	Iron (Fe)	mg/l	0.80	0.28	0.20	0.26	1.3	0.19	0.21	0.20	---	0.3
21	Maganisium(Mg)	mg/l	7.20	9.60	14.40	4.80	14.40	9.60	1.92	7.20	30	100
22	Manganese (Mn)	mg/l	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.1	0.3
23	Mineral Oil	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.5	0.5
24	Nitrate	mg/l	19	<0.5	3.9	1.7	7.3	3.6	<0.5	1.7	45	45
25	Phenol	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	0.002
26	Selenium (Se)	mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.01	0.01
27	Sulphate	mg/l	30	<1.0	2.6	2.3	14.7	3.7	<1.0	2.9	200	400
28	Potassium	mg/l	10	9.7	16	5.8	8.6	12	1.2	6.2	-	-
29	Total Phosphorous	mg/l	4.58	9.41	7.90	6.78	10.7	8.03	7.20	7.52	-	-
30	Sodium	mg/l	29.2	29	40	10	28	30	6.3	11	-	-

S.N.	Parameters	Unit	GW1/B1	GW2/B1	GW3/B1	GW4/B1	GW5/B1	GW6/B1	GW7/B1	GW8/B1	Desirable limit	Permissible limit
31	Total Alakalinity	mg/l	30.0	160	280	80	120	240	16.0	90	200	600
32	Total Hardness	mg/l	80	80	100	60	130	120	20.0	80	200	600
33	Total Nitrogen	mg/l	4.4	<0.3	0.9	0.40	1.6	0.83	<0.3	0.84	-	-
34	Zinc(Zn)	mg/l	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	5	15
(III)	Toxic Substances											
35	Cadmium (Cd)	mg/l	<0.001	<0.005	<0.005	<0.001	<0.001	<0.001	<0.001	<0.001	0.003	0.003
36	Cyanide (as CN)	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.05	
37	Lead (Pb)	mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.01	0.01
38	Mercury (Hg)	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	0.001
39	Molybdenum (as Mo)	mg/l	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.07	
40	Nickel (as Ni)	mg/l	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.02	
41	Hexavalent Chromium(Cr+6)	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.05	0.05
42	Arsenic(As)	mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.01	0.05
(IV)	Pesticides Residues											
43	Alchor	µg/l	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	20	20
44	Atrazine	µg/l	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	2	2
45	Aldrin	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.03	0.03
46	Dialdrin	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		

S.N.	Parameters	Unit	GW1/B1	GW2/B1	GW3/B1	GW4/B1	GW5/B1	GW6/B1	GW7/B1	GW8/B1	Desirable limit	Permissible limit
47	α-HCH	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.01
48	β-HCH	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.04	0.04
49	Butachlore	µg/l	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	125	125
50	Chlorpyrifos	µg/l	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	30	30
51	δ-HCH	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	2	2
52	2,4 Dichlorophenoxyacetic acid	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	30	30
53	p,p DDT	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	1	1
54	o,p DDT	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	1	
55	o,p DDE	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	1	
56	p,p DDE	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	1	
57	o,p DDD	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	1	
58	p,p DDD	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	1	
59	Endosulphan sulphate	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.4	0.4
60	Alpha-Endosulfan	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.4	
61	Beta-Endosulfan	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.4	
62	Ethion	µg/l	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	3	3
63	γ-HCH (Lindane)	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	2	2
64	Iso Protron	µg/l	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	9	9
65	Malathion	µg/l	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	190	190

S.N.	Parameters	Unit	GW1/B1	GW2/B1	GW3/B1	GW4/B1	GW5/B1	GW6/B1	GW7/B1	GW8/B1	Desirable limit	Permissible limit	
66	Methyl Parathion	µg/l	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.3	0.3	
67	Monocrotphos	µg/l	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	1	1	
68	Phorate	µg/l	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	2	2	
69	Pesticides as Lindane	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-	
(V)	Bacteriological Parameters												
70	Total Coliform	MPN/100ml	IS 1622 : 1981 (RA 2014)	DETECTED (17 MPN/100 ml)	NOT DETECTED	NOT DETECTED	DETECTED (14 MPN/100 ml)	NOT DETECTED	NOT DETECTED	NOT DETECTED	DETECTED (8 MPN/100 ml)	Total Coliform	MPN/100ml
71	Faecal Coliform	MPN/100ml	IS 1622 : 1981 (RA 2014)	DETECTED (4 MPN/100 ml)	NOT DETECTED	NOT DETECTED	NOT DETECTED	NOT DETECTED	NOT DETECTED	NOT DETECTED	NOT DETECTED	Faecal Coliform	MPN/100ml

Interpretation of Groundwater Quality Results

Physical Parameters

The colour of the samples was found <1 hazen units and with agreeable odour. The pH of water samples ranged from 7.05to 8.44. Turbidity of all the samples varied from 3.1 to 18.0 NTU. The TDS in the water samples varied from 42 mg/l to 318 mg/l.

Inorganic Parameters

The total alkalinity of the samples varied from 16.0 to 280 mg/l which falls within their corresponding permissible limit of 600 mg/l. Total hardness of the samples varied from 20 to 130 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.

Coliform

E-coli and Faecal coliform have been found to be absent in all the water samples whereas the total coliform content was below the detection limit of less than 2 MPN/100 ml.

Other Parameters

Most of the samples are below detectable limits for toxic substances. The groundwater quality have not been found to be suitable for drinking purposes (without primary and secondary treatment) at locations where their TDS, hardness are beyond the permissible limits.

Photographs of Ground water sampling is given below.

Photographs1: GW sampling in GW2

Photographs 2: GW sampling in GW6

Photographs 3: GW sampling in GW4

Photographs 3: GW sampling in GW5

Surface water quality

Primary monitoring of surface water quality was given importance during scoping of the EIA study as the effluent generated during the exploratory and development well drilling operations are likely to be discharged to nearby surface water bodies/natural drainage channels/rivers after ensuring that it meets prescribed norms of CPCB. Further, an effort has been made to establish the baseline quality of the existing major watersheds and sub watersheds (comprising the major drainage of the study area) to identify any possible contamination due to any current industrial activities.

Surface Water Quality Monitoring Location

A monitoring network consisting of 8 locations for surface water monitoring was selected. Water sampling and analysis[2] was done following CPCB standard guidelines for physical, chemical and bacteriological parameters. Surface Sampling Location is presented in Figure 31

Table 3.12 Surface Water Sampling Locations

Location Code	Sampling Location	Coordinate
SW1	Dhansiri River Near Jabrajan	26°10'05.00"N, 93°49'30.00"E
SW2	Dhansiri River Near Kathalguri	26°03'57.20"N, 93°48'00.08"E
SW3	Dhansiri River Near Khalkhati Pakaphil	25°57'02.00"N, 93°45'29.40"E
SW4	Dhansiri River Near Nuland Village	25°54'26.00"N, 93°57'52.80"E
SW5	Dhansiri River Near Rangna Village	26°01'17.60"N, 93°54'06.20"E
SW6	Pond Near Vihokhil Village	25°51'57.80"N, 93°51'19.10"E
SW7	Dhansiri River Near Durgapur Village	26°0'38.60"N, 93°49'19.80"E
SW8	Dhasiri River Near Naga United Village	25°51'54.00"N, 93°46'55.40"E

[2] *http://www.cpcb.nic.in/latest/guidelines-water.doc*

Table 3.13 Surface water quality

Parameters	Unit	SW1/B1	SW2/B1	SW3/B1	SW4/B1	SW5/B1	SW6/B1	SW7/B1	SW8/B1
Colour	Hazen	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Odour	None	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable
Taste	µg/l	Not Done	Not Done	Not Done	Not Done	Not Done	Not Done	Not Done	Not Done
Temperature	Deg C	25	25	25	25	25	25	25	25
pH value	None	7.37 at 25 deg C	7.58 at 25 deg C	7.41 at 25 deg C	7.44 at 25 deg C	7.73 at 25 deg C	7.33 at 25 deg C	7.32 at 25 deg C	7.61 at 25 deg C
Conductivity	us/cm	206	221	430	246	265.6	124.5	118.2	144
DO	mg/l	6.2	6.3	6.4	6.2	6.4	6.1	6.5	6.2
Turbidity	N.T.U.	33	64	37	98	151	42	18	85
Total Dissolved Solids (as TDS)	mg/l	148	164	275	180	176	82	80	240
Biochemical Oxygen Demand (as BOD)	mg/l	<2.0	<2.0	<2.0	<2.0	<2.0	3.8	<2.0	2.2
Chemical Oxygen Demand (COD)	mg/l	8	8	<4.0	<4.0	<4.0	24	<4.0	12
Total Hardness (as CaCO3)	mg/l	56.0	72.0	120	90.0	100	50.0	40.0	60.0
Alkalinity (as CaCO3)	mg/l	48	64.0	100	80.0	90	30	30	120
Sodium (as Na)	mg/l	11	12	20	17	23	2.5	7.6	5.22
Potassium (as K)	mg/l	3.6	4.4	5.7	2.5	3.0	2.7	2.5	2.0
Sodium Adsorption Ration (as SAR)	None	0.6	0.6	0.8	0.8	1.0	0.2	0.5	0.3
Free Ammonia	mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Phosphorus	mg/l	5.54	6.40	6.45	9.28	10.63	4.05	3.26	9.6
Total Nitrogen	mg/l	4.0	4.8	4.5	3.36	5.0	2.5	1.7	5.2
Aluminium (as Al)	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Anionic Detergents (as MBAS)	mg/l	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Barium (as Ba)	mg/l	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Calcium (as Ca)	mg/l	14.4	16	32.0	28.0	32.0	12.0	12.0	16.0
Chloramines (as Cl2)	mg/l	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Chloride (as Cl)	mg/l	18.2	8.08	30.29	10.10	10.10	5.05	10.10	20.19
Copper (as Cu)	mg/l	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Fluoride (as F)	mg/l	0.22	0.35	0.32	0.25	0.29	0.28	0.84	0.15
Free Residual Chlorine	mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Iron (as Fe)	mg/l	3.6	12	4.01	11	20	6.8	3.3	5.84
Magnesium (as Mg)	mg/l	4.8	7.68	9.60	4.80	4.80	4.80	2.40	4.80
Manganese (as Mn)	mg/l	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Mineral Oil	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nitrate (as NO3)	mg/l	16.04	20.06	19.96	16.20	20.48	8.67	6.21	22
Selenium (as Se)	mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005

Parameters	Unit	SW1/B1	SW2/B1	SW3/B1	SW4/B1	SW5/B1	SW6/B1	SW7/B1	SW8/B1
Sulphate (as SO4)	mg/l	33.84	40.2	42.6	34.26	36.12	16.15	12.12	26.67
Cadmium (as Cd)	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cyanide (as CN)	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Lead (as Pb)	mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Mercury (as Hg)	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Molybdenum (as Mo)	mg/l	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Arsenic(as As)	mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Nickel (as Ni)	mg/l	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Zinc (as Zn)	mg/l	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Hexavalent Chromium (as Cr+6)	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Salinity	None	0.13 In Respect to KCL equivalent salinity 35.	0.14 In respect to KCl equivalent salinity 35	0.25 In respect to KCl equivalent salinity 35	0.14 In respect to KCl equivalent salinity 35.	0.15 In respect to KCl equivalent salinity 35.	0.07 In respect to KCl equivalent salinity 35.	0.07 In respect to KCl equivalent salinity 35	0.08 In respect to KCl equivalent salinity 35
Phenol	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Bromoform	µg/l	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Dibromochloromethane	µg/l	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Bromodichloromethane	µg/l	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Chloroform	µg/l	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Alachlor	µg/l	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Atrazine	µg/l	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Aldrin	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Dieldrin	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Alpha-HCH	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Beta-HCH	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Butachlor	µg/l	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Chlorpyrifos	µg/l	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Delta-HCH	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
2,4-Dichlorophenoxyacetic acid	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
p,p DDD	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
o,p-DDT	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
p,p-DDT	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
o,p-DDE	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
p,p-DDE	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
o,p-DDD	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Endosulfan sulfate	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Alpha -endosulfan	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Beta-Endosulfan	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Ethion	µg/l	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Gama-HCH(Lindane)	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

Parameters	Unit	SW1/B1	SW2/B1	SW3/B1	SW4/B1	SW5/B1	SW6/B1	SW7/B1	SW8/B1
Isoproturon	µg/l	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Malathion	µg/l	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Methyl parathion	µg/l	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Monocrotophos	µg/l	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Phorate	none	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Polychlorinated biphenyls (as PCB)	mg/l	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Polynuclear Aromatic Hydrocarbons (as PAH)	mg/l	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Total coliform	MPN/100ml	140	110	70	50	90	33	80	130
Faecal coliform	/100ml	DETECTED (11 MPN/100 ml)	DETECTED (8 MPN/100 ml)	DETECTED (7 MPN/100 ml)	DETECTED (4 MPN/100 ml)	DETECTED (9 MPN/100 ml)	DETECTED (4 MPN/100 ml)	DETECTED (11 MPN/100 ml)	DETECTED (11 MPN/100 ml)

Based on the comparison of observed values of physiochemical & biological parameters of surface water samples with CPCB surface water quality criteria, surface water for S6 matches with Class A - Drinking water source without conventional treatment but after disinfection and whereas surface water for SW1, SW2, SW3, SW4, SW5 SW7 and SW8- outdoor bathing.

Photographs for Surface water monitoring

Photographs1: SW sampling in SW1

Photographs 2: SW sampling in SW2

Photographs 3SW sampling in SW6

Photographs 3:SW sampling in SW7

3.12 Soil Quality

The soil in the area varies from loam to clay loam soil types. The general classification of soil is based on the soil texture and origin of the soil.

Samples for soil quality study have been collected from eight (8) locations from the study area. Details of Soil Sampling locations, analysis results of soil samples are presented in tables 3.14 and table 3.15 showing soil sampling locations in the study area is presented in Figure 31

Table 3.14 Soil sampling locations

Location Code	Co-ordinates	Village	Land-Use Pattern
SQ1	26°10'07.40"N, 93°46'48.90"E	Jabrajan	AGRICULTURAL LAND
SQ2	25°56'26.25"N, 93°54'56.75"E	Near Sarihajan	TEA GARDEN
SQ 3	26° 1'55.56"N, 93°46'2.01"E	Ekrani Basti	AGRICULTURAL LAND
SQ 4	25°56'57.10"N, 93°44'43.20"E	Khatkhati	AGRICULTURAL LAND
SQ 5	26°02'06.00"N, 93°44'18.00"E	Near Bandipur Forest	FOREST LAND
SQ 6	25°58'55.92"N, 93°44'17.17"E	Santipur	TEA GARDEN
SQ 7	25°52'28.80"N, 93°48'49.30"E	Khehkhu	AGRICULTURAL LAND
SQ 8	25°51'58.20"N, 93°51'20.10"E	Vihokhil	FOREST LAND

Table 3.15 Soil Quality Result

Parameters	Unit	S1/B1	S2/B1	S3/B1	S4/B1	S5/B1	S6/B1	S7/B1	S8/B1
pH value	None	6.12 (1:2.5) at 25 deg C	8.13 (1:2.5) at 25 deg C	6.02 (1:2.5) at 25 deg C	4.48 (1:2.5) at 25 deg C	8.32 (1:2.5) at 25 deg C	5.28 (1:2.5) at 25 deg C	5.68 (1:2.5) at 25 deg C	5.19 (1:2.5) at 25 deg C
Acidity	None	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Alkalinity (as CaCO3)	mg/kg	100	480	120	80	480	120	140	100
Antimony (as Sb)	mg/kg	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25
Arsenic(as As)	mg/kg	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25
Available Nitrogen (as N)	mg/kg	202	179	218	280	106	330	420	314
Available Phosphorus (as P)	mg/kg	3.2	4.2	3.7	4	3.4	4.5	4.9	3
Available Potassium (as K)	mg/kg	76	100	71	62	285	169	267	99
Barium (as Ba)	mg/kg	55	55	24	51	56	71	51	17
Boron (as B)	None	8	15	4	7	15	9	7	3
Bulk Density	g/cc	1.11	1.18	1.14	1.25	1.21	1.05	1.03	1.18
Cadmium (as Cd)	mg/kg	<2	<2	<2	<2	<2	<2	<2	<2
Calcium (as Ca)	mg/kg	600	2050	950	450	2750	1500	950	350
Carbonate	mg/kg	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Cation Exchange Capacity	meq/100 gm	10	25	10	8	25	18	12	8
Chloride (as Cl)	mg/kg	40	40	50	70	40	70	30	30
Cobalt (as Co)	mg/kg	<2	<2	<2	3	<2	<2	<2	<2
Copper (as Cu)	mg/kg	11	17	8	17	17	21	17	4
Cyanide (as CN)	mg/kg	<1	<1	<1	<1	<1	<1	<1	<1
Electrical conductivity	us/cm	38.7 (1:2) at 25 deg C	202 (1:2) at 25 deg C	56.8 (1:2) at 25 deg C	118 (1:2) at 25 deg C	219 (1:2) at 25 deg C	135 (1:2) at 25 deg C	173 (1:2) at 25 deg C	33.9 (1:2) at 25 deg C
Hexavalent Chromium (as Cr+6)	mg/kg	<2	<2	<2	<2	<2	<2	<2	<2

Parameters	Unit	S1/B1	S2/B1	S3/B1	S4/B1	S5/B1	S6/B1	S7/B1	S8/B1
Infiltration Capacity	mm/Hr	6.2	7.8	8.9	16	10	3.6	2.2	12
Iron (as Fe)	mg/kg	9	84	37	60	8	98	14	30
Lead (as Pb)	mg/kg	7	12	5	11	12	12	12	4
Magnesium (as Mg)	mg/kg	300	1230	90	150	900	690	360	210
Manganese (as Mn)	mg/kg	240	210	67	230	200	250	242	198
Mercury (as Hg)	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Moisture	%	22	25	20	15	24	27	34	19
Molybdenum (as Mo)	None	<2	<2	<2	<2	<2	<2	<2	<2
Nickel (as Ni)	mg/kg	12	63	17	57	64	26	57	11
Organic Matter	%	0.59	0.36	0.56	1.12	0.51	1.4	1.9	0.97
Particle Size Distribution	mg/kg	Sand:34% Silt:28% Clay:38%	Sand:52% Silt:22% Clay:26%	Sand:47% Silt:21% Clay:32%	Sand:40% Silt:36% Clay:24%	Sand:53% Silt:14% Clay:33%	Sand:32% Silt:27% Clay:41%	Sand:27% Silt:21% Clay:52%	Sand:38% Silt:36% Clay:26%
Permeability	Cm/hr	0.9	1.2	1.5	2.4	1.8	0.11	0.09	2
Total Phosphorus	mg/kg	47	102	74	284	64	56	28	85
Sodium (as Na)	mg/kg	43	60	49	25	31	64	25	19
Sodium Adsorption Ration (as SAR)	None	0.23	0.05	0.18	0.13	0.04	0.21	0.03	0.06
Specific gravity	None	2.26	2.35	2.7	2.45	2.46	2.33	2.49	2.52
Sulphate (as SO4)	mg/kg	<15	<15	<15	<15	<15	<15	<15	<15
Texture	None	Clay Loam	Sandy Clay Loam	Sandy Clay Loam	Loam	Sandy Clay Loam	Clay	Clay	Loam
Thiocyanate	mg/kg	<5	<5	<5	<5	<5	<5	<5	<5
Total Nitrogen (as N)	mg/kg	588	538	655	829	319	991	1613	941
Total Organic Carbon	%	0.34	0.21	0.32	0.65	0.3	0.83	1.1	0.56
Total Porosity	%	50.9	49.7	57.8	49	52	54.9	58.9	53.2
Total Potassium	mg/kg	362	612	334	188	532	324	474	284

Parameters	Unit	S1/B1	S2/B1	S3/B1	S4/B1	S5/B1	S6/B1	S7/B1	S8/B1
Trivalent Chromium as Cr-III (TCLP)	None	<2	<2	<2	<2	<2	<2	<2	<2
Water Holding capacity	%	43	40	37	26	33	48	52	30
Zinc (as Zn)	mg/kg	9	38	9	37	38	41	36	10

ND = Not Detectable; LDL: Lower detection limit

India does not have any specific concentration-based soil contamination standards. In absence of any existing standards, Dutch standards have been considered for the purpose of analysis.

Table 3.16 Soil Remediation Intervention Values as per Dutch Standards

S. No.	Parameter	Intervention Values (mg/kg dry matter)
1	Zinc	720
2	Arsenic	76
3	Lead	530
4	Cadmium	13
5	Copper	190
6	Mercury (inorganic)	36
7	Nickel	100

Source: Soil Remediation Circular 2009, Minister of Housing, Spatial Planning and Environment, Netherlands.

Note: Concentrations are shown for standard soil (10% organic matter and 25% clay)

The physical, chemical and heavy metal concentration of the soil samples determined and compared with the standard soil classification provided by the Indian Council of Agricultural Research (ICAR) and as given in table 3.17

Table 3.17 Standard Soil Classification

	Soil Test	Classification
1.	pH	<4.5 Extremely acidic 4.51- 5.50 Very strongly acidic 5.51-6.0 moderately acidic 6.01-6.50 slightly acidic 6.51-7.30 Neutral 7.31-7.80 slightly alkaline 7.81-8.50 moderately alkaline 8.51-9.0 strongly alkaline 9.01 very strongly alkaline
2	Salinity Electrical Conductivity (mmhos/cm) (1 ppm = 640 mmho/cm)	Upto 1.00 Average 1.01-2.00 harmful to germination 2.01-3.00 harmful to crops (sensitive to salts)
3	Organic Carbon	Upto 0.2: very less 0.21-0.4: less 0.41-0.5 medium, 0.51-0.8: on an average sufficient 0.81-1.00: sufficient >1.0 more than sufficient
4	Nitrogen (kg/ha)	Upto 50 very less 51-100 less 101-150 good 151-300 Better >300 sufficient
5	Phosphorus (kg/ha)	Upto 15 very less 16-30 less 31-50 medium, 51-65 on an average sufficient 66-80 sufficient >80 more than sufficient
6	Potash (kg/ha)	0 -120 very less

Soil Test	Classification
	120-180 less 181-240 medium 241-300 average 301-360 better >360 more than sufficient

Source: Handbook of Agriculture, Indian Council of Agricultural Research, New Delhi

pH

Soil acidity has a correlation with the availability of nutrients in terms of their deficiency and toxicity. A soil having pH less than 6 is considered as acidic. The soil samples in the study area have been found to be Very strongly acidic to moderately alkaline as pH ranges from 4.48 to 8.32.

Texture and Electrical Conductivity

Texture is an expression to indicate the coarseness or fineness of the soil as determined by the relative proportion of the various sized primary particles in the soil mass. The textures of the collected soil samples have been found to be loam to sandy clay loam in the study area.

EC values for the soils monitored at the study area range between 33.9 and 219.0 µs/cm. For a productive soil, the electrical conductance (EC) would be < 100000 µs/cm.

Macronutrients and Organic Carbon

Nutrient status of the soil samples can be determined from the concentration of N, P, K and organic carbon in soil samples. Standard rating chart for soil nutrients is provided in Table 24.

Nitrogen contents in the soil samples ranged between 2163 kg/ha. phosphorus content in the soil samples ranged between 25 kg/ha and potassium contents ranges between 1367 kg/ha. With comparison to the rating chart, nutrient status of the soil is high.

Metals

Heavy metals such as copper (4.0 -27.0 mg/kg), lead (4.0 - 12.0 mg/kg) and zinc (9.0- 38.0 mg/kg) have been found to be detectable in the soil of the study area. The concentration of copper, lead, Zinc and the other heavy metals in the soil sample was much below the soil remediation intervention values specified in Dutch Soil Remediation Circular (Refer table3.16).

Sodium Absorption Ratio (SAR)

Sodium absorption ratio for the samples varied between 0.03-0.23.

Conclusion

The soil samples have been found to be loam in nature with sandy clay loam basic in reaction. The macronutrient contents viz. NPK values of the soil samples have been found to be high. Metal contamination have not been observed in the analysed soil samples.

Photographs of Soil Quality Monitoring Activity is given below.

Photographs1: Soil sampling in S1

Photographs 2: Soil sampling in S4

Photographs 3: Soil sampling in S6

Photographs 3: Soil sampling in S3

3.13 Traffic Survey

In order to appreciate the traffic and transport system characteristics traffic surveys have been conducted within the study area. The brief methodology adopted, location, nature and extent of data collected under each of the above-mentioned surveys is discussed below. The field data collection activities have been carried out in May & June, 2019.

The main objective of classified traffic volume counts was to assess the traffic characteristics in terms of average daily traffic, hourly traffic variation, peak hour traffic, traffic composition and directional distribution. The surveys have been conducted manually, on a normal working day and weekend. The survey has been conducted continuously for 24 hours. In order to express the intensity of traffic, it would be convenient to express all these different vehicle types in single unit terms. For this purpose, the PCU factors (IRC 106:1990) have been adopted and are given in **Table 3-18.**

Table 3.18 Adopted Passenger Car Units

Mode	PCU factor
Heavy Motor Vehicles	4.5
Light Motor Vehicles	1.5
Car	1.0
Three Wheelers	1.0
Two Wheelers	0.5

Source: IRC-106:1990

These roads cater to inter and intra city travel needs of various facilities and population residing in study area. Other roads provide links connecting to various facilities inside the study area.

The hourly variation of PCUs at above mentioned road intersections are presented below.

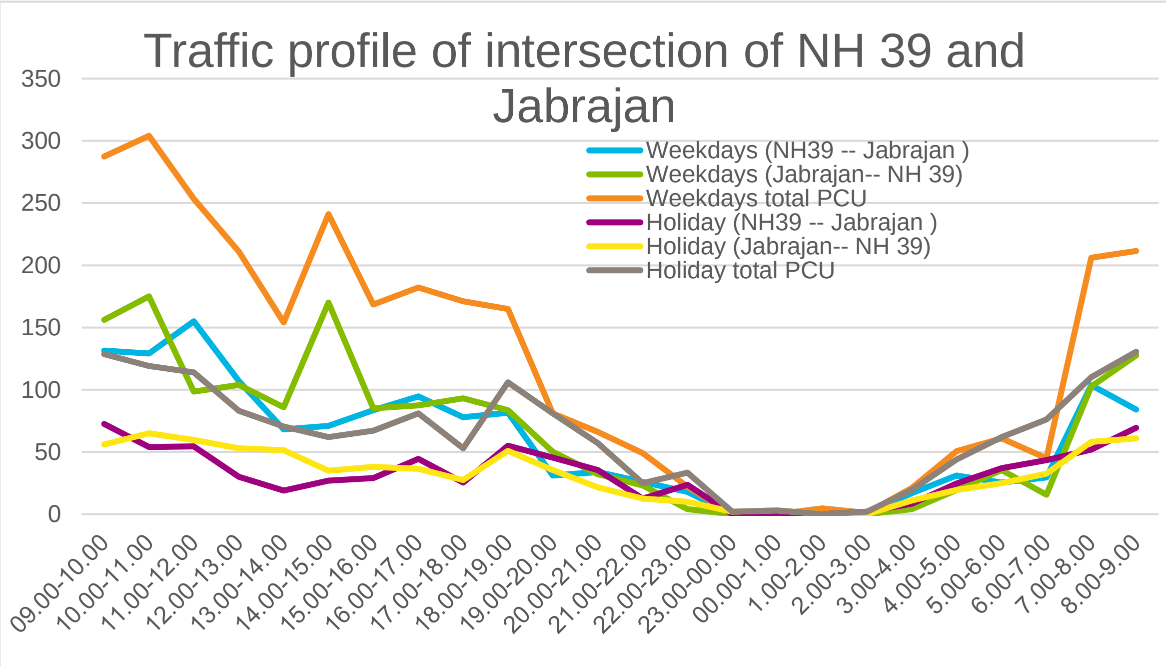


Figure 32. Hourly Traffic Profile at NH39 and Jabarjan

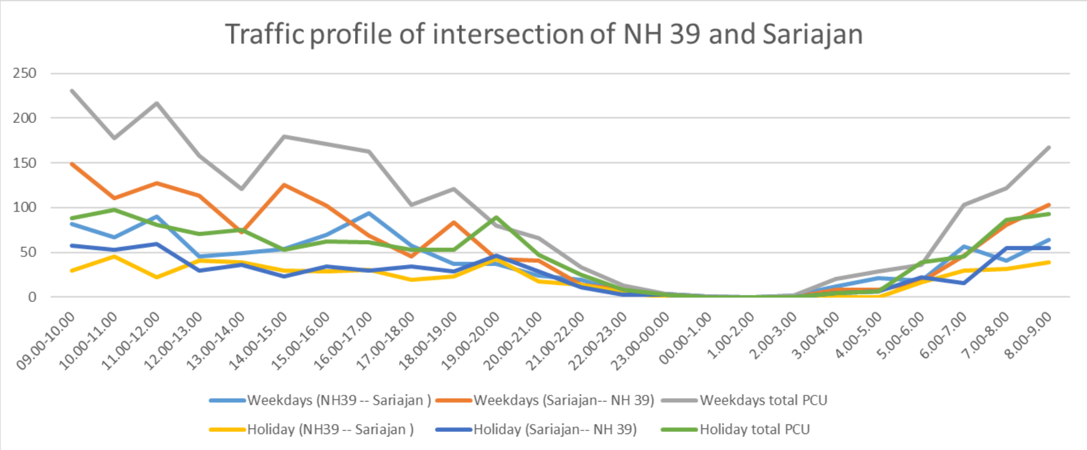


Figure 33. Hourly Traffic Profile at Intersection of Sariajan and Dillai Tinali road

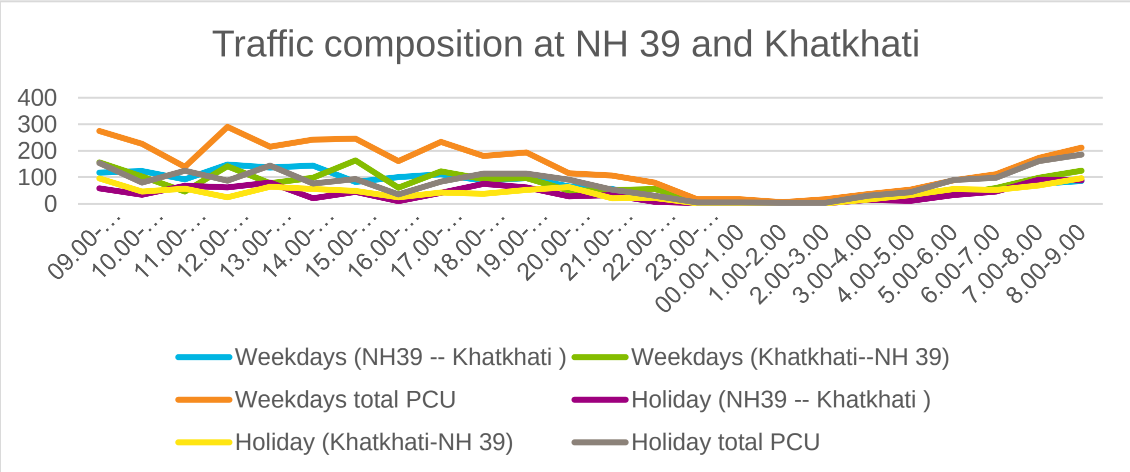


Figure 34. Hourly Traffic Profile at Intersection of NH39 and Khatkhati

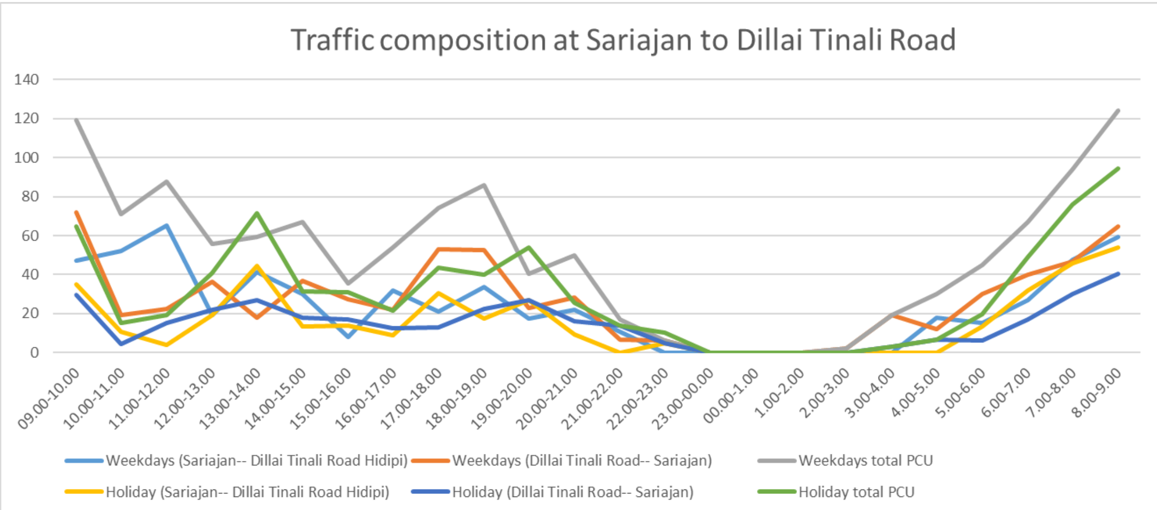


Figure 35. Hourly traffic Profile at Sariajaan to Dillai Tinali road

Peak Hour Traffic

Peak hour traffic composition at different major intersections are given below.

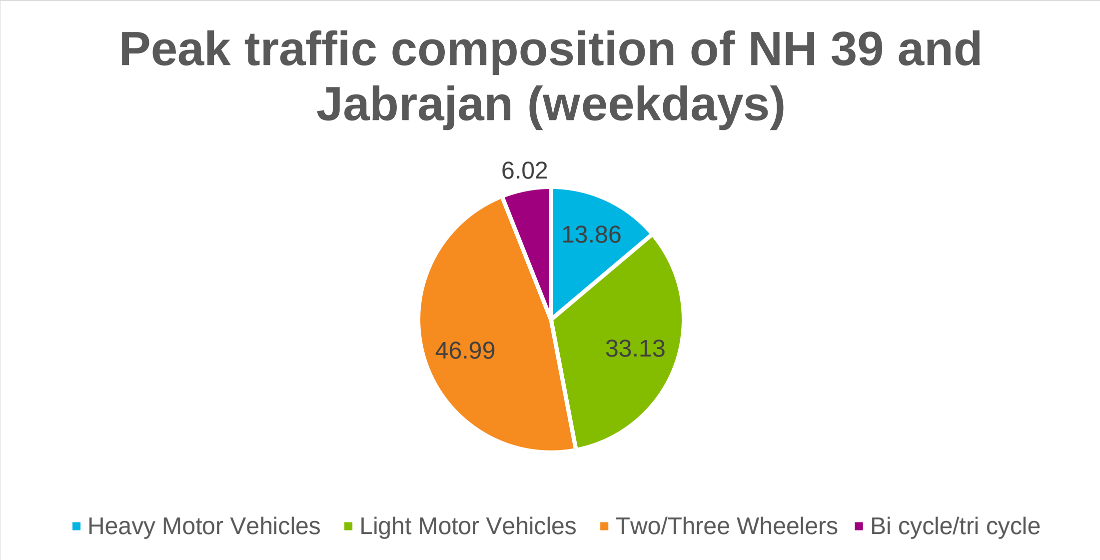


Figure 36. Peak Hour Traffic Composition (Vehicular) NH39 and Jabarjan Road.

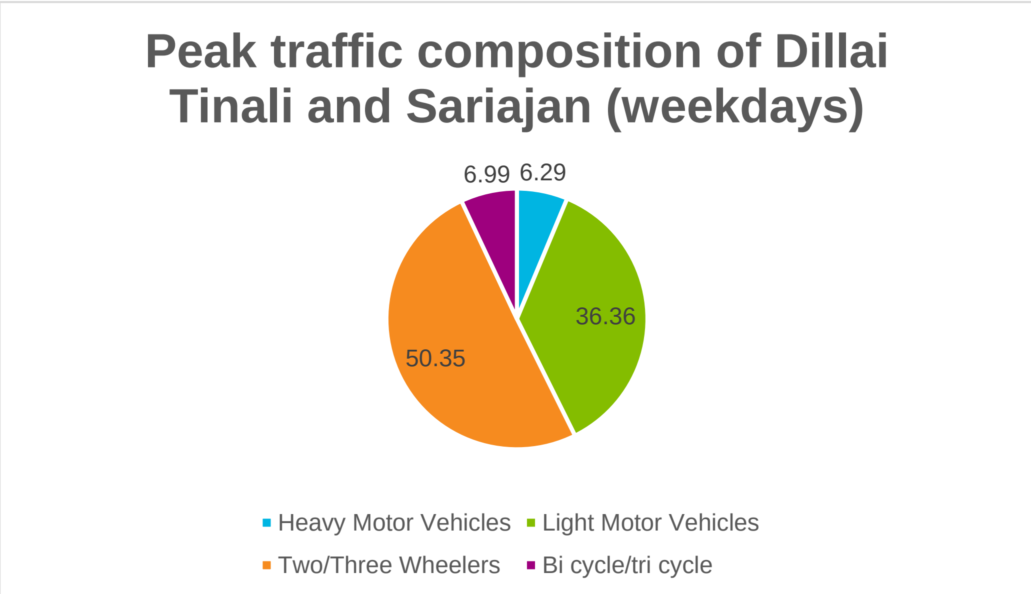


Figure 37. Peak Hour Traffic Composition (Vehicular) NH39 and Sariajan Road.

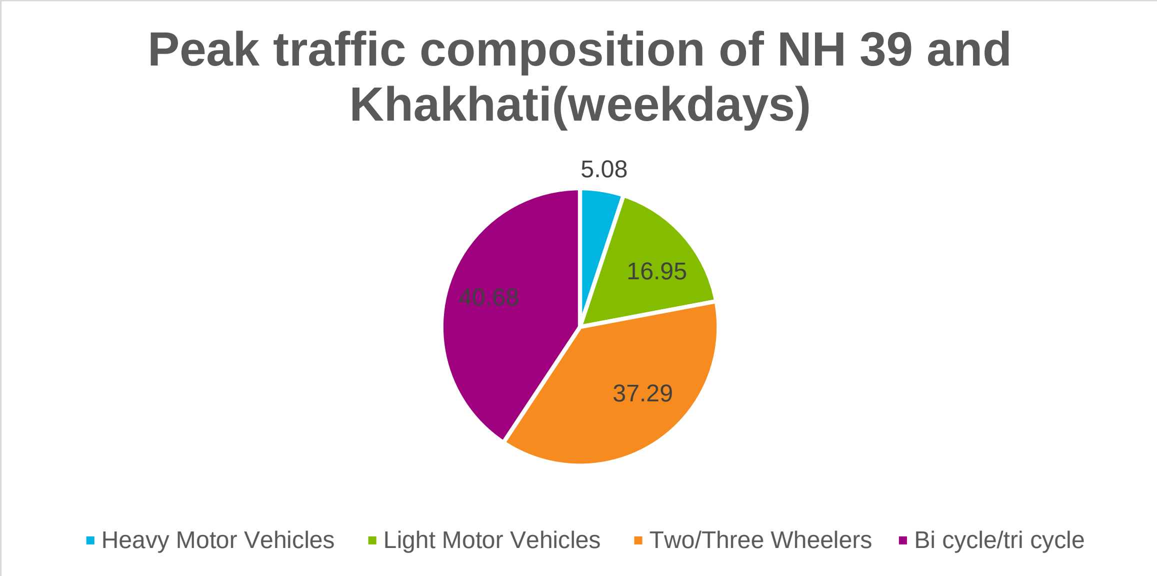


Figure 38. Peak Hour Traffic Composition (Vehicular) NH39 and Khatkati road.

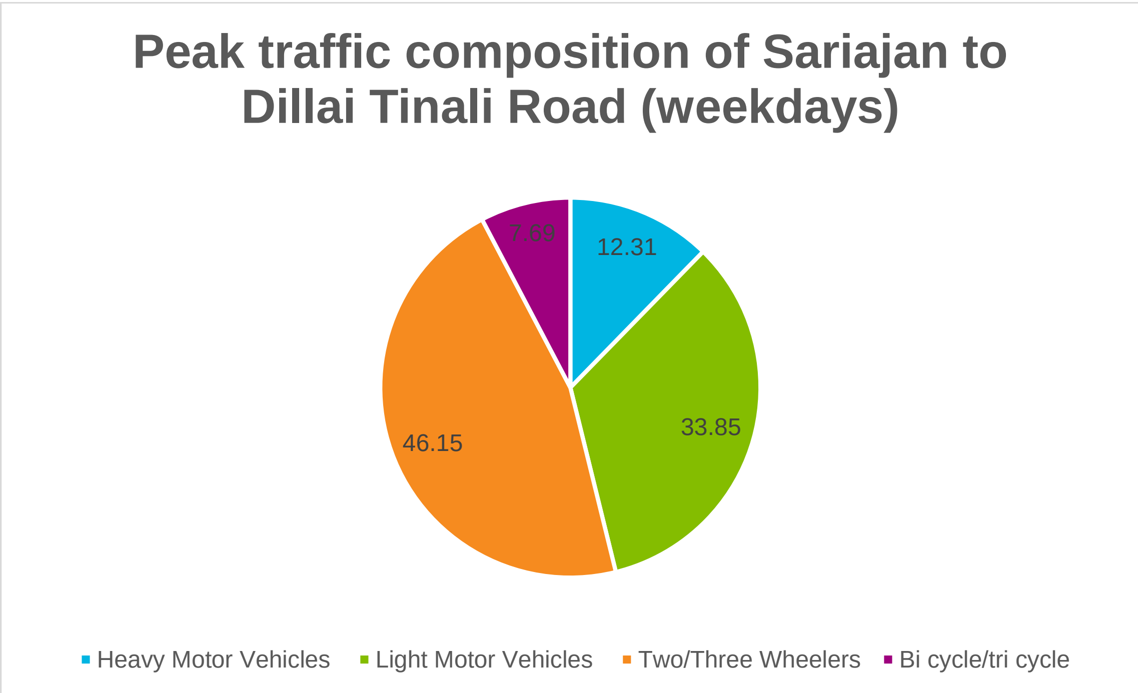


Figure 39. Peak Hour Traffic Composition (Vehicular) Saraijan and Dillai Tinali Road

The peak hours at various intersections are given in **Table 3-19**

Table 3.19 Peak hour traffic at Critical intersection

SL No	Intersection	Peak Time
1	NH39 and Jabranjan road	10:00 – 11:00
2	Sariajan and Dillai Tinali Road	9.00 - 10.00
3	NH39 and Khatkhati road	9.00 - 10.00
4	Sariajan and Dillai Tinali Road	8.00 - 9.00

Source: Traffic survey,2019

Traffic Composition

The composition of vehicles at these Intersections indicates that of the total vehicles observed, a total of 20 % vehicles are light vehicles, which includes cars, JCBs, two wheelers and auto rickshaws. A total of 28% vehicles have been found to be heavy vehicles comprising of HMV, 20ft trucks, 40ft trucks, Tractor, Tractor trailor, cranes etc whereas 29 % vehicles constitutes of two-wheeler and three wheelers.

Table 3.20 Classified volume Count at Major Intersection

SL No	Location	Heavy Motor Vehicles	Light Motor Vehicles	Two/Three Wheelers	VEHICLES
1	NH39 and Jabranjan road	23	55	78	10
2	Sariajan and Dillai Tinali Road	9	52	72	10
3	NH39 and Khatkhati road	14	50	72	16
4	Sariajan and Dillai Tinali Road	5	16	20	7

3.14 Ecological Environment

An Ecology and Biodiversity study of Block AA-ONHP-2017/01, located in Karbi Anglong and Golaghat district of Assam was conducted for assessment of biological diversity of the area and to identify the 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. A Total 7 transects, 16 quadrats, 5 PBZ locations and 5 primary productivity sampling locations were selected within the block based on topography, land use, habitat and vegetation pattern. For assessment of floral species, quadrats of size 10m x 10m for trees, 5m x 5m for shrubs and 1m x 1m for herbs were plotted and qualitative and quantitative analysis of the same was carried out. Faunal species were assessed by transect method by traversing a known distance and noting observed faunal species along the length. Assessment of faunal species was also done using indirect method, wherein searching for evidences such as scats, pug marks, prey kills, calls, nests, feathers, skin molts, road-kills etc was done. Secondary data was collected from RFO office, Bokajan; Freshwater Fish of Peninsular India, Birds of the Indian Sub-continent, Indian Mammals-A field guide, Indian snakes-A field guide, Book of Indian reptiles and Amphibians and academic publications were also consulted.

3.14.1 Methodology of the Study

Primary Data

Primary data have been collected at sixteen sampling sites selected by applying the stratified systematic sampling method. Table 3-21 presents details of the sampling sites, including location code, location coordinates, elevation above mean sea level (a msl), nearest village or town and habitat-profile of each site.

Table 3.21 Details of Sampling Sites

S.No..	Quadrat	Location	Nearest well	Type of Habitat
1	Quadrat 1	25°58'12.15"N, 93°42'14.34"E	Well 4	Agriculture land
2	Quadrat 2	25°57'57.71"N, 93°42'30.49"E	Well 4	Agriculture land
3	Quadrat 3	25°57'53.81"N, 93°42'37.70"E	Well 4	Agriculture land
4	Quadrat 4	25°57'16.03"N, 93°43'50.08"E	Well 1	Roadside vegetation
5	Quadrat 5	25°57'32.83"N, 93°44'51.78"E	Well 1	Agriculture land
6	Quadrat 6	25°58'21.65"N, 93°45'10.30"E	Well 5	Roadside vegetation

S.No..	Quadrat	Location	Nearest well	Type of Habitat
7	Quadrat 7	26° 2'33.26"N, 93°44'46.34"E	Well 12	Roadside vegetation
8	Quadrat 8	26° 3'1.00"N, 93°44'49.89"E	Well 12	Agriculture land
9	Quadrat 9	26° 3'38.41"N, 93°45'41.38"E	Well 13	Agriculture land
10	Quadrat 10	25°54'14.56"N, 93°50'14.08"E	Well 2	Riverine
11	Quadrat 11	25°54'38.59"N, 93°50'29.07"E	Well 2	Riverine
12	Quadrat 12	25°55'1.40"N, 93°48'28.69"E	Well 2	Agriculture land
13	Quadrat 13	26° 7'24.06"N, 93°47'11.22"E	Well 18	Roadside vegetation
14	Quadrat 14	26° 7'50.27"N, 93°47'17.09"E	Well 19	Roadside vegetation
15	Quadrat 15	26° 1'37.42"N, 93°48'11.02"E	Well 10	Roadside vegetation
16	Quadrat 16	26° 3'6.28"N, 93°48'59.23"E	Well 9	Roadside vegetation

In case of floristic species, qualitative and quantitative data was collected at each sampling site, using the standard quadrat methodology. Quadrat sizes employed are 10m x 10m for trees, 5m x 5m for shrubs and 1m x 1m for herbs.

In case of faunal species, qualitative data have been collected mainly at each sampling site. Any species recorded outside the sampling sites have been ascribed to the nearest sampling site. Faunal records are based on direct sightings, as well as, indirect evidence, such as calls, burrows, nests, droppings or scats. Only higher faunal species, namely vertebrates, including mammals, birds, reptiles, amphibians and fishes, have been covered.

Primary data was collected through most of the diurnal period from early morning till late evening.

Faunal Survey Methodology

Faunal species were assessed by transect method by traversing a known distance and noting observed faunal species along the length. Analysis was done through direct observation or visual encounter techniques and also through observation of indirect signs such as calls, scat, pug marks and road kills. seven line transects were laid in the study area. Seven line transects were laid in the study area. GPS locations of transects laid is given in following table 3.22.

Direct observation (Visual Encounter): In this method, the species of animals observed visually were noted. Also, a count of each species observed was recorded.

Indirect observation (Searching for signs): Signs such as scat, feeding signs, pug marks, burrows and dens were recorded as evidence of the presence of mammals. For accuracy, the burrows and dens were checked to confirm whether they were active or abandoned. Notable behaviours of the bird such as calls, feeding, nesting, or breeding and the associated habits were also observed and accordingly the recorded Apart from line transects, vantage point surveys were also conducted along the village ponds for aquatic birds.

Table 3.22 Geographic co-ordinates of Transact Location

Transect	Start point	End point	Nearest Wells
Transect 1	25°58'13.49"N, 93°42'10.81"E	25°57'40.06"N, 93°43'11.40"E	Well 1
Transect 2	25°57'12.18"N, 93°43'46.82"E	25°58'22.05"N, 93°45'10.51"E	Well 1

Transect	Start point	End point	Nearest Wells
Transect 3	26° 2'33.13"N, 93°44'46.20"E	26° 3'44.53"N, 93°45'46.54"E	Well 13
Transect 4	25°53'30.43"N, 93°49'30.50"E	25°54'47.52"N, 93°50'35.25"E	Well 2
Transect 5	25°54'52.81"N, 93°48'34.05"E	25°56'13.20"N, 93°48'0.40"E	Well 2
Transect 6	26° 9'0.53"N, 93°47'30.14"E	26° 7'24.06"N, 93°47'11.22"E	Well 18,19
Transect 7	26° 1'36.18"N, 93°48'10.28"E	26° 3'6.73"N, 93°48'59.44"E	Well 9,10

Source: <AECOM Primary Survey>

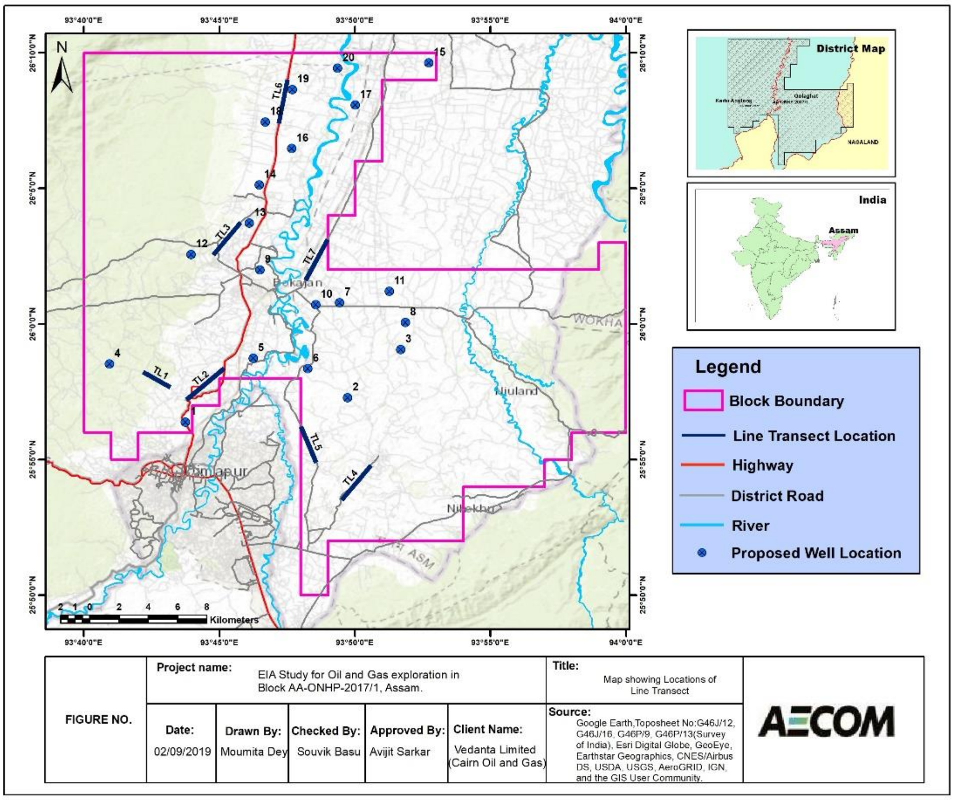


Figure 40. Geographic Co-ordinates of Transact Location

Field identification has been based on professional experience, and following , standard field guides and identification keys were made use of. Fauna was checked for their IUCN status (International Union for Conservation of Nature , Red List Version 4) and also their status in the Schedules of Wildlife Protection Act, 1972.

Phyto-sociological Analysis

Frequency, density and dominance were calculated following Mishra (1968) and dos Santos et al. (2015) according to the formulae –

$$Relative\ Frequency = \frac{Number\ of\ quadrats\ in\ which\ species\ occured}{Total\ number\ of\ quadrats\ studied}\ x\ 100$$

$$Relative\ Density = \frac{Total\ number\ of\ individual\ s\ of\ the\ species}{Sum\ of\ all\ individual\ s\ of\ all\ species}\ x\ 100$$

$$Relative\ dominance = \frac{Dominance\ of\ given\ species}{Total\ dominance\ of\ all\ species}\ x\ 100$$

Important value index (IVI) is used to determine the overall importance of each species in the community structure. It is used to identify the dominance of any given species in the study area which helps in getting an overall importance of any given species in the community by statistical analysis. It can be calculated by summing the values of relative frequency, relative density and relative dominance.The IVI of the individual species has been calculated as the following formula

$$\text{IVI} = \text{Relative frequency} + \text{Relative density} + \text{Relative dominance}$$

The rationale behind the number of transect and quadrats laid was to ensure thorough and proportionate coverage of all the habitat types observed in the study area.

Desktop review and Secondary Data Collection

A desktop review has been carried to identify the forest area, land use pattern, Vegetation type etc. information regarding sensitive ecological habitat such as Biosphere Reserve, National Park, Wild life Sanctuary , Game reserve, Conservation reserve also collected from sources such as Forest Working Plan of Golaghat and East-Karbi-Anglong District, different Scientific report published in peer reviewed journals, Government reports, To identify the different classification of different forest types , report from Forest Survey Of India (SoFR, 2017) was consulted Stakeholder consultation with forest Department and local villagers was also carried out to gather the relevant information during field survey..

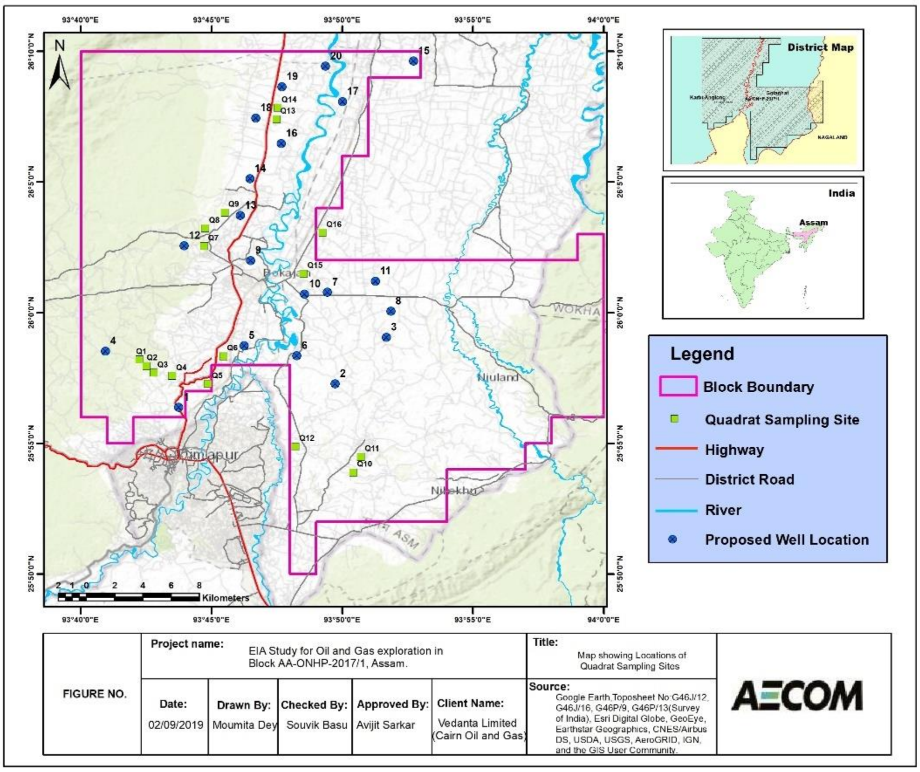


Figure 41. Quadrat sampling location maps.

Flora of the Study Area

The floristic baseline was carried out after considering the different habitats present in the study area. Forest types are also identified as per the Champion and Seth Classification, 1967. Forest working Plans of Golaghat and Karbi Anglong District are also consulted during identification of Forest types.

Forest Types

The Study area falls within the Golaghat and Karbianglong district of Assam. Both of the district receive heavy rain fall in the monosson season and moderate to light rainfall rest the year which. This type of rainfall helps to development of forest area. In Karbi District, 76.51 % of the Geographic area comes under forest cover whereas in Golaghat Dostrict , 18.59 % of geographic area falls in the forest area (SoFR. 2017). The Major forest types which are observed in the study area are Moist Semi Evergreen Forest, Moist mixed Deciduous Forest, etc.

Moist semi-evergreen forests (2BC 1/b and 2 BC)

These types of forests have a mixture of the wet evergreen trees and the moist deciduous trees. This type of forest are widely found in the block area and are covered with trees of commercial importance like Badam, Sopa, Bonsum, Bhola, Gomari, Ponam, Amari, Cham, etc.

Moist Mixed Deciduous forests (3C/C 3b)

The trees in this category are mostly deciduous with sparkling of few evergreen and semi-evergreen species. Important species includes Albizia species (Siris, Kala siris, ,), Ficus species (Bot, Bor, Dimoru), *Careya arborea* (Kumbhi), Mallotu species (Senduri, Joral, Dudhloti) and Lagerstroemia species (Jarul, Ajar).

Riverain Type

This type of forest occupies the localities with alluvial soil of more recent origin in the vicinity of rivers and streams of the district. The common species of importance are Khair, Sissoo, Simul, Urium, Kokoli etc.

Miscellaneous type with scattered pure or mixed patches of bamboos

Miscellaneous type of forest comprises of Amari, Sopa, Cham, Bonsum, Bogipoma, Gonsoroi, Dhuna and Hingori etc.

Floristic Species Recorded

A consolidated list of flora species observed in the study area, prepared on the basis of primary survey has been provided in following Table 3.23. Orchids such as *Cymbidium aloipholium, Dendrobium aphyllum, Rhynchostylis rhetusa, Aerides rosea, Aerides odorata, Bulbophyllum sp, Papilionanth teres, Dendrobium densiflirum and Papilionanthe* teres were observed in the study area.

Trees

Total 44species of trees have been recorded in the study area. Species belonging to family Moraceae showed highest diversity followed by Fabaceae and Euphorbiaceae. Species such as *Tectona grandis, Streblus asper* and *Sterculia viollosa* were commonly seen in the study area.

Table 3.23 List of Tree species observed in the study area

Sr.no	Botanical name	Local Name /Common Name	Family	IUCN Status, Ver.4
1	*Mangifera indica*	Aam	Anacardiaceae	DD
2	*Alstonia scholaris*	Satwan	Apocynaceae	LC
3	*Holarrhena antidysenterica*	Dhulkari	Apocynaceae	Not assessed
4	*Wrightia tinctoria*	Dudhi	Apocynaceae	LC
5	*Wrightia tomentosa*	Atkuri	Apocynaceae	Not assessed
6	*Oroxylum indicum (L.) Kurz*	Toguna	Bignoniaceae	Not assessed
7	*Bombax ceiba L.*	Dumboil	Bombacaceae	Not assessed
8	*Cassia fistula*	Amaltas	Fabaceae	LC
9	*Senna sp.*	-	Fabaceae	Not assessed
10	*Trema orientalis (L.) Bl.*	Indian Charcoal Tree	Cannabaceae	Not assessed
11	*Alangium chinense*	Chinese Alangium	Cornaceae	Not assessed
12	*Croton oblongifolius*	-	Euphorbiaceae	Not assessed
13	*Euphorbia sp.*	-	Euphorbiaceae	Not assessed
14	*Mallotus philippensis*	Kamala tree	Euphorbiaceae	LC
15	*Securinega virosa*	-	Euphorbiaceae	Not assessed
16	*Trevia nudiflora*	Many fruited trevia	Euphorbiaceae	Not assessed
17	*Acacia auriculiformis*	-	Fabaceae	LC
18	*Parkia sp.*	-	Fabaceae	Not assessed
19	*Pongamia pinnata*	korosh	Fabaceae	LC
20	*Albizia procera*	Tantari asing	Fabaeae	LC
21	*Erythrina stricta*	Dhaul Dhak	Fabaceae	Not assessed
22	*Gmelina arborea*	Gamhar	Lamiaceae	LC
23	*Delonix regia*	Flame tree	Leguminoceae	LC
24	*Lagerstroemia speciosa*	Ejar	Lytheraceae	Not assessed
25	*Garuga pinnata* Roxb.	Pama	Burseraceae	Not assessed
26	*Melia azadirach*	Bakain	Meliaceae	Not assessed
27	*Ficus religiosa*	Ahot	Moraceae	Not assessed
28	*Artocarpus lakoocha*	Bohot	Moraceae	Not assessed
29	*Ficus hispida*	Devil fig	Moraceae	Not assessed

Sr.no	Botanical name	Local Name /Common Name	Family	IUCN Status, Ver.4
30	*Streblus asper*	Khorua	Moraceae	Not assessed
31	*Artocarpus heterophyllus*	Jackfruit	Moraceae	Not assessed
32	*Morus sp*	-	Moraceae	Not assessed
33	*Psidium guajava*	-	Myrtaceae	Not assessed
34	*Glochidion sp.*	-	Phyllanthaceae	Not assessed
35	*Phyllanthus acidus*	-	Phyllanthaceae	Not assessed
36	*Bambusa sp.*	-	Poaceae	Not assessed
37	*Ziziphus jujuba*	-	Rhamnaceae	Not assessed
38	*Neolamarckia cadamba*	Kadamb	Rubiaceae	Not assessed
39	*Murraya koenigii*	Bishahari	Rutaceae	Not assessed
40	*Murraya sp.*	-	Rutaceae	Not assessed
41	*Sterculia villosa*	Udal	Sterculiaceae	Not assessed
42	*Grewia multiflora*	-	Tiliaceae	Not assessed
43	*Tectona grandis*	Segun	Verbenaceae	Not assessed
44	*Vitex negundo*	Nirgundi	Verbenaceae	Not assessed

Source: Primary Survey

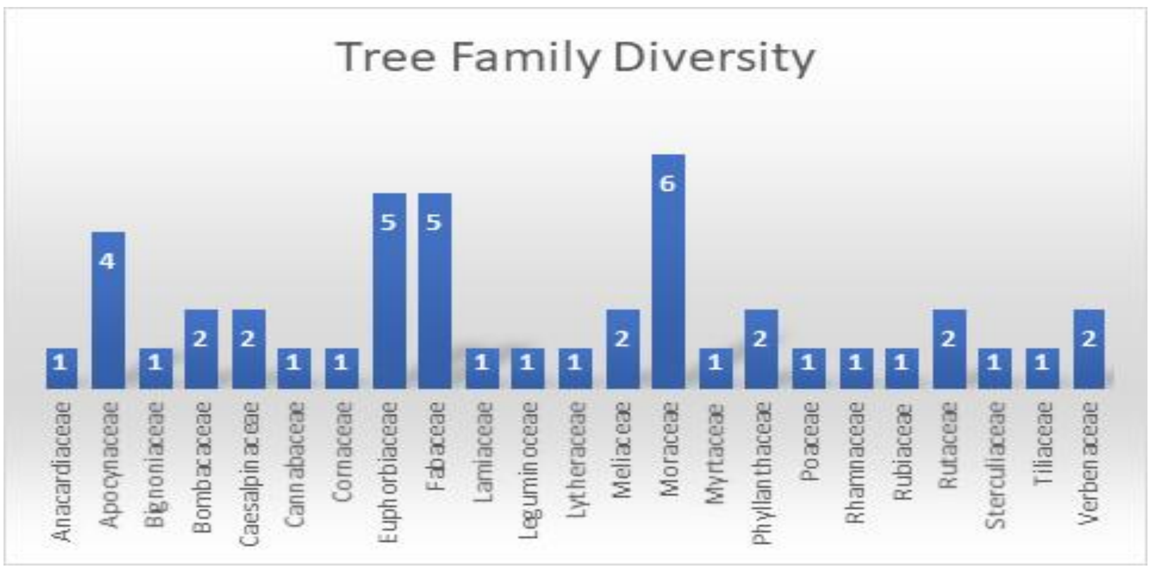


Figure 42. Tree species Diversity in Study Area

Shrubs:
15 shrub species have been observed during field survey in study area. Species belonging to Lamiaceae family were found to be higher in the study area followed by Rubiaceae and Verbenaceae. Species such *as Lantana camara, Solanum torvum, Cassia tora* and *Clerodendrum viscosum* were commonly observed in the study area. *Lantana Camara* is an invasive weed.

Table 3.24 List Shrub Species observed in study area

Sr.no	Botanical name	Common Name/Local Name	Family	IUCN
1	*Licuala peltata*	Japi Pat	Arecaceae	Not Assessed
2	*Eupatorium odoratum*	Motmoti	Asteraceae	Not Assessed
3	*Cassia tora*	Bon medelua	Caesalpinaceae	Not Assessed
4	*Capparis spinosa*	-	Capparaceae	Not Assessed
5	*Jatropha curcas*	Bhenda	Euphorbiaceae	Not Assessed
6	*Clerodendrum viscosum*	Bhetita	Lamiaceae	Not Assessed
7	*Clerodendrum sp.*	-	Lamiaceae	Not Assessed
8	*Hyptis sp*	-	Lamiaceae	Not Assessed
9	*Melastoma melabathricum*	Phutuka	Melastomaceae	Not Assessed
10	*Ixora polyantha*	Many-Flowered Ixora	Rubiaceae	Not Assessed
11	*Coffea benghalensis*	Bengal coffee	Rubiaceae	Not Assessed
12	*Glycosmis pentaphylla*	Gin Berry	Rutaceae	Not Assessed
13	*Solanum torvum*	Bhit tita	Solanaceae	Not Assessed
14	*Stachytarpheta indica*	Kariyartharani	Verbenaceae	Not Assessed
15	*Lantana camara*	Gubon	Verbenaceae	Not Assessed

Source: <Primary Survey,AECOM>

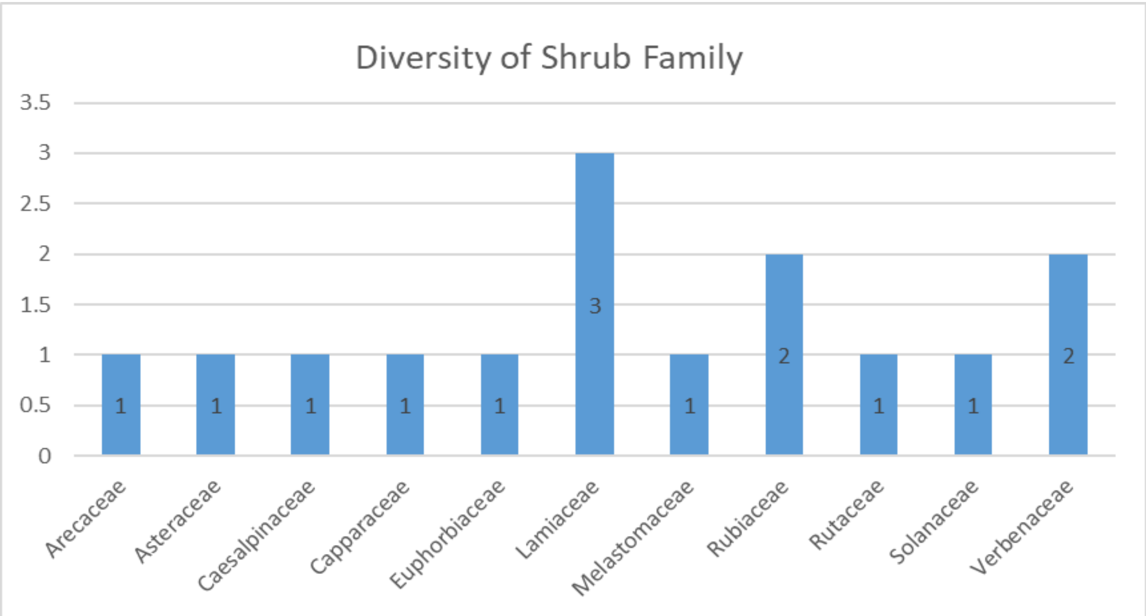


Figure 43. Shrub Species diversity in Study Area

Herbs:

31 species of herbs were observed in the study area. Herbs family belonging to Asteraceae was found to be higher, followed by Malvaceae. Species such as *Desmodium triflorum* showed higher diversity followed by *Urena lobate, Evolvulus sp. and Acalypha indica* were commonly observed in the study area.

Table 3.25 List of Herbs Species observed in Study area

S.no	Botanical name	Family	Common Name/Local Name	IUCN Status
1	*Ruellia tuberosa*	Acanthaceae	Chatpati	Not assessed
2	*Achyranthes aspera*	Amaranthaceae	Chaff flower	Not assessed
3	*Typhonium trilobatum*	Asteraceae	-	Not assessed
4	*Ageratum conyzoides*	Asteraceae	Goat weed	Not assessed
5	*Parthenium sp*	Asteraceae	-	Not assessed
6	*Parthenium hysterophorus*	Asteraceae	Gajor Ghas	Not assessed
7	*Parthenium haustorium*	Asteraceae	-	Not assessed
8	*Heliotropium indicum*	Boraginaceae	Indian helitrope	Not assessed
9	*Cassia occidentalis*	Caesalpinaceae	Hant-thenga	Not assessed
10	*Cassia sp*	Caesalpinaceae	-	Not assessed
11	*Commelina benghalensis*	Commelinaceae	Bengal day flower	Not assessed
12	*Evolvulus sp*	Convolvulaceae	-	Not assessed
13	*Costus speciosus*	Costaceae	Jom lakhut	Not assessed
14	*Cyperus rotundus*	Cyperaceae	Keyabon	Not assessed
15	*Cyperus sp*	Cyperaceae	-	Not assessed
16	*Desmodium triflorum*	Fabaceae	Kodalia	Not assessed
17	*Pogostemon benghalensis*	Lamiaceae	Sukloti	Not assessed
18	*Acalypha indica*	Lamiaceae	Muktojhuri	Not assessed
19	*Lindernia sp.*	Linderniaceae	-	Not assessed
20	*Sida sp*	Malvaceae	-	Not assessed
21	*Urena lobata*	Malvaceae	Caesarweed	Not assessed
22	*Sida acuta*	Malvaceae	Mallow	Not assessed
23	*Mimosa pudica*	Mimosaceae	nilajban	LC
24	*Oxalis debilis*	Oxalidaceae	Pink wood sorrel	Not assessed
25	*Phyllanthus sp*	Phyllanthaceae	-	Not assessed
26	*Borreria hispida*	Rubiaceae	Button weed	Not assessed
27	*Scoparia dulcis*	Scrophulariaceae	Sweet broom weed	Not assessed
28	*Solanum indicum*	Solanceae	Black berry	Not assessed
29	*Chrystella parasitica*	Thelypteridaceae	-	Not assessed
30	*Stachytarpheta indica*	Verbenaceae	Common snake weed	Not assessed
31	*Alpinia sp.*	Zingiberaceae	-	Not assessed

Source: Primary Survey,AECOM

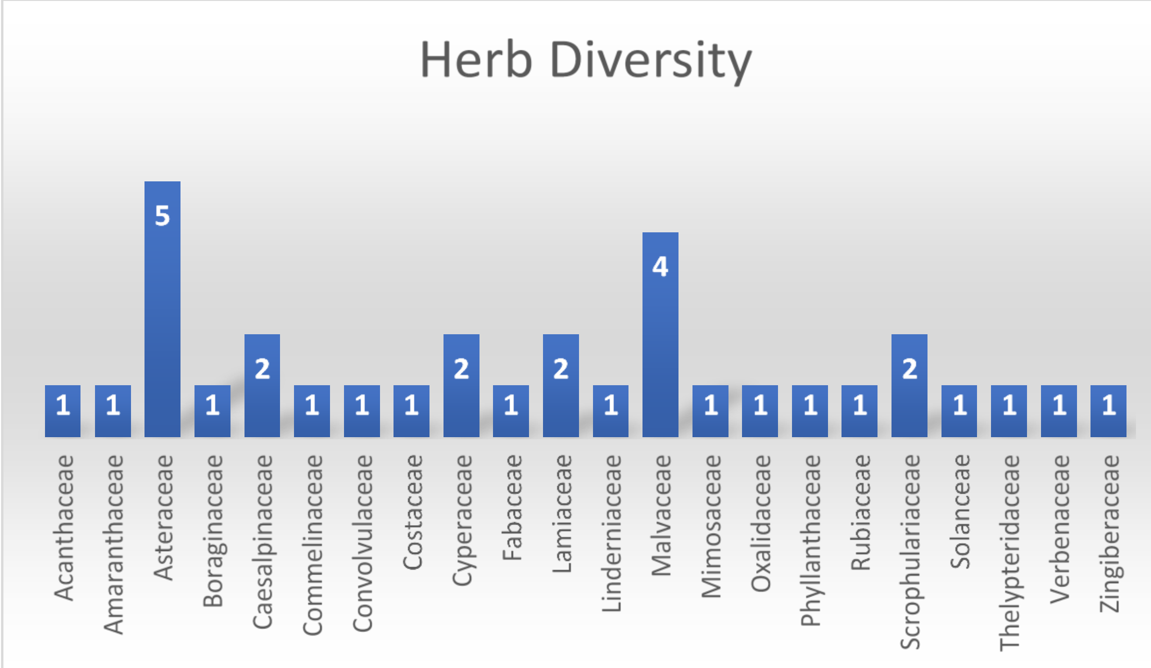


Figure 44. Herbs Species Diversity in Study Area.

Climbers:

13 species of climber belonging to 11 families have been recorded from the study area during site visit. Species belonging to Convolvulaceae showed higher diversity followed by Dioscoraceae.

Table 3.26 List of Climbers observed in Study Area

Sr.no	Botanical name	Family	Common Name	IUCN
1	*Thunbergia grandiflora*	Acanthaceae	Kokua lota	Not assessed
2	*Calamus* sp.	Arecaceae	-	Not assessed
3	*Mikania micrantha*	Asteraceae	Chinese creeper	Not assessed
4	*Ipomoea digitata*	Convolvulaceae	Morning glory	Not assessed
5	*Cuscuta reflexa*	Convolvulaceae	Akashi lata	Not assessed
6	*Ipomea* sp.	Convolvulaceae	-	Not assessed
7	*Momordica* sp.	Cucurbitaceae	-	Not assessed
8	*Dioscora* sp.	Dioscoraceae	-	Not assessed
9	*Croton caudatus*	Euphorbiaceae	Miracle plant	Not assessed
10	*Abrus precatorius*	Fabaceae	Latumoni	Not assessed
11	*Cissampelos pareira*	Menispermiaceae	Tubukilota	Not assessed
12	*Pyrossia adnescence*	Polypodiaceae	-	Not assessed
13	*Cayratia trifolia*	Vitaceae	Chepeta lata	Not assessed

Source: <Primary Survey>

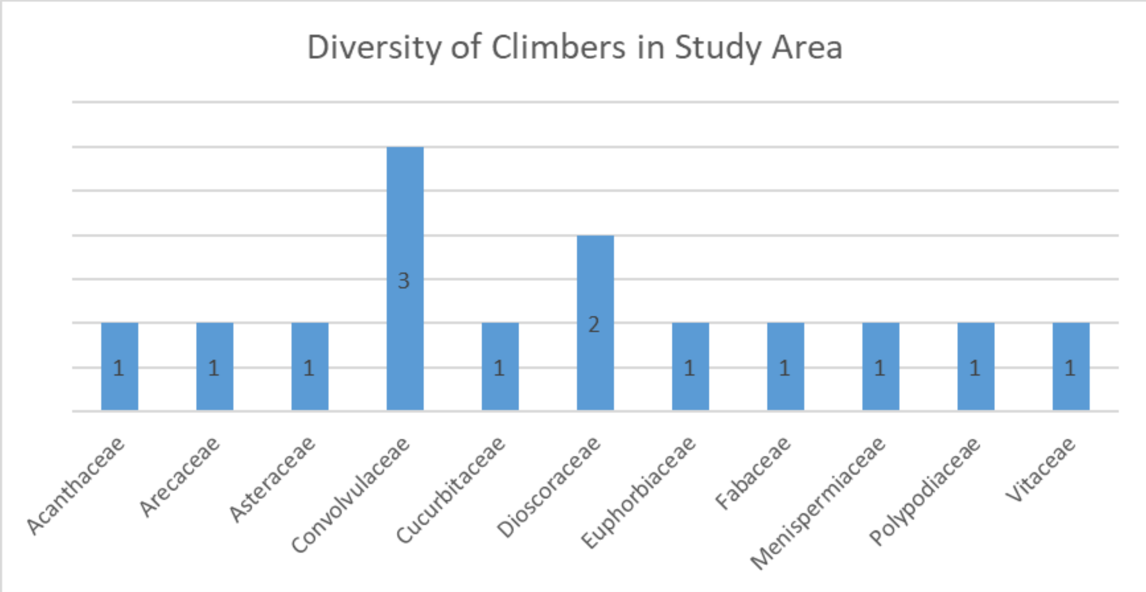


Figure 45. Diversity of Climber Species in study area

Phytosociological Analysis`

The phytosociological analysis of the observed floral diversity has been carried out and the frequency, density and dominance of each observed species is given in following tables 3.27 to 3.29

Trees:

Among trees, *Tectona grandis* (IVI 29.162), *Streblus asper* (IVI 24.845) *and Sterculia viollosa* (IVI 22.356) were found to be dominant in study area.

Table 3.27 List of Trees

Sr.No	Botanical Name	Relative Frequency	Relative Density	Relative dominance	IVI
1	*Tectona grandis*	6.741573	10.79137	11.62875	29.16169
2	*Streblus asper*	7.865169	9.71223	7.267969	24.84537
3	*Sterculia viollosa*	2.247191	4.676259	15.43232	22.35577
4	*Pongamia pinnata*	3.370787	5.035971	9.647556	18.05431
5	*Wrightia tinctoria*	3.370787	8.633094	3.165604	15.16948
6	*Ficus hispida*	7.865169	2.877698	4.220806	14.96367
7	*Cassia fistula*	5.617978	2.877698	6.223535	14.71921
8	*Securinega virosa*	3.370787	4.316547	2.444945	10.13228
9	*Tremma orientalis*	2.247191	5.035971	2.411889	9.695051
10	*Bambusa* sp.	1.123596	7.194245	0.215347	8.533187
11	*Mallotus phillipions*	1.123596	2.877698	4.220806	8.222099
12	*Murraya koenigii*	3.370787	4.676259	0.139976	8.187021
13	*Garuga pinnata*	3.370787	1.438849	3.111767	7.921403
14	*Delonix regia*	2.247191	1.438849	3.488625	7.174665
15	*Gmelina arborea*	2.247191	1.079137	2.915263	6.241591

Sr.No	Botanical Name	Relative Frequency	Relative Density	Relative dominance	IVI
16	*Mangifera indica*	1.123596	0.719424	4.220806	6.063826
17	*Ziziphus jujuba*	3.370787	1.438849	0.689111	5.498747
18	*Senna* sp.	2.247191	1.798561	1.34592	5.391672
19	*Croton oblongifolius*	3.370787	1.798561	0.164875	5.334223
20	*Erythrina stricta*	2.247191	1.438849	1.5505	5.23654
21	*Alstonia scholaris*	2.247191	1.798561	0.818858	4.86461
22	*Trewia nudiflora*	2.247191	1.438849	0.527601	4.213641
23	*Anthrocephalous cadamba*	1.123596	0.719424	1.943509	3.786529
24	*Parkia* sp.	1.123596	2.517986	0.036932	3.678513
25	*Bombax ceiba*	1.123596	0.359712	2.110403	3.593711
26	*Holarrhena antidysenterica*	1.123596	1.798561	0.659501	3.581658
27	*Artocarpus heterophyllas*	1.123596	0.359712	1.5505	3.033808
28	*Artocarpus lackoocha*	1.123596	0.359712	1.423984	2.907291
29	*Ficus religiosa*	1.123596	0.359712	1.423984	2.907291
30	*Grewia multiflora*	1.123596	0.359712	1.302851	2.786158
31	*Glochidion* sp.	1.123596	1.079137	0.395701	2.598433
32	*Lagerstroemia speciosa*	1.123596	0.719424	0.651425	2.494445
33	*Albizia procera*	1.123596	1.079137	0.201888	2.40462
34	*Alangium begoniifolium*	1.123596	1.079137	0.156342	2.359074
35	*Euphorbia* sp.	1.123596	1.079137	0.046515	2.249247
36	*Psidium gujava*	1.123596	0.719424	0.021535	1.864555
37	*Morus*	1.123596	0.719424	0.015559	1.858579
38	*Murraya* sp.	1.123596	0.719424	0.010552	1.853572
39	*Acacia auriculiformis*	1.123596	0.359712	0.325713	1.80902
40	*Spondias pinnata*	1.123596	0.359712	0.218039	1.701347
41	*Melia azadirach*	1.123596	0.359712	0.1319	1.615208
42	*Wrightia tomantosa*	1.123596	0.359712	0.1319	1.615208
43	*Oroxyllum indicum*	1.123596	0.359712	0.067296	1.550604
44	*Vitex negundo*	1.123596	0.359712	0.013029	1.496336
45	*Phyllanthus acidus*	1.123596	0.359712	0.005276	1.488584

Source: <Primary Survey, >

Shrubs:

Among Shrub, *Lantana camara* (92.671), *Solanum torvum (28.729), Cassia tora* (19.926) *and Clerodendrum viscosum* (16.981) *are the dominant species*

Table 3.28 Phyto sociological Analysis of Shrub Species

Sr.No	Botanical Name	Relative Frequency	Relative Density	Relative Dominance	IVI
1	*Lantana camara*	23.52941	35.38462	55.0667322	113.9808
2	*Solanum torvum*	17.64706	10	11.2437887	38.89085
3	*Cassia tora*	5.882353	15.38462	4.84826664	26.11523

Sr.No	Botanical Name	Relative Frequency	Relative Density	Relative Dominance	IVI
4	*Clerodendrum viscosum*	11.76471	7.692308	4.30957035	23.76658
5	*Glycosmis pentaphylla*	5.882353	6.923077	1.31980592	14.12524
6	*Licuala peltata*	5.882353	2.307692	5.61141972	13.80146
7	*Coffea benghalensis*	2.941176	6.923077	3.25911257	13.12337
8	*Eupatorium odoratum*	5.882353	4.615385	1.14921876	11.64696
9	*Melastoma melabathricum*	2.941176	2.307692	3.95941776	9.208287
10	*Jatropha curcus*	2.941176	0.769231	3.45962731	7.170035
11	*Capparis spinosa*	2.941176	1.538462	2.39420575	6.873844
12	*Ixora polyantha*	2.941176	1.538462	2.39420575	6.873844
13	*Hyptis sp.*	2.941176	3.076923	0.19153646	6.209636
14	*Clerodendrum sp.*	2.941176	0.769231	0.43095703	4.141364
15	*Croton caudatus*	2.941176	0.769231	0.36212362	4.072531

Source: Primary Survey, AECOM

Herbs:

Among herbs, *Desmodium triflorum* (25.861) showed higher diversity followed by *Urena lobate* (25.793), *Evolvulus sp*. (22.866) and *Acalypha indica* (18.526) were the dominant species observed in the study area.

Table 3.29 Phyto sociological Analysis of Herbs Species

Sr.No	Botanical Name	Relative Frequency	Relative Density	Relative Dominance	IVI
1	*Desmodium triflorum*	8.196721	4.834494	12.98246	26.15028
2	*Urena lobata*	9.836066	3.810975	12.2807	26.09168
3	*Evolvulus sp*	6.557377	5.22648	11.22807	23.12122
4	*Acalypha indica*	1.639344	11.10627	5.964912	18.73785
5	*Ruellia tuberosa*	1.639344	10.45296	5.614035	17.73366
6	*Borreria hispida*	6.557377	2.61324	5.614035	14.89394
7	*Cassia occidantalis*	4.918033	3.70209	5.964912	14.667
8	*Typhonium trilobatum*	1.639344	7.83972	4.210526	13.71691
9	*Sida acuta*	1.639344	5.87979	3.157895	10.70435
10	*Lindernia* sp.	3.278689	3.26655	3.508772	10.10866
11	*Cyperus rotundus*	1.639344	5.22648	2.807018	9.700164
12	*Ageratum conyzoides*	3.278689	2.939895	3.157895	9.431123
13	*Mimosa pudica*	4.918033	1.52439	2.45614	8.98053
14	*Stachytarpheta indica*	4.918033	1.52439	2.45614	8.98053
15	*Achyranthus aspera*	4.918033	1.30662	2.105263	8.411883
16	*Parthenium* sp.	1.639344	3.91986	2.105263	7.69179
17	*Chrystela parasitica*	1.639344	3.91986	2.105263	7.69179
18	*Partherium haustorium*	1.639344	3.91986	2.105263	7.69179
19	*Scoparia dulcis*	3.278689	0.979965	1.052632	5.36593
20	*Parthenium hysterophorus*	3.278689	0.979965	1.052632	5.36593
21	*Pogostemon benghlensis*	1.639344	1.95993	1.052632	4.679228
22	*Cyperus* sp.	1.639344	1.95993	1.052632	4.679228

Sr.No	Botanical Name	Relative Frequency	Relative Density	Relative Dominance	IVI
23	*Cassia* sp.	1.639344	1.95993	1.052632	4.679228
24	*Sida* sp.	1.639344	1.30662	0.701754	3.675041
25	*Scoparia dulcis*	1.639344	1.30662	0.701754	3.675041
26	*Solanum indicum*	1.639344	1.30662	0.701754	3.675041
27	*Commelina benghalensis*	1.639344	1.30662	0.701754	3.675041
28	*Costus speciosa*	1.639344	0.65331	0.350877	2.670854
29	*Sida sp*	1.639344	0.65331	0.350877	2.670854
30	*Phyllanthus sp*	1.639344	0.65331	0.350877	2.670854
31	*Helitropium indicum*	1.639344	0.65331	0.350877	2.670854
32	*Oxalis debilis*	1.639344	0.65331	0.350877	2.670854
33	*Alpines sp*	1.639344	0.65331	0.350877	2.670854

Source: <Primary Survey>

Biodiversity Indices

The diversity measurement reflect as to how many diverse species are present, the density measurement indicates number of individuals of a species in the study area. Species diversity is the best measure of community structure and it is sensitive to various environmental stresses. Smaller value of Simpson's Diversity Index shows healthy ecosystem and the higher value shows that an ecosystem is under environmental stress. The floral diversity was found to be medium to high as Shannon's index value varied from 2.044 - 3.265, whereas Simpson's indices value varied from 0.8327 -0.9655. Quadrat wise value of Shannon's and Simpson's index is given in following Table 3.30

Table 3.30 Quadrat wise Diversity indices

Sr. no.	Quadrat	Shannon's index	Simpson's index
1	Quadrat 1	2.178	0.919
2	Quadrat 2	2.694	0.9619
3	Quadrat 3	2.527	0.9221
4	Quadrat 4	2.381	0.8991
5	Quadrat 5	2.664	0.9413
6	Quadrat 6	2.421	0.9222
7	Quadrat 7	2.722	0.8273
8	Quadrat 8	2.388	0.9134
9	Quadrat 9	2.168	0.8327
10	Quadrat 10	2.655	0.9314
11	Quadrat 11	3.265	0.9582
12	Quadrat 12	3.135	0.9655
13	Quadrat 13	2.437	0.8753
14	Quadrat 14	2.6	0.9289
15	Quadrat 15	2.497	0.9261
16	Quadrat 16	2.044	0.8732

Source: Primary Survey

Fauna of the Study Area

The faunal baseline of the study area is based on the species having recorded ranges that include the study area, supported by the primary faunal data recorded during field visit The following sub-sections provide details of the faunal species reported from or recorded in the study area.

Mammals

Among Mammals, only Hoary-bellied squirrel (*Callosciurus pygerythrus*) was observed in the study area during field visit. The IUCN stataus of this species is Least concern (LC) and as per Wild life protection Act, 1972, this species is enlisted in ScheduleHowever, 62 mammalian species have been reported from the Karbi-Anglong and Golaghat district from different secondary sources such as forest working Plan, peoples Biodiversity registrar, scientific literatures etc. The list of mammalian species which is observed in the study area is given in table 3.31 And recorded mammalian species from this area are given Appendix 3.8

Table 3.31 Mammalian Species observed in the Study Area

Sr. No.	Common Name	Scientific Name	Family	IUCN, 3.1 Status	WPA 1972 Schedule
1	Hoary - bellied Squirrel	*Callosciurus pygerythrus*	Sciuridae	LC	-

Source: Primary Survey, AECOM

Avifauna

49 avian species have been observed in the study area. Among the avian species Alexandrian parakeet(*Psittacula eupatria)*, Blossom Headed parakeet(*Psittacula roseate)* and Red Breasted parakeet(*Psittacula alexandri)*are Near Threatened species according to IUCN red data Book. No other globally threatened avian species has been observed in the study area. Detailed checklist of birds observed in the study area is given in Table 3.32

Table 3.32 List of Avifauna observed in the Study Area

S. No.	Common name	Scientific name	Order	Family	IUCN Status	Schedule as per WPA, 1972
1	Oriental Honey buzzard	*Pernis ptilorhynchus*	Accipitriformes	Accipitridae	LC	-
2	Crested Serpent Eagle	*Spilornis cheela*	Accipitriformes	Accipitridae	LC	-
3	Red-wattled lapwing	*Vanellus indicus*	Charadriiformes	Charadriidae	LC	-
4	Common Pigeon	*Columba livia*	Columbiformes	Columbidae	LC	-
5	Spotted Dove	*Stigmatopelia Chinensis*	Columbiformes	Columbidae	LC	IV
6	Thick billed Green Pigeon	*Treron curvirostra*	Columbiformes	Columbidae	LC	IV
7	Emerald Dove	*Chalcophaps indica*	Columbiformes	Columbidae	LC	IV
8	Indian Roller	*Coracias benghalensis*	Coraciiformes	Coraciidae	LC	IV
9	White throated Kingfisher	*Halcyon smyrnensis*	Coraciiformes	Alcedinidae	LC	IV
10	Common Hawk Cuckoo	*Hierococcyx varius*	Cuculiformes	Cuculidae	LC	IV
11	White-breasted waterhen	*Amaurornis phoenicurus*	Gruiformes	Rallidae	LC	IV
12	Scarlet Minivet	*Pericrocotus speciosus*	Passeriformes	Campephagidae	LC	IV
13	Long tailed Shrike	*lanius schach*	Passeriformes	Laniidae	LC	-
14	Spangled Drongo	*Dicrurus hottetottus*	Passeriformes	Dicruridae	LC	IV
15	Black Drongo	*Dicrurus macrocercus*	Passeriformes	Dicruridae	LC	IV
16	Black Hooded oriole	*Oriolus xanthornus*	Passeriformes	Oriolidae	LC	IV

S. No.	Common name	Scientific name	Order	Family	IUCN Status	Schedule as per WPA, 1972
17	Rufous Treepie	*Dendrocitta vagabunda*	Passeriformes	Corvidae	LC	IV
18	Eastern Jungle Crow	*Corvus levillantii*	Passeriformes	Corvidae	LC	IV
19	House Crow	*Corvus splendens*	Passeriformes	Corvidae	LC	IV
20	Great Tit	*Parus major*	Passeriformes	Paridae	LC	IV
21	Black Creasted Bulbul	*Pycnonotus flaviventris*	Passeriformes	Pycnonotidae	LC	IV
22	Red-whiskered Bulbul	*Pycnonotus jocosus*	Passeriformes	Pycnonotidae	LC	IV
23	Red Vented Bulbul	*Pycnonotus cafer*	Passeriformes	Pycnonotidae	LC	IV
24	Plain Prinia	*Prinia inornata*	Passeriformes	Cisticolidae	LC	IV
25	Great Myna	*Acridotheres grandis*	Passeriformes	Sturnidae	LC	IV
26	Jungle Myna	*Acridotheres fuscus*	Passeriformes	Sturnidae	LC	IV
27	Common Myna	*Acridotheres tristis*	Passeriformes	Sturnidae	LC	IV
28	Asian Pied Starling	*Gracupica contra*	Passeriformes	Sturnidae	LC	IV
29	Oriental Magpie Robin	*Copsychus saularis*	Passeriformes	Muscicapidae	LC	IV
30	Black backed Forktail	*Enicurus immaculatus*	Passeriformes	Muscicapidae	LC	IV
31	Golden fronted Leafbird	*Chloropsis aurifrons*	Passeriformes	Chloropseida e	LC	-
32	Purple Sunbird	*Cinnyris asiaticus*	Passeriformes	Nectariniidae	LC	IV
33	Crimson Sunbird	*Aethopyga siparaja*	Passeriformes	Nectariniidae	LC	IV
34	House sparrow	*Passer domesticus*	Passeriformes	Passeridae	LC	-
35	Eurasian Tree Sparrow	*Passer montanus*	Passeriformes	Passeridae	LC	-
36	Baya Weaver	*Ploceus philippinus*	Passeriformes	Ploceidae	LC	IV
37	Chestnut Munia	*Lonchura malacca*	Passeriformes	Estrildidae	LC	IV
38	Indian Pond heron	*Ardeola grayii*	Pelecaniformes	Ardeidae	LC	IV
39	Cattle Egret	*Bubulcus ibis*	Pelecaniformes	Ardeidae	LC	IV
40	Little Egret	*Egretta garzetta*	Pelecaniformes	Ardeidae	LC	IV
41	Lineated Barbet	*Megalaima lineata*	Piciformes	Megalaimidae	LC	IV
42	Blue throated Barbet	*Megalaima asiatica*	Piciformes	Megalaimidae	LC	IV
43	Alexandrian parakeet	*Psittacula eupatria*	Psittaciformes	Psittacidae	NT	IV
44	Rose ringed parakeet	*Psittacula krameri*	Psittaciformes	Psittacidae	LC	IV
45	Blossom Headed parakeet	*Psittacula roseata*	Psittaciformes	Psittacidae	NT	IV

S. No.	Common name	Scientific name	Order	Family	IUCN Status	Schedule as per WPA, 1972
46	Red Breasted parakeet	*Psittacula alexandri*	Psittaciformes	Psittacidae	NT	IV
47	Asian Barred owlet	*Glaucidium cuculoides*	Strigiformes	Strigidae	LC	IV
48	Spotted owlet	*Athene brama*	Strigiformes	Strigidae	LC	IV
49	Asian Palm Swift	*Cypsiurus balasiensis*	Strigiformes	Apodidae	LC	IV

Source: Primary Survey, AECOM

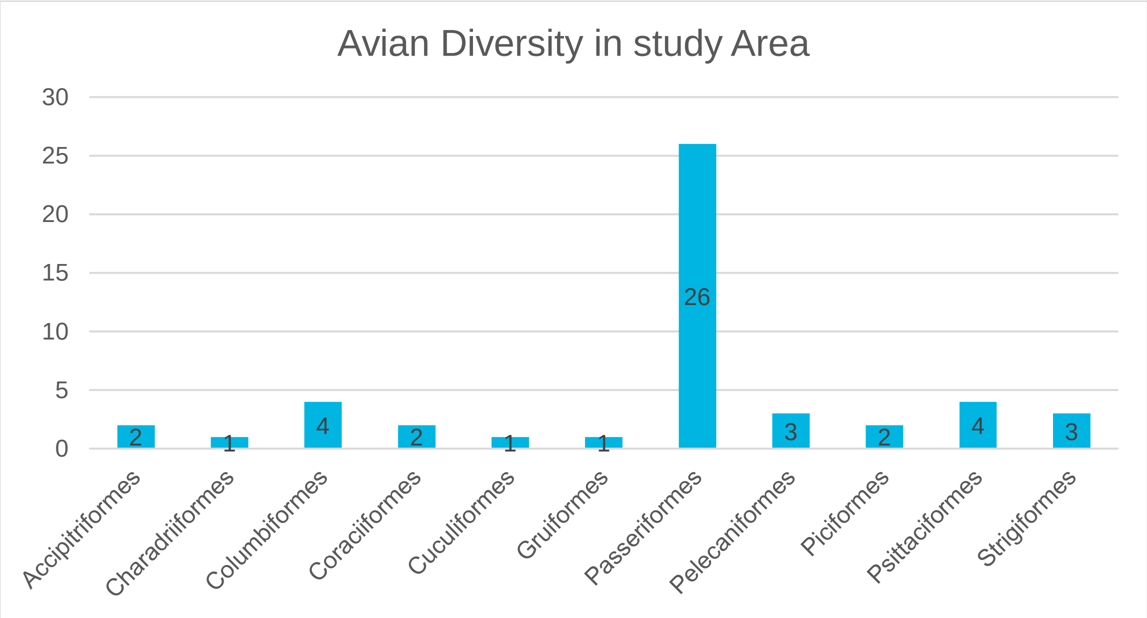


Figure 46. Diversity of Avifauna in Study Area

Maximum diversity of birds belonging to order Passeriformes were found in the study area. *Passeriformes* are also known as perching birds. These birds are commonly observed in the Study area.

Reptiles

No reptile species observed during the site visit. Although, a list of reptiles species which have reported from the study area has been given in Appendix 3.10

Amphibians

A list of Amphibians species that are reported from the study area is given in Appendix 3.11

Butterfly Species

Total 7 butterfly species have been observed in the study area during site visit. Detailed list of the butterflies observed in the area is given in **Table 3.33**

Table 3.33 List of butterflies observed during the Site Visit

Sr.no	Scientific name	Common name	Family	IUCN,3.1 status
1	*Euploea core*	Common Indian Crow	Nymphalidae	Least Concern
2	*Zeltus amasa*	Fluffy Tit	Zeltus amasa	-

Sr.no	Scientific name	Common name	Family	IUCN,3.1 status
3	*Moduza procris*	Commander	Nymphalidae	-
4	*Danaus chrysippus*	Plain Tiger	Nymphalidae	Least Concern
5	*Danaus genutia*	Common or Striped Tiger	Nymphalidae	-
6	*Tanaecia lepidea*	Grey Count	Nymphalidae	-
7	*Catopsilia pomona*	Common Emigrant	Pieridae	-

Eco-sensitive Areas

This section highlights Protected Areas and other ecologically sensitive features in and around the study area, to the proposed project related infrastructure.

Nambor and Nambor-Doigurung Wild Life Sanctuary

Nambor (3,700 ha) wildlife sanctuaries in Karbi Anglong district and the proposed Nambor-Doigrung Wildlife Sanctuary located in Golaghat district. The Nambor WLS sanctuary is situated at a distance of 22.37 km from the block boundary in northern direction and Nambor-Doigurung WLS located at a distance of 15.79 km from the project boundary in northern direction. The plains are the floodplains of the Dhansiri River. The forest type is Tropical Semi-evergreen with pockets of pure Evergreen, interspersed with small forest marshes. The Nambor forests are important for the Asian Elephant and Gaur. More than 160 species of birds have been recorded in the area, including the Endangered White-winged Duck, Near Threatened Great Pied Hornbill and the Lesser Adjutant in the adjoining fields. This could be a very important IBA for the conservation of White-winged Duck. Besides the Asian Elephant and the Gaur, there are Tiger, Leopard, Pig-tailed Macaque, Assamese Macaque, Rhesus Macaque, Slow Loris, Capped Langur and Hoolock Gibbon.

Aquatic Ecology

In an aquatic ecosystem, the environment is water, and all the system's plants and animals live either in or on that water. Aquatic ecosystems include wetlands, rivers, lakes, and coastal estuaries. Dhansiri river is the major river in the area providing a huge aquatic habitat in the block. Small canals, ponds were also found in the study area.

Total five locations were selected in the study area for plankton and benthic diversity studies, GPS coordinates of locations selected for phytoplankton, zooplankton and benthic sampling are given in table 3.34 and Figure 47.

Table 3.34 Geographic Co-ordinates of Plankton and Benthic study location

Sr. no.	Sample	GPS Coordinate	Name of the River	Nearest well
1	Sample I	26° 9'47.58"N, 93°49'29.00"E	Dhansiri River	Well 20
2	Sample II	25°57'2.08"N, 93°45'28.77"E	Dhansiri River	Well 1
3	Sample III	25°55'40.77"N, 93°47'16.58"E	Dhansiri River	Well 2
4	Sample IV	25°52'0.07"N, 93°46'58.50"E	Dhansiri River	Well 2
5	Sample V	26° 1'12.75"N, 93°47'10.46"E	Dhansiri River	Well 9

Source: Primary Survey,

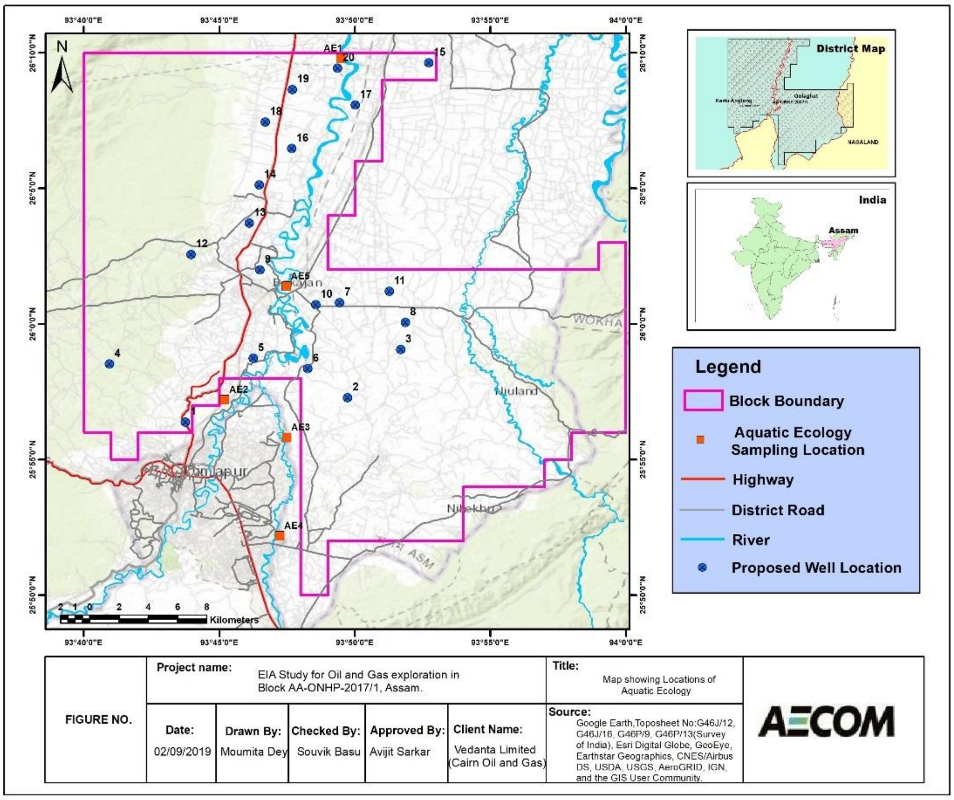


Figure 47. PBZ Sampling Location

Plankton

Phyto plankton

For phytoplankton analysis, composite samples were collected at each sampling location till the euphotic depth. Sample preservation was done with Lugol's iodine (final concentration 1 part to 100 parts water sample). Phytoplankton were viewed under a 40X lens in a compound microscope using a Sedgewick rafter cell. The protocol was as per NIO field manual (2004).

Table 3.35 Plankton in the study area

Sr. No.	Name of the species	Location 1 (Dhansiri River)	Location 2 (Dhansiri River)	Location 3 (Dhansiri River)	Location 4 (Dhansiri River)	Location 5 (Dhansiri River)
			DIATOMS			
1	*Gyrosigma sp.*	2	1	2	5	2
2	*Melosira granulata*	3	-	-	-	3
3	*Melosira varians*	-	-	-	2	-
4	*Cymbella ehrenbergii*	2	4	2	6	2
5	*Cymbella sp.*	-	2	-	4	2
6	*Navicula sp.*	-	9	16	8	5

7	*Synedra sp.*	-	-	-	3	1
8	*Synedra ulna*	-		-	1	-
9	*Nitzschia sp.*	-	5	7	4	3
10	*Nitzschia linearis*	1	-	-	-	
11	*Corethron sp.*	-	-	-	-	2
12	*Pinnularia sp.*	3	2	3	3	1
13	*Surirella sp.*	-	-	-	2	-
14	*Gomphonema olivaceum*	-	-	-	1	-
15	*Aulacoseira sp.*	-	-	-	1	-
16	*Fragilaria sp.*	2	5	-	-	2
			EUGLENOIDS			
17	*Trachelomonas sp.*	-	-	1	4	-
18	*Trachelomonas bacilifera*	4	-	-	-	-
19	*Euglena agilis*	1	-	-	-	3
20	*Euglena gracilis*	2	-	-	-	-
21	*Euglena acus*	-	-	-	-	2
22	*Planktolyngbya circumcreta*	2	-	2	-	-
23	*Oscillatoria sp.*	1	-	3	-	1
24	*Pseudanabaena catenata*	-	-	1	-	-
25	*Dinobryon sp.*	-	-	-	4	-
26	*Ceratium sp.*	1	-	-	2	1

Of the 26 species of phytoplankton observed in thestudy area , 16were diatoms. Plankton react rapidly to ecological changes and are viewed as excellent indicators of water quality and trophic conditions due to their short time and rapid rate of reproduction.

Euglena gracilis indicates mild organic pollution in lakes (Hosmani 2014). As per another study conducted by Singh et al. (2013), *Microcystis sp., Oscillatoria sp., Fragilaria sp., Navicula cryptocephala, Euglena sp., Closterium sp., Gomphonema sp., Nitzschia palea, Synedra ulna, Scenedesmus sp*. were reported to be tolerant to pollution. *Surirella robusta, Pinnularia biceps*, and *Gomphonema sphaerophorum* indicate mild pollution, as per a study conducted in the River Ganges by Dwivedi and Srivastava (2017). Biodiversity indices were calculated for the phytoplankton details of the same are given in **Table 3.36**

Table 3.36 Plankton diversity indices

Sr. no.	Location	Shannon's Index	Simpson's index
1	Location I (Dhansiri River)	0.954	2.71
2	Location II (Dhansiri River)	0.83	1.75
3	Location III (Dhansiri River)	0.78	1.82
4	Location IV (Dhansiri River)	0.91	2.49
5	Location V (Dhansiri River)	0.95	2.65

Source: <Primary Survey, >

Zoo Plankton

Zoo plankton were sampled using a standard zooplankton net of mesh size 75 µm. The samples were collected with a horizontal haul. After collection sample was rinsed thoroughly and then concentrated. Fixing was done with 4-5% formalin (1-part formalin and 9 parts sample) within 2-3 minutes of sample collection. 4-5% formalin also work as preservative. Few drops of Rose Bengal solution were used for sample staining. Zooplankton were viewed under a 20X lens in a stereo microscope. The protocol was as per NIO field manual (2004).

Table 3.37 List of Zoo Plankton

List of Group	Mayfly	Copepod			Cladocerans			Rotifer Larvae	
	Larve of Ephemeroptera	Cyclopoida	Calanoida	Nauplius larvae	Sida sp.	Diaphanosoma Sp.	Daphnia sp.	Trichotria sp.	Brachionus calyciforus
Location I	-	-	3	-	-	3		-	2
Location II	2	-	-	5	-	-		-	-
Location III	-	3	1	-	-	-	2	-	-
Location IV	-	12	-	4	-	-	1	-	-
Location V	3	-	3	-	1	-		2	-

Zooplanktons belonging to Mayfly, Copepod, Cladocrans and Rotifer group were observed in the study area. Higher diversity was observed at Location V of the Dhansiri River. More diversity of Calanoida was observed in the study area.

Benthic Organism

For analysis of benthic organisms, the sediment has been collected using a scoop or grab sampler. The samples were mixed with water to have a slurry-like consistency and a mesh of size 500µm was used with low pressure rinsing to ensure sample concentration. Residue were fixed with 4% (v/v) formalin. Benthic biodiversity was viewed using a hand-held lens as well as under a 20X lens in a stereo microscope. The protocol was as per NIO field manual (2004).

Table 3.38 List of Benthic Organism

	Macrobenthos					Meiobenthos			
List of Group	Amphipoda	Insecta		Gastropoda		Cladocera	Calanoida	Harpacticoida	Cyclopoida
Location		May fly	Glassworm	Pilla sp.	Paludomus Sp.	Cladocera	Calanoida	Harpacticoida	Cyclopoida
Location I	-	1	-	-	-	Daphnia sp.			Macrocyclops sp.
Location II	-	2	-	-	2	-	-	-	1
Location III	3	-	1	2	-	3	-	-	3
Location IV	-	-	-	-	1	-	-	-	-
Location V	-	4	-	5	-	2	1	-	-

Among benthos, three groups of Macrobenthos and four group of meiobenthic were reported in the study area.

Primary Productivity

Primary productivity is a term used to describe the rate at which plants and other photosynthetic organisms produce organic compounds in an ecosystem. There are two aspects of primary productivity:

Gross productivity is the entire photosynthetic production of organic compounds in an ecosystem.

Net productivity is the organic materials that remain after photosynthetic organisms in the ecosystem have used some of these compounds for their cellular energy needs (cellular respiration).

Primary productivity will be calculated using Winkler's light and dark bottle method. The technique developed by Gaarder and Gran uses variations in the concentration of oxygen under different experimental conditions to infer gross primary production. Typically, three identical transparent vessels are filled with sample water and stoppered.

The first is analysed immediately and used to determine the initial oxygen concentration; this is done by performing a Winkler titration. The other two vessels are incubated, one each in under light and darkened. After a fixed period of time (usually 24 hrs), the experiment ends, and the oxygen concentration in both vessels is measured. As photosynthesis has not taken place in the dark vessel, it provides a measure of ecosystem respiration. The light vessel permits both photosynthesis and respiration, so provides a measure of net photosynthesis (i.e. oxygen production via photosynthesis subtract oxygen consumption by respiration). Gross primary production is then obtained by adding oxygen consumption in the dark vessel to net oxygen production in the light vessel.

Procedure:

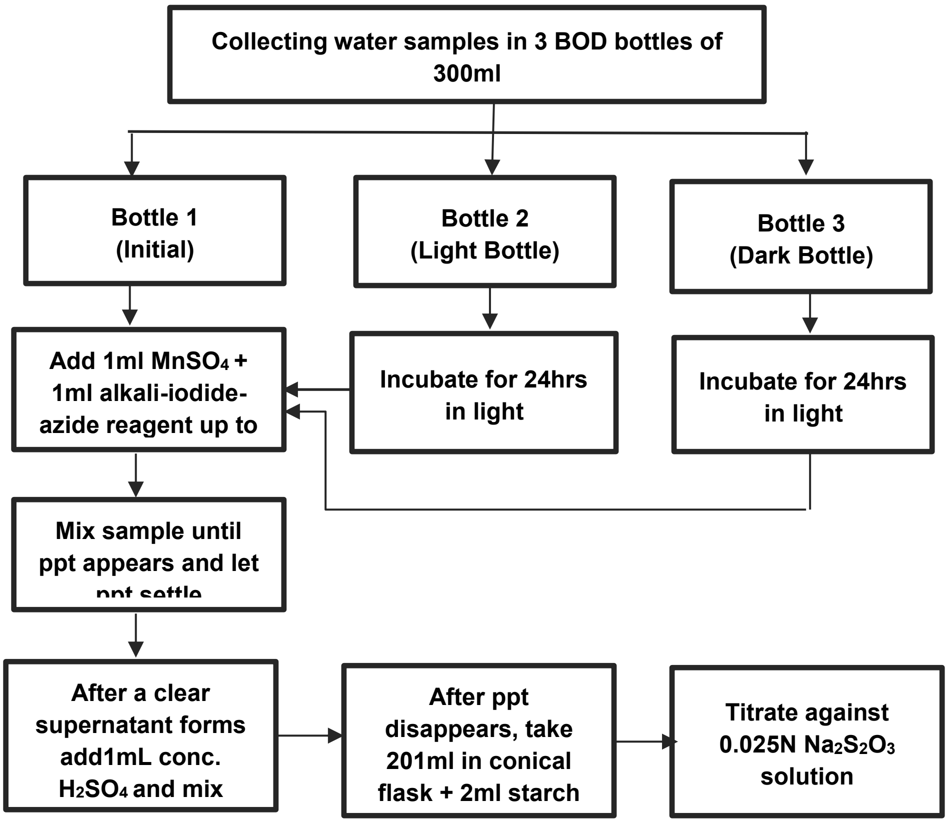


Table 3.39 Geographic Co-ordinates of primary productivity sampling site

Sr. no.	Sample	GPS Coordinate	Name of the River	Nearest well
1	Sample I	26° 9'47.58"N, 93°49'29.00"E	Dhansiri River	Well 20
2	Sample II	25°57'2.08"N, 93°45'28.77"E	Dhansiri River	Well 1
3	Sample III	25°55'40.77"N, 93°47'16.58"E	Dhansiri River	Well 2
4	Sample IV	25°52'0.07"N, 93°46'58.50"E	Dhansiri River	Well 2
5	Sample V	26° 1'12.75"N, 93°47'10.46"E	Dhansiri River	Well 9

Source: <Primary Survey >

Primary productivity for five locations were calculated and the results are given in **Table3.39**

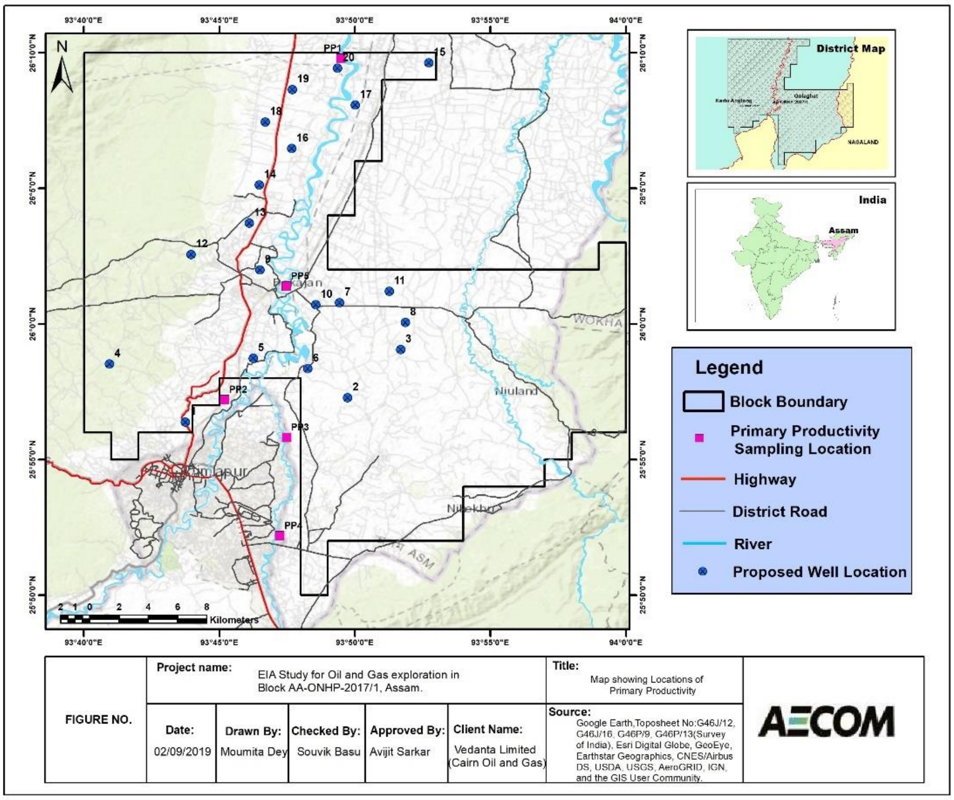


Figure 48. Primary Productivity Sampling Location

Table 3.40 Primary Productivity of Different sites

Sr.no.	Sample	GPP	NPP
1	Sample I	16.250	14.687
2	Sample II	16.250	13.125
3	Sample III	14.687	13.125
4	Sample IV	17.1875	16.25
5	Sample V	23.4375	20.3125

Source: <Primary Survey, >

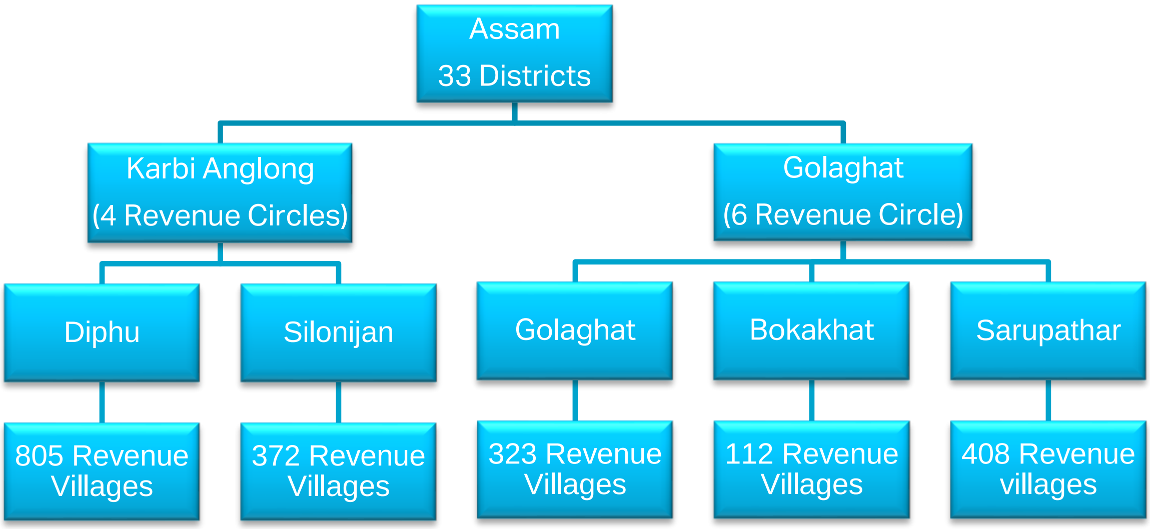

Photographs1: Forest Ecosystem | **Photographs 2: Tea Estate**


Photographs 3: Aquatic Ecosystem | **Photographs 4: *Costus speciosus***

3.15 Socio economic Environment

A socio-economic assessment is a procedure, in which the positive and negative impacts on the people likely would be directly and indirectly affected by the project was conducted along with other studies during the EIA. The assessment facilitated an understanding of the needs, demands, preferences, capacities and constraints of the people in the vicinity of the project operation. It was undertaken primarily to enhance the understanding of other relevant factors such as social organizations and networks, livelihood patterns, social infrastructure etc. The assessment attempts to predict and evaluate future impacts of project upon people, their physical and psychological health and well-being, their economic facilities, cultural heritage, lifestyle and other value system and helped in prioritizing Vedanta's commitment towards the CER initiatives. Inputs from the social assessment into the design phase facilitated in:

- Tracking potential adverse effects over different time frames and different activities
- Reviewing options to eliminate such negative impacts through design changes or mitigate them through specific social protection or mitigation measures
- Reviewing options to extend or enhance benefits for the population in the vicinity of the project site.



Area of Influence

Study area for present study has been divided in two part i.e. Core area and Buffer Area based on the impact type direct and indirect. Core area means the area where the local community and villages are mostly impacted both negative and positive impact. Buffer area is just outside (within 2.5 km radius of the proposed well location) the core area where local community and villages might be impacted due to spill over of impact outside the core area.

The villages, where the proposed well sites are located are considered as core area, and the villages within 2.5 km radius of the core zone villages are regarded as buffer area villages, for the present project.

These villages are primarily selected based on reconnaissance surveys, census data information, topo sheet maps, understanding of the project and professional judgment. The villages falling under the Core area and the Buffer area for which socio-economic baseline assessment has been undertaken have been mentioned in Table 3.41 and 3.42

Table 3.41 Villages within proposed well area

Villages	Well no.	Block	District
Bali Pathar	Well No.12	Bokajan	Karbi Anglong
Bokajan	Well No.10	Bokajan	Karbi Anglong
Chungajan Hazari gaon	Well No.7	Golaghat South	Golaghat
Dilaojan	Well No.16	Bokajan	Karbi Anglong
Kai Terang, Habe Timung	Well No.5	Bokajan	Karbi Anglong
Netezu	Well No.11	Golaghat South	Golaghat
No. 2 Kori	Well No.16	Golaghat South	Golaghat
No.2 Panjan	Well No.20	Golaghat South	Golaghat
Paniram terang	Well No.15	Bokajan	Karbi Anglong
Rongagara	Well No.19	0135	Karbi Anglong
Sariajan	Well No.13	0135	Karbi Anglong
Sarthe Killing	Well No.4	0135	Karbi Anglong
Sukhanjan	Well No.9	Golaghat South	Golaghat
Tengatol Basti	Well No.3	Golaghat South	Golaghat

Table 3.42 List of villages located within 500meter Buffer of Proposed Well Location

Well No.	Villages within 500m	Exact Dist	Direction	CD Block	District
Well No.1	No Village Found	-	-	-	-
Well No.2	No Village Found	-	-	-	-
Well No.37	Tengatol Basti	184 m	NW	Golaghat South	Golaghat
Well No 4	Sarthe Killing	300m	NE	Bokajan	Karbi Anglong
Well No.5	Habe Timung	424 m	W	Bokajan	Karbi Anglong
Well No.6	No Village Found	-	-	-	-
Well No.7	Chungajan Hazari gaon	200 m	NW	Golaghat South	Golaghat
Well No.8	No village found	-	-	-	-
Well No.9	Sukhanjan	350 m	W	Golaghat South	Golaghat
Well No.10	Bokajan	300 m	SW		Karbi Anglong
Well No.11	Netezu	480 m	S	Golaghat South	Golaghat
Well No.12	Bali Pathar	498 m	N	Bokajan	Karbi Anglong
Well No.13	Sariajan	322m	N, S	Bokajan	Karbi Anglong
Well No.14	No Village Found	-	-	-	-
Well No.15	Paniram terang	400 m	S	Bokajan	Karbi Anglong
Well No.16	Dilaojan	423 m	E	Bokajan	Karbi Anglong
Well No.17	No. 2 Kori	100 m	E, N , S	Golaghat South	Golaghat
Well No.18	No Village Found	-	-	-	-
Well No.19	Rongagara	230 m	S	Bokajan	Karbi Anglong
Well No.20	No.2 Panjan	460 m	E	Golaghat South	Golaghat

Methodology for Socio-economic Study

The socio-economic assessment was primarily based on the analysis of the secondary data obtained from the census survey 2011 and Community consultations. Following tools have been used for gathering information and validating secondary data after considering nature of project operation and understanding the demographic characteristic of the area.

Secondary Data Analysis

To evaluate socio-economic environment in the study area, secondary information from the 2011 Census handbook has been referred to and details pertaining to habitations in the study area have been extracted and assessed. Apart from that district level secondary information has also been collected for district statistical hand book, Year 2011.

Stakeholder Consultation

At the beginning of the EIA process, the AECOM team conducted a preliminary identification of probable stakeholders. An inventory of potential stakeholders, including local groups and individuals, local institutions like panchayats which may be directly or indirectly affected by the project or with interest in the development activities of the region was made at preliminary.

Consultations with community are a continuous process that was carried in the EIA process and would be continued during the construction and operation phases of the project. Issues like land and resource damage, social disturbance, severance and increased congestion, noise and air pollution, employment opportunities, need for development of basic infrastructure, safe drinking water, sanitation facilities in the villages located in 2.5 km periphery have been discussed during the consultations so that they can be adequately addressed through the environment management plans. The consultations also helped in developing preliminary understanding of the requirement of social development initiatives, which are required in the project village and may be undertaken as part of the Vedanta's CER activity.

Socio-economic profile

Demographic Profile

Demographic details are details related to statistical and dynamic aspects of a population. Data related to households, population, sex ratio, caste, literacy rate was obtained from Census, 2011 that is conducted every 10 year since 1872.

Population and Household

Population and households are basis units of demography. A population in statistics can be defined as a discrete group of people that are identical with at least one common characteristic whereas a household is majorly composed of two or more persons who are occupying a single housing unit. Details of the population and households was obtained from District Census, 2011 handbook of Golaghat and Karbi Anglong district.

Population and Household Size of Villages in the Study Area

As per Census 2011, Dihingia villages had 851 households, whereas Wokha TE had 771. Other villages with more than 400 households were Hallo Khuwa, Rongagara and Kath Katia. In total, there were 6 villages with 400-800 households, while 33 villages had 100-300 households. As many as 132 villages had less than 100 housholds. In the study area, as many as 70 vilages had less than 500 population whereas the population of 18 villages was in the range of 1000-4000. As per census 2011, the sex ratio of the villages was found to be 961 whereas that of Golaghat and Karbi Anglong district is 964 and 951 respectively. The sex ratio of the villages in the block is more than the sex ratio of Assam i.e, 958 (Census, 2011).

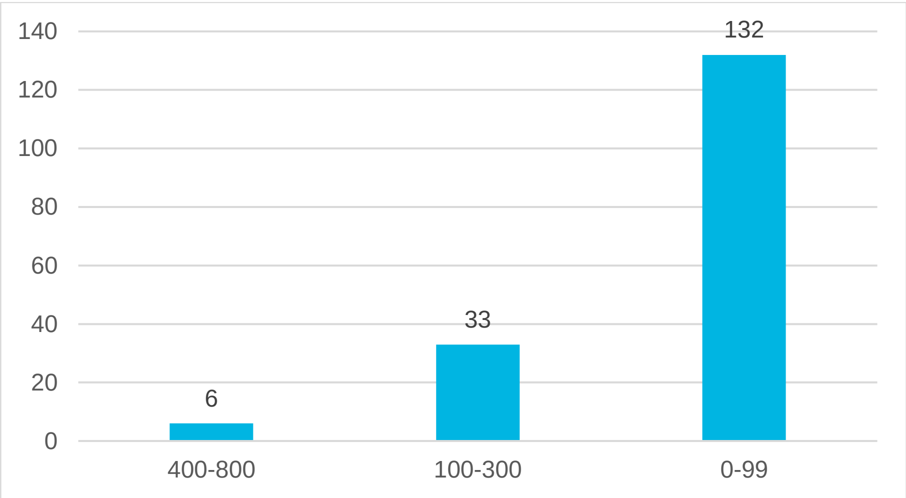


Figure 49. Number of households in villages within the Study Area Source: Census of India, 2011 (Golaghat and Karbi Anglong districts)

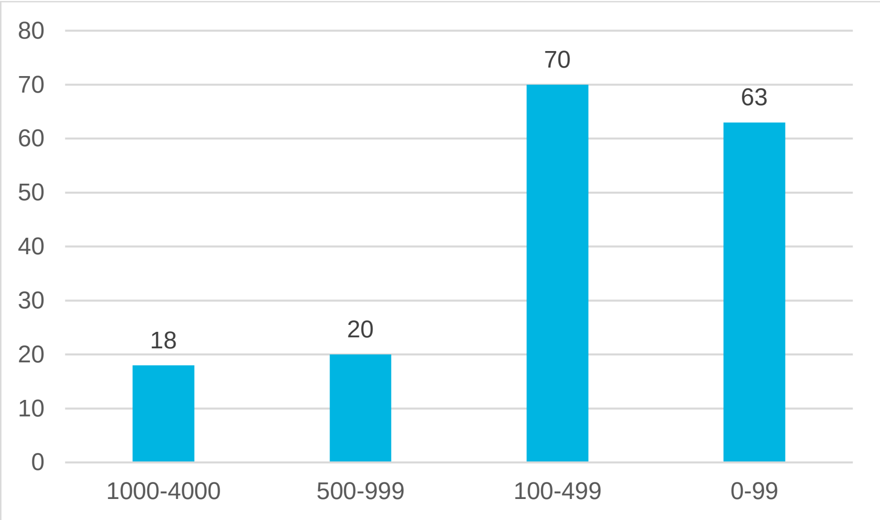


Figure 50. Population in Villages within the Block

Villages where Proposed Well Area Located

Details of the household and population of the villages located near well is given in Fig.49. As per census 2011, the sex ratio of the villages was found to be 964 whereas that of Golaghat and Karbi Anglong district is 964 and 951 respectively. The sex ratio of the villages in the block is more than the sex ratio of Assam, i.e, 958 (Census, 2011).

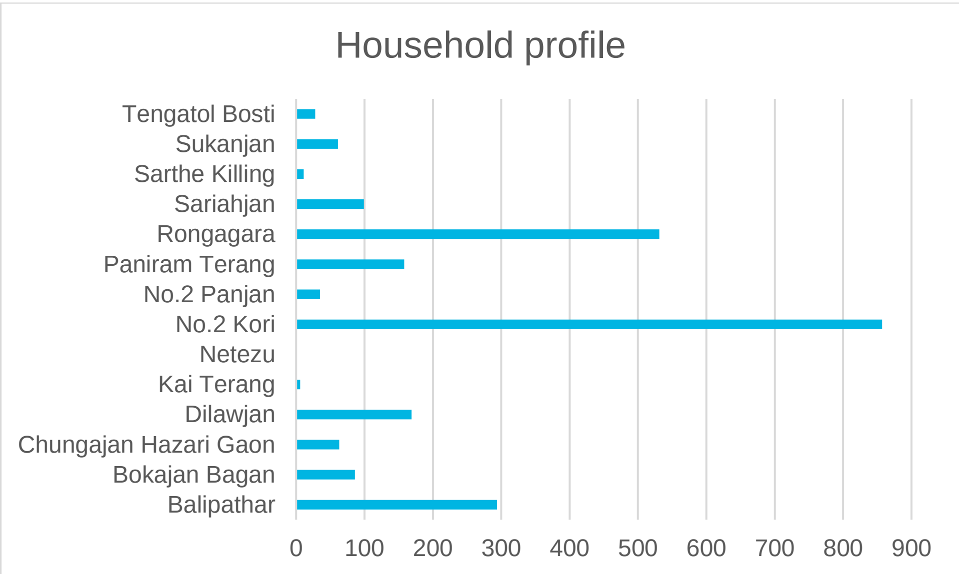


Figure 51. No. of Households in the Villages in which Wells are Located

Villages Located within 500 meter Buffer of the Proposed Well Location

As per Census data 2011, No. 2 Kori and Rongagara had the most number of households in the villages in the 500m buffer of the wells. As per census 2011, the sex ratio of the villages was found to be 950 whereas that of Golaghat and Karbi Anglong district is 964 and 951 respectively. The sex ratio of the villages in the block is less than the sex ratio of Assam i.e, 958 (Census, 2011).

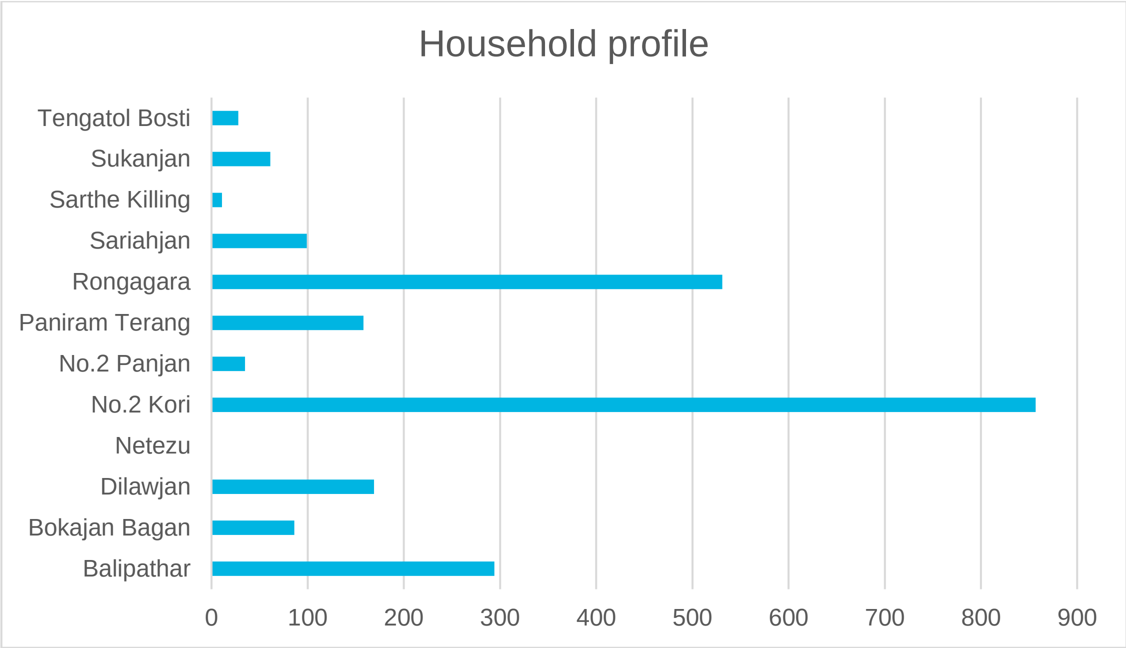


Figure 52: Households in the 500m Buffer of Well Locations

SC and ST Population

The Scheduled Castes and Scheduled Tribes are officially designated groups of people who are historically disadvantaged in India. The terms was derived in the Constitution of India and the groups are designated in one or other of the categories.

Villages Located within the Study Area

As per Census 2011, 41 villages had more than 80% ST population, among which 13 had 100% ST population. In contrast, only one village (Samukjan) had more than 80% SC population.

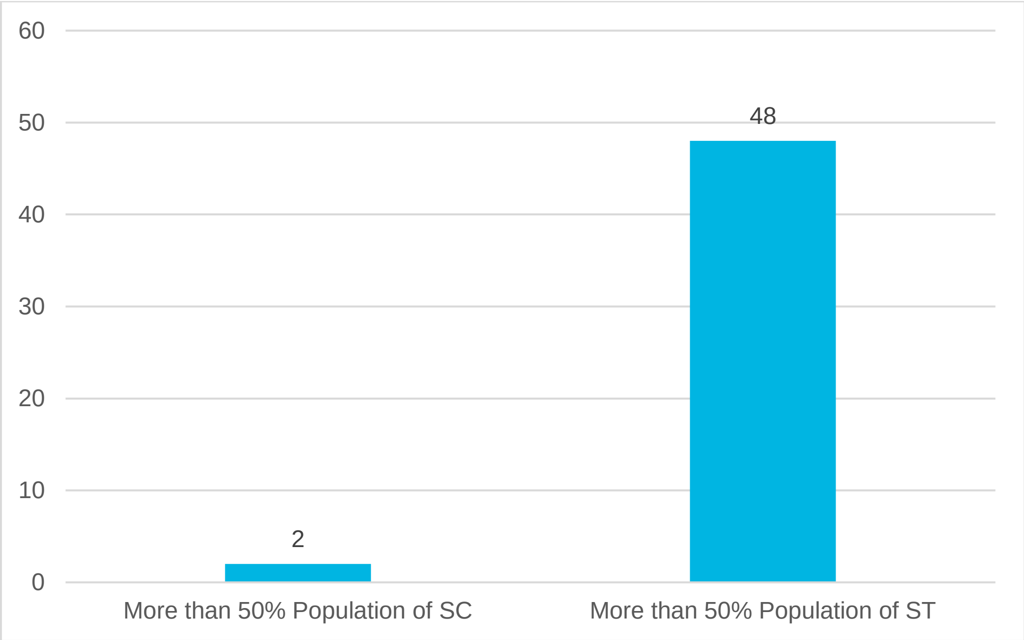


Figure 53: Villages located within the study area

As per census 2011, the caste of the villages in the block was found to be 48% ST and 2% SC whereas that of Golaghat is 5.84% SC and 10.48% ST is and Karbi Anglong district is 15% SC and 52% ST respectively in Assam State.The SC & ST population of Assam is 7.15% SC and 12.45 % ST(Census, 2011).

Villages where Proposed Wells Are Located

7 villages in among those where the proposed wells are located had more than 80% population of Scheduled Tribes. Kai Terung had 100% ST population.

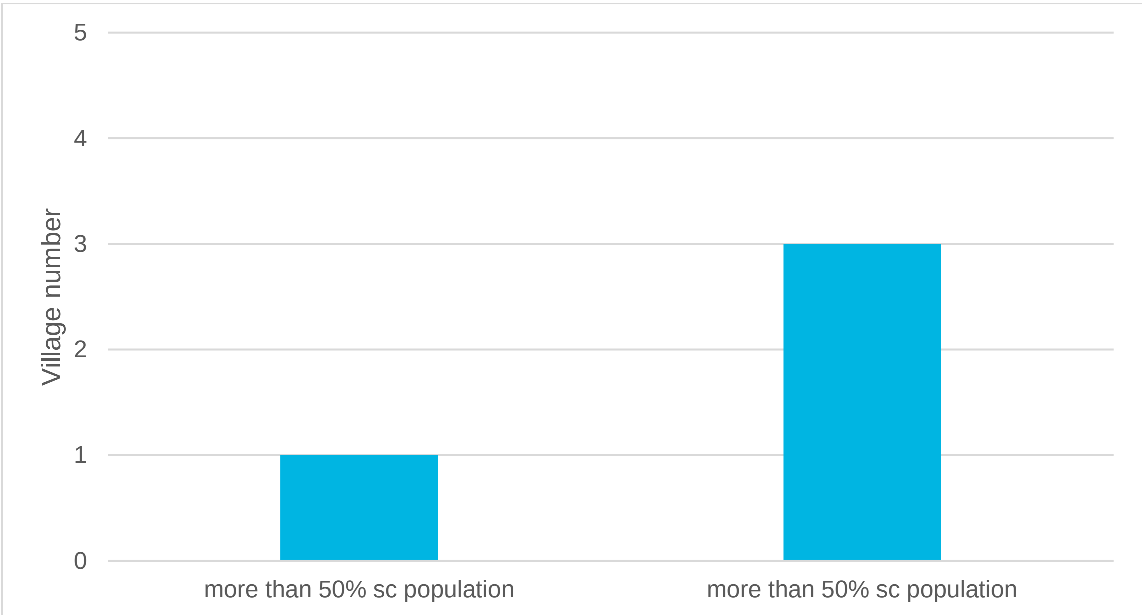


Figure 54. Social Structure of the villages where proposed wells are located

As per census 2011, the caste of the villages in the block was found to be 48% ST and 2% SC whereas that of Golaghat is 5.84% SC and 10.48% ST is and Karbi Anglong district is 15% SC and 52% ST respectively in Assam State.The SC & ST population of Assam is 7.15% SC and 12.45 % ST(Census, 2011).

Villages Located within 500 meter Buffer of the Proposed Well Location

As per census 2011, 8 villages in the 500m buffer area of the proposed well locations had more than 80% population of Scheduled Tribes. Habe Timung, Kai Terung has 100% ST population, whereas Samukjan village has more than 80% SC population.

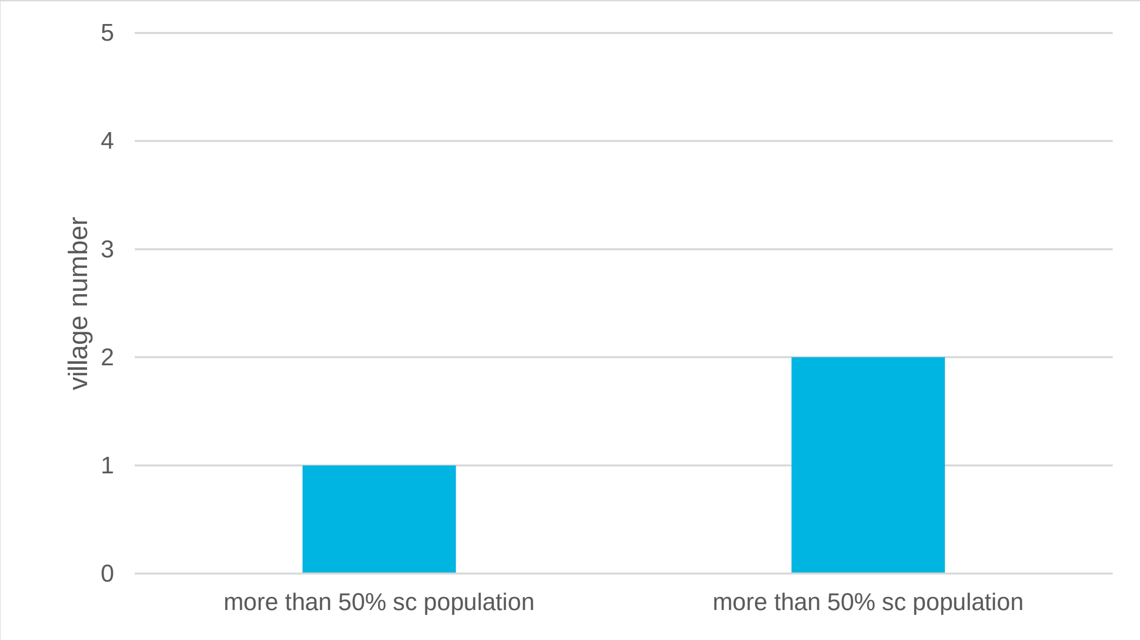


Figure 55. Social Structure of the villages within 500m buffer of the Proposed Well Locations

As per census 2011, the caste of the villages in the block was found to be 48% ST and 2% SC whereas that of Golaghat is 5.84% SC and 10.48% ST is and Karbi Anglong district is 15% SC and 52% ST respectively in Assam State.The SC & ST population of Assam is 7.15% SC and 12.45 % ST(Census, 2011).

Literacy Rate

Literacy, as defined in Census data, is the ability to read and write with understanding in any language and literacy rate is a key indicator of the level of education prevalent amongst the sample population. It is also considered as one of the key factors of socioeconomic progress. All children of age below 7 years are treated as illiterate. People who are blind and could read in Braille are also treated as literates.

Villages Located within Block

The literacy rate of Assam was 72.19 % as per the 2011 census. According to Census 2011, in 39 villages the literacy rate was 80-100%, while in 79 villages it was 50-80%. 53 villages of the study area the literacy rate was below 50%. The average literacy rate was 73.3 percent. Rengma Naga village displayed 100 percent literacy as per Census 2011 data

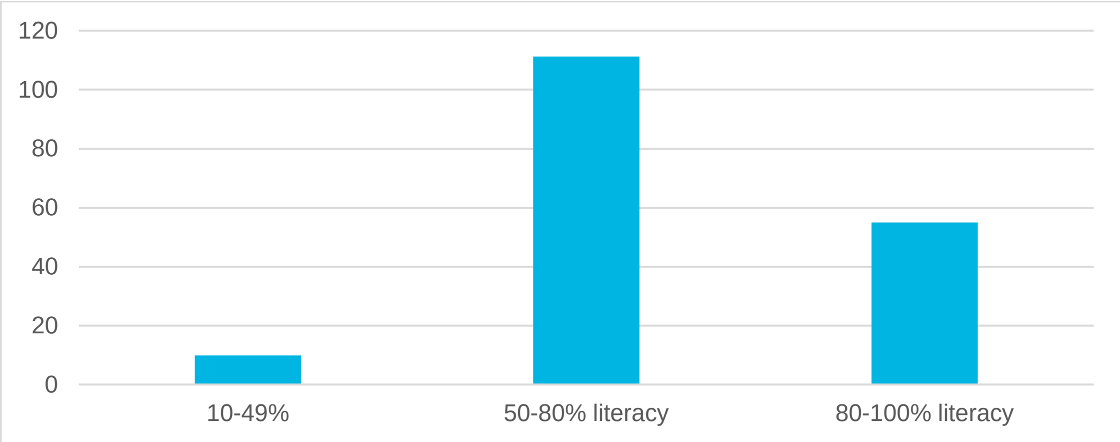


Figure 56. Literacy Rate in the Villages in the Study Area

Most of the villages in the block has 50- 80% literacy rate whereas average literacy rate in Karbi Anglong District is 69.25% and in Golaghat District is 77.43%. In Assam state, the literacy rate is 72.19%

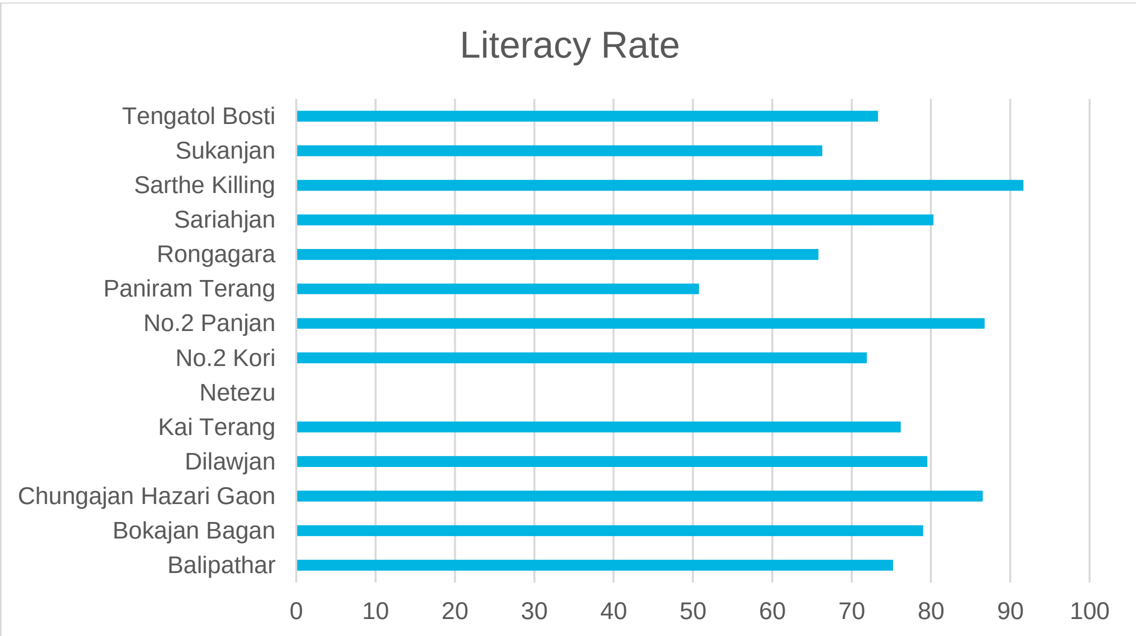


Figure 57. Literacy rate in the Villages in which Proposed Wells are Located

Villages Located within 500 meter Buffer of the Proposed Well Location

Sarthe Killing village in the 500m buffer of the study area had more than 90% literacy rate, while Dilawjan Longbui, Chandra Teron, Samukjan and Dhorampur had more than 80% literate population.

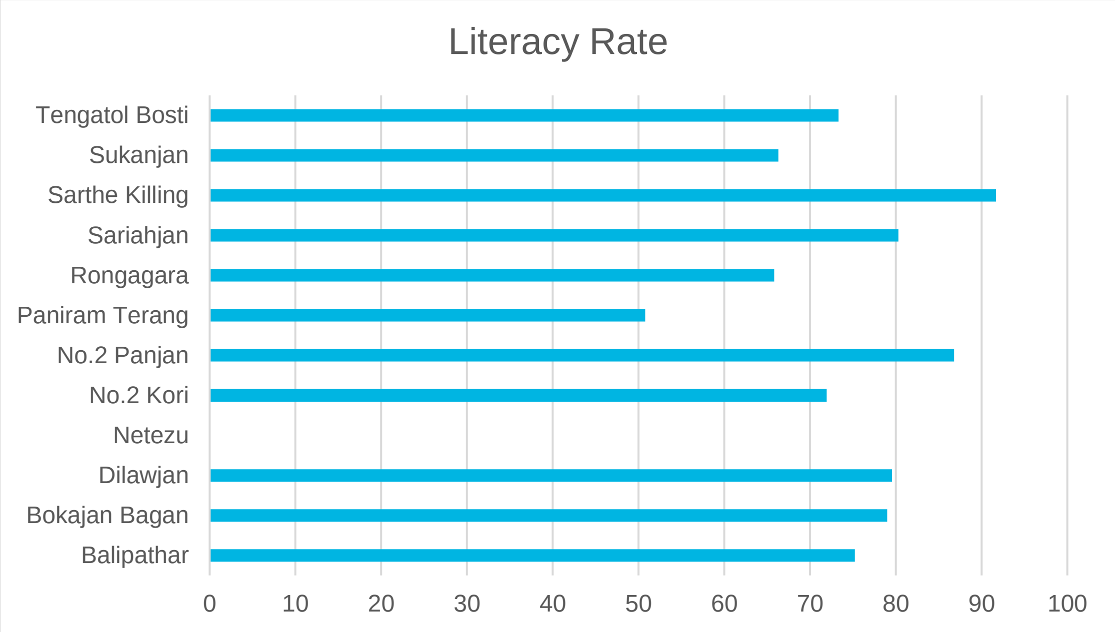


Figure 58. Literacy Rate in Villages in the 500m Buffer of the Proposed Well Locations

Most of the villages in the block has 50- 80% literacy rate whereas average literacy rate in Karbi Anglong District is 69.25% and in Golaghat District is 77.43%. In Assam state, the literacy rate is 72.19%.

Villages Located within Block

As per census 2011, in 11 of the villages in the study area, the entire working population comprised of main workers, while in 56 villages, more than 70 percent of the workforce were employed for more than six months in a year.

In contrast, there were 14 villages wherein more than 80 percent of the working population comprised of marginal workers. These villages include Sukanjan, Dilawjan Koch Gaon, Longkicho Engti, Sartha Phangcho, Bill Pathar etc.

Villages where Proposed Well Area Located

As per census 2011, more than 70 percent of the total workers in 14 of the Villages in which wells were located were comprised of Main Workers. Marginal workers were more than 70 percent in 3 of the villages (Sukanjan, Sarthe Killing and Longkicho Engti).

Villages Located within 500 meter Buffer of the Proposed Well Location

As per Census 2011, in nearly 55 percent (n = 18) of the villages in the 500 m buffer area, the proportion of main workers was more than 70 percent. Sukanjan, Sarthe Killing, Longkicho Engti and Joypur were villages in which more than 70 percent of the working population comprised of marginal workers.

Details of Amenities Present in Study Area Villages

Drinking Water

Less than 17 percent of the villages in the block had access to treated tap water, while less than 15 percent had access to untreated tap water (as per Census of India 2011). Most of the villages in the study area sourced their drinking water from hand pumps and tube wells. As per Census 2011, treated tap water was available to less than 10 percent of the villages while untreated tap water reached about 12 percent.

Educational Facility

As per Census 2011, govt primary schools were available in nearly 45 percent of the villages in the study area whereas government middle school, secondary school and senior secondary schools were not available in most of the villages (89 percent, 98 percent and 100 percent, respectively). Most of the villages in the 500m buffer had access to Govt. primary school. There were very few villages with Middle school (about 5 percent) or Secondary and Senior Secondary schools.

Most of the villages in which wells are located had access to Govt. primary school. There were very few villages with Middle school (about 5 percent) or Secondary and Senior Secondary schools.

Sanitation Condition

As per census 2011, more than 50 percent of the villages in the study area had no access to drainage system, while 10 percent had open drainage. Only about 17 percent of the villages in the study area were covered under the Total Sanitation Campaign, and less than 2 percent of the villages had access to a community toilet complex.

Only about 5 percent of the villages in the 500m buffer area were provided drainage facility (closed or open), with about 40 percent villages without any drainage facility. In about 25 percent villages, the drain was dischagred directly into water bodies.

As per Census of India 2011, none of the villages in the 500 m buffer area had access to community toilets and only about 7 percent of the villages were covered under the Total Sanitation Campaign. However, during the primary survey, better access to private toliets was observed under the Swachh Bharat Abhiyan.

In most of the studied villages, villagers used kachha toilets. New toilet construction was observed under the Swachh Bharat Abhiyan. There were no formal solid waste management facilities, and villagers tended to burn their waste. In Bokajan, which is governed by a municipal board, more citizens had access to pukka toilets.

Villages in which Proposed Wells are Located

Only about 4 percent of the villages in which the proposed wells are located were provided draingage facility (closed or open), with about 30 percent villages without any drainage facility.

As per Census of India 2011, none of the villages in which the proposed wells are located had access to community toilets and only about 5 percent of the villages were covered under the Total Sanitation Campaign. However, during the primary survey, better access to private toliets was observed under the Swachh Bharat Abhiyan.

Health Facility

Health is an important aspects concerned with wellbeing of an individual physically and mentally. Health of the people affects socio-economic condition of a community and is also linked with the environment. The healthcare facility is divided into a three-tier system in rural area, which is given as follows:

Sub-centre: The Sub Centre is the most peripheral and first contact point between the primary health care system and the community. The major task sub-centres are assigned are to provide service associated with maternal and child health, nutrition, family welfare, immunization, diarrhoea control and control of various communicable diseases programmes.

Primary Health Centre (PHC): PHC is the first point of contact between village community and the medical officers. The Centre was envisaged to provide facilities integrated with curative and preventive health care to the rural population, majorly focusing on various preventive and promotive aspects of health.

Community Health Centres (CHCs): CHCs are maintained by the State government under MNP/ BMS programme. As per norms, a CHC is required to be managed by 4 medical specialists (surgeon, physician, gynaecologist and paediatrician) including 21 paramedical and other required staff. It has 30 in-door beds with one OT, X-ray, labour room and laboratory facilities.

The standards set by the national health policy are given below:

Table 3.43 National Health Policy Standards

Population	Infrastructure	Personnel
3000- 5000	1 Sub-centre	1 ANM (Auxiliary Nurse Midwives)
25,000- 30,000	1 PHC, 6 Beds	2 Medical Officers
1,00,00	Rural Hospital	Medical Superintendent

Electricity

Villages in the Study Area:

According to Census 2011, in only 9 villages, 99 hours electricity was supplied during summer (April to Sept) and winter months (Oct to March). These included No. 2 Kori, Sariajan, Dilawjan, Dhorampur etc. and Bokajan. Although the electricity supply was not regular, most of the villages were connected to the grid, with only 9 villages getting no electricity. This was as per data obtained from the Census of India, 2011.

Villages in 500m Buffer of the Proposed Wells

According to Census 2011, in 9 villages located in the 500 m buffer of the, 99 hours electricity was supplied in the summer as well as winter months. These villages were Chandra Teron, Dhorampur, Dilawjan, Joypur, No. 2 Kori etc. and Bokajan town. There were 9 villages with no access to electricity.

Villages in which Proposed Wells are Located

According to Census 2011, in 8 villages located in the 500 m buffer of the, 99 hours electricity was supplied in the summer as well as winter months. These villages were Chandra Teron, Dhorampur, Dilawjan, Joypur, No. 2 Kori etc. There were 8 villages with no access to electricity.

Photographs of Social Survey conducting during Month of April-May, 2019.

Photographs1: Consultation in Sukhajan village

Photographs 2: Consultation in Shantigaon Village(Anganwadi Staff)

Photographs 3: Consultation in discussion in Bokajan Village

Photographs 4: Consultation in Deputy Range Forest offcer – Interaction session

4. Anticipated Environmental Impact and Mitigation Measures

This chapter presents the identified environmental impacts due to the proposed project and outlines alternatives any mitigation measures for minimizing adverse impacts.

4.1 Impact Assessment Methodology

An environmental impact identification matrix has been developed to present an overview of possible interactions between project aspects and components of the environment which may get affected. The matrix considers physical, biological and socio-economic components of the environment on one axis (X axis) and activities of the proposed drilling project on the other side (Y axis). Aspects and impacts on environmental components which would be relevant to the different phases of the project e.g. pre-drilling activities, drilling, early production decommissioning have been addressed in the matrix. Environmental and socio-economic components were identified based on reviewing of applicable legislations project specific features and baseline environment, site reconnaissance visits, discussions with stakeholders.

Potential environmental impacts that may result from any of the identified project activity has been identified in a matrix based on activity-component interaction and is presented in table below. The impacts which has been identified in the matrix have been assessed for its significance based on significance criteria delineated in **Table 4.1** and **4.2**.

4.2 Impact Criteria and Ranking

Once all project environmental aspects were comprehensively identified for the different activities of the project, the level of impact that may result from each of the activity-component interactions has been assessed based on subjective criteria.

For this, three key elements have been taken into consideration based on standard environmental assessment methodologies:

- **Severity of Impact:** Degree of damage that may be caused to the environmental components concerned;
- **Extent of Impact:** Geographical spread of impact around project location and corridors of activities; and
- **Duration of Impact:** Time for which impact lasts taking project life-cycle into account.

These elements have been ranked in three levels viz. 1 (low), 2 (moderate) and 3 (high) based on the following criteria provided in Table 4.1:

Table 4.1 Impact Prediction Criteria

Impact Elements	Criteria	Ranking
Severity	• Regional impact resulting in long term and/ or medium damage to the natural environment. • Major impact on community and occupational health (e.g. serious injury, loss of life) on account of accidental events *viz.* well blow-outs and related operational activities.	3
	• Local scale impact resulting in short term change and / or damage to the natural environment. • Temporary loss of land, source of livelihood for affected communities • Local scale impact on terrestrial habitat, endangered species, drainage pattern and community resources. • Moderate impact on occupation and community health &well being (e.g. noise, light, odour, dust, injuries to individuals)	2
	• Limited local scale impact causing temporary loss of some species etc.	1

Impact Elements		Criteria	Ranking
	•	Limited impact on human health and well-being (e.g. occasional dust, odour, light, and traffic noise).	
Extent	•	Regional scale impact and including impacts to physical, biological and socio-economic environment of the block	3
	•	Largely local level impact limited to immediate vicinity of the proposed well sites	2
	•	Impact not discernible on a local scale and is limited within the boundaries of the drill site	1
Duration	•	The impact is always likely to occur during the entire project life cycle .	3
	•	The impact is likely to occur in some phases of project life under normal operating conditions.	2
	•	The impact is very unlikely to occur at all during project life cycle but may occur in exceptional circumstances.	1

A positive or beneficial impact that may result from this project has not been ranked and has been depicted in the form of ++.

4.3 Impact Significance

The significance of impact has been determined based on a multiplicative factor of three element rankings. Table 4.2 depicts impact significance in a scale of LOW-MEDIUM-HIGH and would be used for delineation of preventive actions, if any, and management plans for mitigation of impacts.

Impact significance has been determined considering measures which have been factored in the design and planning phase of the project. Legal issues have been taken into account, wherever appropriate in the criterion sets, to aid in Cairn Oil & Gas effort to comply with all relevant legislation and project HSE requirements. Additionally, the results of quantitative impact prediction exercise, wherever undertaken, have also been fed into the process.

Table 4.2 Criteria Based Significance of Impacts

Severity of Impact (A)	Extent of Impact (B)	Duration of Impact (C)	Impact Significance (A X B X C)	
1	1	1	1	Low
1	1	2	2	
1	2	1	2	
1	1	2	2	
2	1	2	4	Medium
1	2	2	4	
3	1	2	6	
1	3	2	6	
2	2	2	8	
3	2	2	12	High
2	3	2	12	
2	2	3	12	
3	3	2	18	
3	2	3	18	
2	3	3	18	
3	3	3	27	

Severity of Impact (A)	Extent of Impact (B)	Duration of Impact (C)	Impact Significance (A X B X C)
- Beneficial Impact -		++	**Positive**

To assist in determining and presenting significance of an impact, an impact evaluation matrix (Table 4.3) has been developed based on the one developed for the impact identification exercise. In addition to ranked weights, significance of impacts has been depicted using colour codes for easy understanding. In case an environmental component is impacted by more than one project activity or the activity would impact a sensitive receptor e.g. settlement, school, hospitals, forest etc. a high significance ranking of ">12" has been considered. A second evaluation matrix presents significance of impacts after considering that proposed mitigation measures would be implemented

The impacts on each of the environmental components and its significance during the different stages of the project have been discussed in detail in the following section. This is followed by a point wise outline of mitigation measures recommended.

Table 4.3. Impact Identification Matrix

Environment / Activity	Physical Environment											Biological Environment							Socio-economic Environment										
	Aesthetics & Visuals	Air Quality	Noise Quality	Transport & Traffic	Land Use	Soil Quality	Local Drainage & Physiography	Surface Water Resources	Surface water quality	Ground Water Resources	Ground water quality	Flora & Floral Habitat	Wildlife Habitat	Fauna	Threatened & Endangered species	Migratory corridor & rout	Aquatic Habitat	Aquatic Flora & Fauna	Loss of Livelihood	Conflict on Job opportunity	Disruption of Infrastructure	Common Property Resources	Dust & Noise Discomfort	Loss of Agricultural Productivity	Influx of Population	Cultural & Heritage Site	Job & Economic Opportunity	Occupational Health & Safety	Community Health & Safety
A. Pre-Drilling Activities																													
Site selection and land acquisition				x	x														x			x							
Site preparation	x	x	x			x	x					x	x	X									x	x			+	x	
Well site & access road construction	x	x	x	x	x		x																x				+	x	x
Sourcing & transportation of borrow material etc	x	x	x	x		x	x					x	x							x	x		x				+	x	x
Storage and handling of construction debris	x	x																										x	
Transportation of drilling rig and ancillaries		x	x	x												x					x		x					x	x
Operation of DG set		x	x																										
Consumption of water for construction & domestic use for labourer											x											x							
Generation of domestic solid waste & disposal	x					x					x						x												x
Generation of waste water & discharge from									x		x							x											x

Environment / Activity	Physical Environment											Biological Environment							Socio-economic Environment										
	Aesthetics & Visuals	Air Quality	Noise Quality	Transport & Traffic	Land Use	Soil Quality	Local Drainage & Physiography	Surface Water Resources	Surface water quality	Ground Water Resources	Ground water quality	Flora & Floral Habitat	Wildlife Habitat	Fauna	Threatened & Endangered species	Migratory corridor & rout	Aquatic Habitat	Aquatic Flora & Fauna	Loss of Livelihood	Conflict on Job opportunity	Disruption of Infrastructure	Common Property Resources	Dust & Noise Discomfort	Loss of Agricultural Productivity	Influx of Population	Cultural & Heritage Site	Job & Economic Opportunity	Occupational Health & Safety	Community Health & Safety
construction activity & labour camp																													
Surface run-off from construction site						x	x		x		x						x					x							
B. Drilling & Testing																													
Physical Presence of drill site	x												x																
Operation of DG sets and machinery		x	x										x															x	x
Operation of drilling rig			x											x									x					x	
Storage and disposal of drill cuttings and mud	x					x			x x		x																		
Generation of process waste water & discharge									x								x												
Surface run-off from drill site						x					x						x												
Generation of domestic waste water & discharge						x					x						x												
Generation of Municipal waste & disposal	x					x					x																		
Workforce engagement & accommodation at drill site																				x		x			x		+		x

Environment / Activity	Physical Environment											Biological Environment							Socio-economic Environment										
	Aesthetics & Visuals	Air Quality	Noise Quality	Transport & Traffic	Land Use	Soil Quality	Local Drainage & Physiography	Surface Water Resources	Surface water quality	Ground Water Resources	Ground water quality	Flora & Floral Habitat	Wildlife Habitat	Fauna	Threatened & Endangered species	Migratory corridor & rout	Aquatic Habitat	Aquatic Flora & Fauna	Loss of Livelihood	Conflict on Job opportunity	Disruption of Infrastructure	Common Property Resources	Dust & Noise Discomfort	Loss of Agricultural Productivity	Influx of Population	Cultural & Heritage Site	Job & Economic Opportunity	Occupational Health & Safety	Community Health & Safety
Flaring during production testing and process upset		x	x																									x	x
Accidental events – blow out		x				x			x		x	x		x			x											x	x
Accidental events- spillage of chemical & oil						x			x		x																		
C. Early Production																													
Flaring of Gas		x	x																										
GEG Emission		x																											
Produced Water						x	x	x	x																				
D. Decommissioning and Reinstatement																													
Dismantling of rig and associated facilities		x	x																									x	X
Transportation of drilling rig and ancillaries		x	x	x																									X
Removal of well site construction materials & disposal		x	x			x																							

4.4 Impact Assessment

This section discusses the impacts of the project activities on the environmental receptors. It discusses probable impacts during various phases of the project lifecycle on the environmental and socio-economic components. Rankings for every activity – component interaction is based on the criterion set earlier and resulting environmental significance with necessary justification that has been recorded below for every set of impacts and the same has been represented in evaluation matrices. In broader context, it is however important to remember that operations related to drilling, testing and early production activities also include positive socio-economic impacts in terms of increase in local business opportunities and on a larger perspective, by providing potential energy security at a national level.

4.5 Potential Impact and Mitigation Measures on Visual Environment & Aesthetics

Source of Impact: Aesthetics and visual environment impacts due to setting up of the proposed project activity would be of low scale and temporary in nature. There would be no significant change in landuse. Only the drilling rig boom with associated facilities including one flare stack and DG sets would be visible from the adjoining road and settlement area. The land area of disturbance is also very less of the order of 9 Ha and the elevated rig would be visible from a distance.

Mitigation Measures:

The entire activity of exploration and appraisal would be limited to less than a year. If no hydro-carbon is found from the well for economic recovery, then same would be closed and all supporting facilities would be demobilized. The surface of earth after any unsuccessful attempts of oil exploration would be restored back to normalcy in line with the prevailing landuse status of the area.

4.6 Potential Impact and Mitigation Measures on Land Use

Source of impact**:** Land would be required for the drilling operations. In case of QPU the same drill site would be used, and no new area would be procured.

Assessment of Impact

Site preparation

Potential impact on drainage is primarily anticipated in the form of disruption of natural drainage pattern during site preparation and approach road construction. Since site preparation involves rising of acquired land to about 1 m from the ground level it may lead to alteration of onsite micro-drainage pattern leading to potential problems of water logging in the agricultural land and settlements abutting the drill site. This problem is likely to be further aggravated due to heavy rainfall experienced by Golaghat and Karbi Analog district throughout the year

The access to majority of the drill sites in AA-ONHP-2017/1 is characterized by paved and unpaved rural roads. Well specific environmental setting study shows that most of the wells can be approached by an existing road. However, for site approach a road need to be constructed. Widening and strengthening of existing paved/unpaved road would be required for transportation of drilling rig and heavy equipment to the well site. Widening/ new construction of roads could result in the alteration of drainage unless proper cross drainage structures are provided and may lead to water-logging of adjacent lands.

Well Site Restoration

Site restoration would be initiated for well site not indicative of any commercially exploitable hydrocarbon reserves. Unplanned restoration may lead to the long-term disruption in natural drainage pattern and water logging in neighbouring agricultural land abutting the site. However, adequate care would be taken by Vedanta Limited. (Division Cairn Oil & Gas) to restore the site back to its original condition based on the originally existing contours and predominant slope to prevent any such adverse drainage impacts. The impact is considered to be of medium significance with onsite drainage being dependent on the proper site restoration.

Severity of Impact	**2**	**Extent of Impact**	**1**	**Duration of Impact**	**2**

Impact Significance = 4 i.e. Low

Mitigation Measure

- During the construction of the access road adequate cross drainage structures would 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;
- The excavated material from the drill site would be stored (temporarily /permanently) in uncultivated land and would be away from any drainage channel.

4.7 Potential impact and Mitigation Measures on Topography & Drainage

Potential impact on drainage and topography *viz.* alteration of drainage pattern are anticipated during well site preparation, widening/strengthening of access roads and restoration of well facilities. The impact details have been discussed in the below section.

Impacts during road & site development

The strengthening of the access road would require some earth works especially at the sharp bends. The existing access road, culverts would not be disturbed. Thus, no change in the micro-drainage pattern along the access roads is expected.

For drilling operations approximately 9 ha site would be required. The site would be selected taking considering drainage pattern, thus during site preparation the cutting and filling would be limited. No change in the micro-drainage pattern and slope of the areas in the vicinity of the site is expected. In case of unplanned disposal of soils and other waste, blockage of local drainage channels can happen. Considering the above factors all these impacts would be temporary (in construction phase only) and are largely at local level.

Severity of Impact	2	Extent of Impact	1	Duration of Impact	2
Impact Significance = 8 i.e. Medium					

Mitigation Measure

- Leveling and grading operations would be undertaken with minimal disturbance to the existing contour, thereby maintaining the general slope of site;
- Provision of drainage system would be made for surface run-off.

4.8 Potential Impact and Mitigation Measures on Air Quality

Source of Pollution: The probable sources of impact on ambient air quality during different phase of the project are listed below.

- Pre-drilling phase,
  - Site development;
  - Operation of vehicles and construction machinery;
  - Transportation, storage, handling of construction material, disposal of construction waste;
  - Operation of DG sets
- Drilling phase:
  - Operation of DG sets;
  - Emissions from flare stack;
  - Transport of drilling chemical and manpower etc.
- Early Production phase:
  - GEG combustion stack

- Flare Stack

- De-commissioning phase:
  - Decommissioning of rig and associated facilities;
  - Transport of de-mobilised rigs and machineries

Control Measures: Project design stage control measures are as follows:

- Vehicle, equipment and machinery used for drilling would conform to applicable emission norms;
- Drilling chemical and materials would be stored in covered areas to prevent fugitive emissions;
- DG set stacks would have adequate height, as per statutory requirements, would be able to adequately disperse exhaust gases; and
- Flare stacks of adequate height would be provided.

Assessment of Impact: The potential impact due to above mentioned activities has been discussed in the following section.

Fugitive emission: 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. The generation of such fugitive dust is likely would be governed by micro-meteorological conditions (wind speed and direction). Effects of dust emissions are heightened by dry weather and high wind speeds and effectively reduced to zero when soils and/or ambient conditions are wet. However, dust generated from the site development and construction activity would be generally settle down on the adjacent areas within a short period due to its larger particle size.

Emissions from Vehicles/Equipment: The pre-drilling, drilling, early production and decommissioning operations would involve movement of diesel operated vehicles and operation of machineries and equipment. Heavy vehicles would be particularly intense during site preparation and decommissioning phases. Gaseous pollutants such as NO_2, SO_2, are likely would be emitted from operation of vehicles and machineries.

Impacts from Operation of DG sets and Flaring:

Flaring of gases primarily during the drilling testing phase will contribute to additional air pollution. Flaring involves high temperature oxidation process to burn combustible gases that may be generated from the proposed well sites. The pollutant of concern from flaring would be NOx and SO_2.

For prediction of Ground Level Concentrations (GLCs) at various distances from the sources of the above-mentioned pollutants, an air modelling exercise has been undertaken which is discussed in the impact prediction section below.

The input parameters considered in the impact prediction modelling undertaken using AERMOD is given in Table 4.4. Prediction of impacts on air environment has been carried out by AERMOD.

Table 4.4 Input Parameters Considered for Dispersion Modelling

Emission sources	Stack height (m)	Stack dia. (m)	Stack gas temp. (K)	Stack gas velocity m/s)	Emission Rate (g/s)		
					NO_2	SO_2	PM_{10}
1000 KVA DG*	10	0.305	573.0	4.52	2.04	0.006	0.07
1000 KVA DG*	10	0.305	573.0	4.52	2.04	0.006	0.07
Flaring Stack (testing)	30	0.078	1273.0	20.0	0.0325	0.00085	-

****Source: DG book***

Presentation of Results

The predicted ground level concentrations (GLC) have been estimated at various receptor locations at 500 m interval in a grid of 20*20 km around the project site. The 24-hrly incremental concentrations have been predicted for the entire year. The results for SO2, NO2 and PM10 are presented in Table-4.5 The isopleths for SO2, NO2 and PM10 ground level concentrations are depicted in Figure-59,60,61 respectively.

Resultant Concentrations after implementation of the Project

The maximum incremental 24 hourly GLCs due to the proposed project for SO2, NO2 and PM10 are superimposed on the maximum baseline SO2, NO2 and PM10 concentrations recorded during the primary study. The resultant concentrations (baseline + incremental) after implementation of the project are tabulated below in Table-4.5

Table 4.5 Resultant Consideration for SO_2, NO_2 and PM 10

Pollutant Maximum	Distance	AAQ Highest Concentration Recorded During the Study (µg/m^3)	Incremental 24hourlyConcentration due to Drilling (µg/m^3)	Resultant Concentration (µg/m^3)
SO2	0-2km	8.5	0.08	8.58
	2-5km	8.5	0.05	8.55
	5-10KM	8.5	0.03	8.53
NO_2	0-2km	36.3	25.0	61.3
	2-5km	36.3	15.0	51.3
	5-10KM	36.3	10.0	46.3
PM10	0-2km	87.3	0.90	88.2
	2-5km	87.3	0.75	88.05
	5-10KM	87.3	0.45	87.75

The rise in ground level concentrations would be practically negligible and the fallout would be mostly occurring within a radius of 500 m. The maximum GLCs for SO2, NO2 and PM10 after implementation of the proposed project would be well within the prescribed standards for rural and residential areas. Based on the above details, it can be inferred that proposed project would have an insignificant impact on the prevailing ambient air quality status.

Impacts during the Early Production (EP) stage:

During the EP phase there would be only one point source emission from GEG combustion stack. There would be no other point sources except a standby DG set which will be operated as backup power source when the GEG is not operating. The flue gases from the GEG would be vent out through a stack of 30 m in to the atmosphere. The emission of flue gas from GEG stack has been modelled with the following emission details.

Input Details

Table 4.6 Input Parameters Considered for Early production

Emission sources	Stack height (m)	Stack dia. (m)	Stack gas temp. (K)	Stack gas velocity (m/s)	Emission Rate (g/s)	
					NO2	SO2
Flaring Stack (EPU)	30	0.3	1273	1.23	0.13	0.0034

Results During the GEG Operation

At the time of early production, due to the GEG operation, the incremental GLCs of SO2 and NO2 are 0.005 µg/m3and 0.18 µg/m3, therefore the incremental GLC of NO2 and SO2 will be again practically negligible. There would be no adverse impact in the site surrounding air environment.

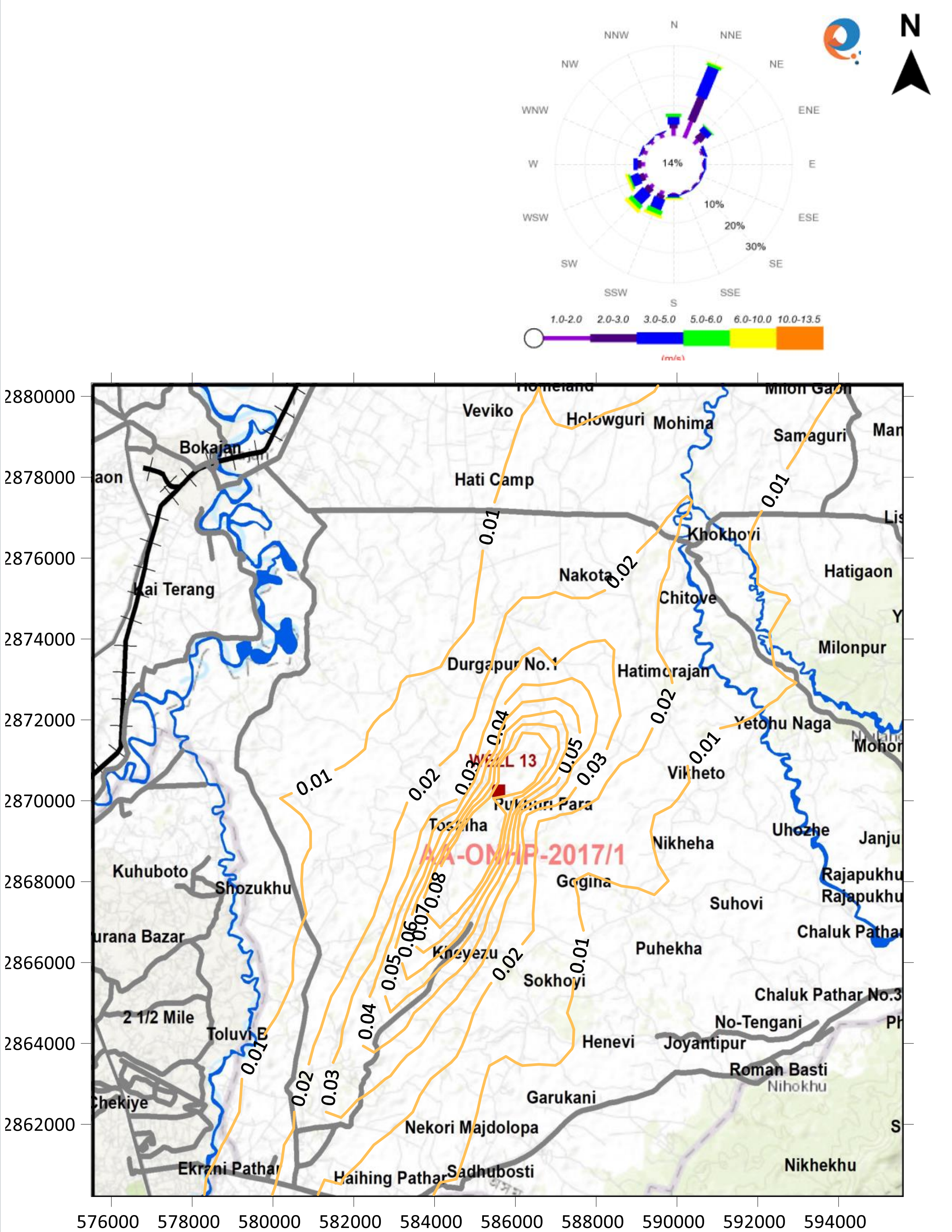


Figure 59. 24 HOURLY GLCs OF SO2 During Exploration and Drilling stages

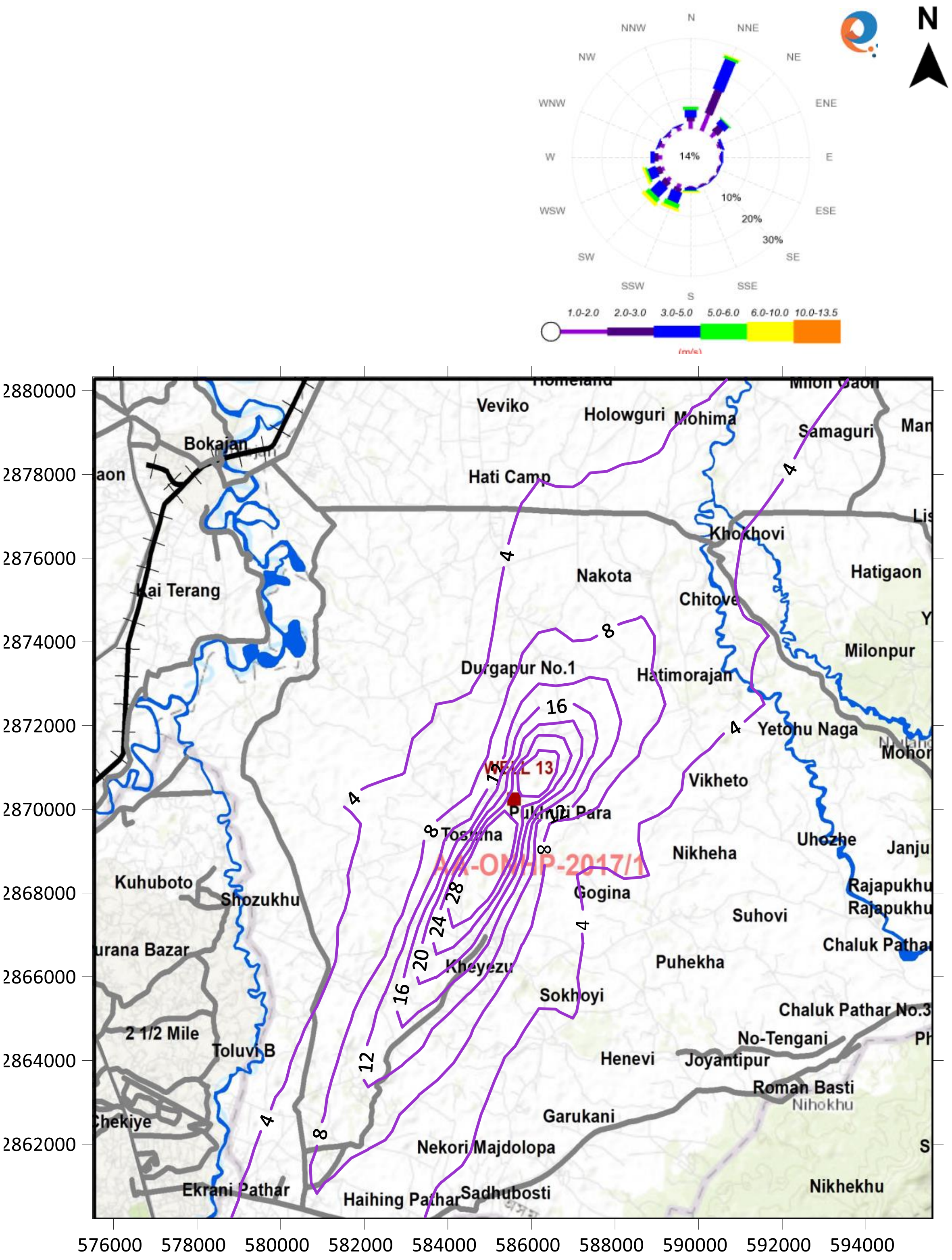


Figure 60. 24 HOURLY GLCs OF NO2 During Exploration and Drilling stages

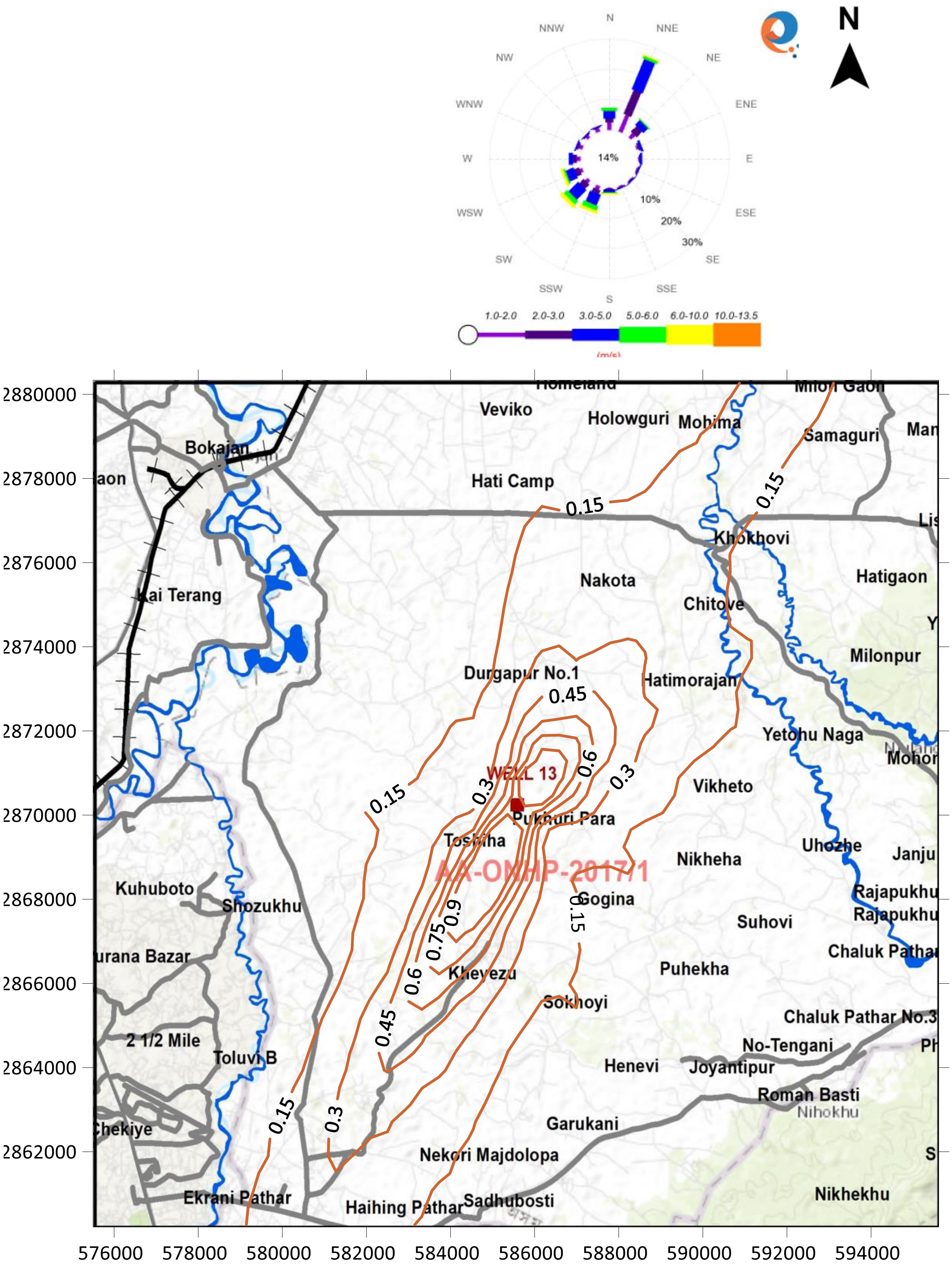


Figure 61. HOURLY GLCs OF PM10 During Exploration and Drilling stages

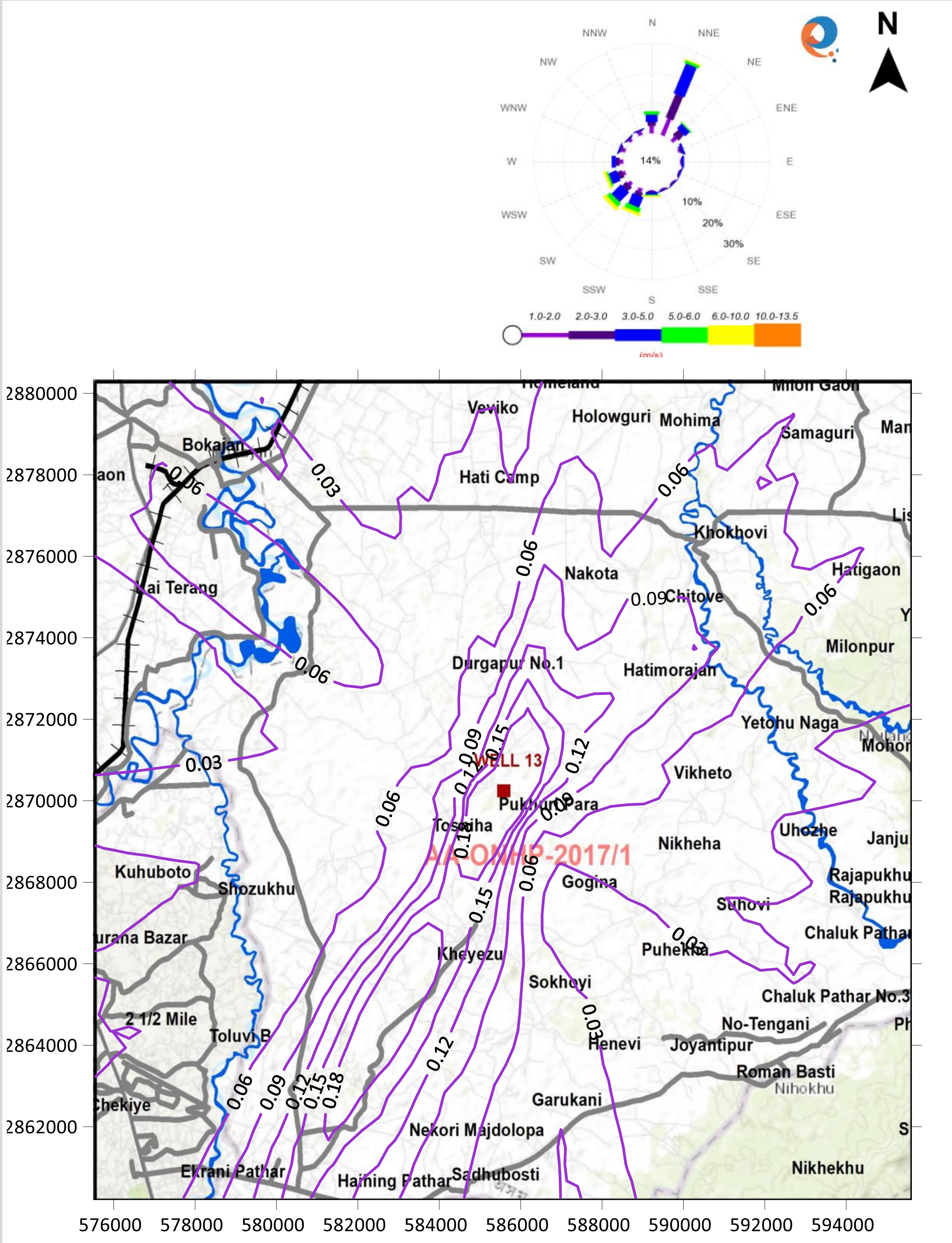


Figure 62. 24 HOURLY GLCs OF NO2 During the Early production Stage

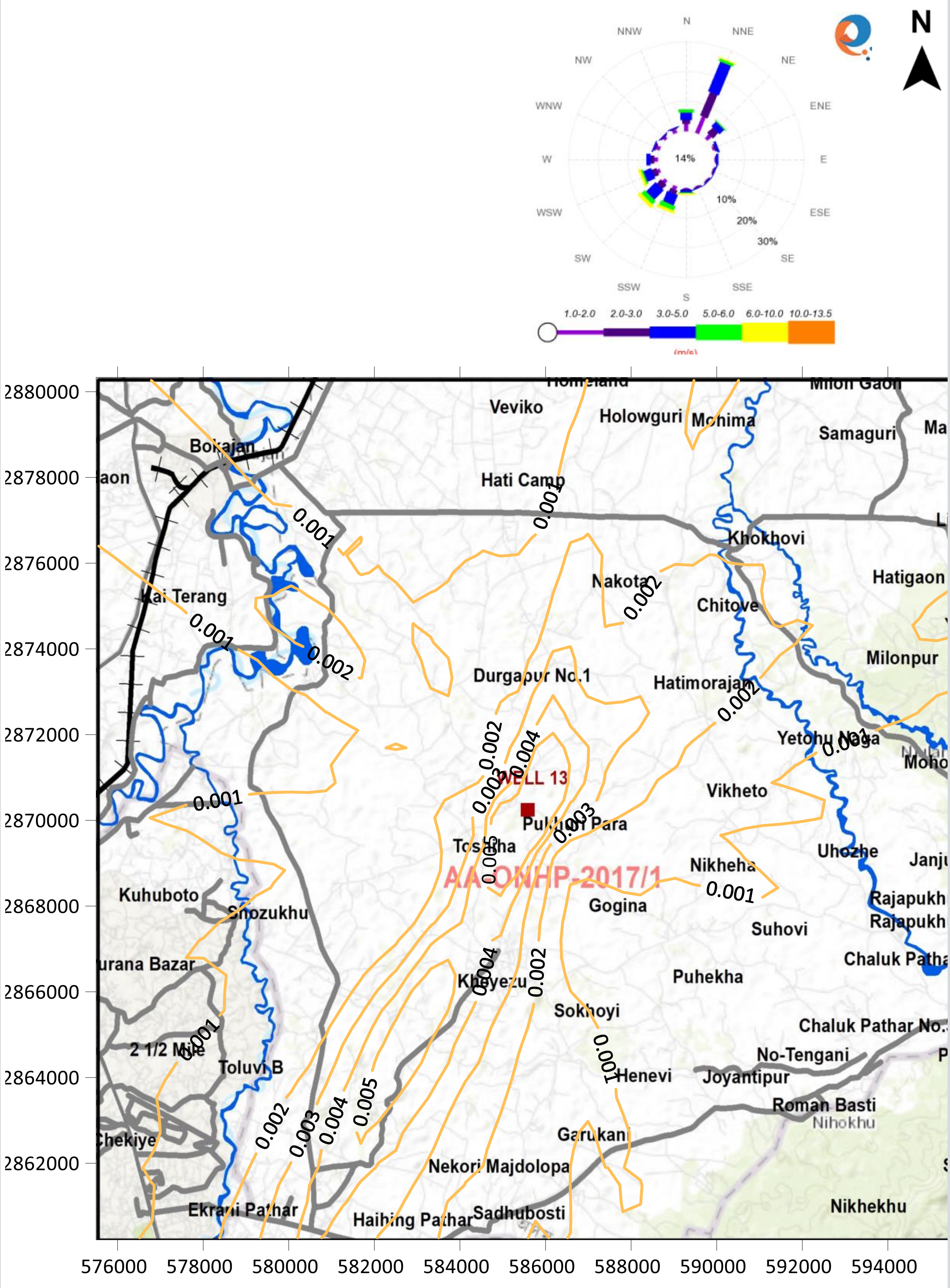


Figure 63. 24 HOURLY GLCs OF SO2 During the Early production Stage

Mitigation Measures: The proposed mitigation measures are as follows:

To minimize emission of fugitive dusts the following measures would be adopted:

- Carry out regular water sprinkling at the site during dry season especially during the site preperationand decommissioning activities;
- During construction, the approach road will be kept clean, free from mud and slurry to prevent any entrainment of dust;
- Location of construction materials will be away from nearby worker's camps;
- Proper handling of materials to ensure minimal emission of dust.

To minimise emission from the vehicles, equipment and machinery the following measures would be adopted:

- Movement of construction vehicles will be minimised and a limited speed of will be enforced along the access and approach roads;
- All diesel-powered equipment will be regularly maintained, and idling time reduced to minimise emissions;
- Low sulphur diesel will be used in diesel powered equipment and best management practices would be adhered to;
- Vehicle / equipment exhausts observed emitting significant black smoke in their exhausts would be serviced/replaced.

To minimise the adverse impacts of flaring the following measures should be adopted:

- Proper engineering controls to ensure complete combustion of gas;
- No cold venting of raw gas will be resorted; instead flaring will be done with combustion efficient elevated flare tip; and
- Location of flare stacks to be chosen considering the sensitive receptors adjoining the site.

4.9 Potential Impact and Mitigation Measures on Noise Quality

Access road strengthening during well site preparation and operation of drilling rig and ancillary equipment during drilling operation and Early production.

Source of Impact:

The potential impacts on noise quality may arise out of the following:

- Pre-drilling phase:
  - Site development/preparation ;
  - Operation of vehicles and construction machinery;
  - Transportation, storage, handling of construction material, disposal of construction waste;
  - Operation of DG sets.
- Drilling phase:
  - Operation of DG sets and drilling rig
  - Operation of machineries & equipment;
  - Vehicular traffic.
- Decommissioning phase:
  - Demobilization activity
  - Vehicular traffic.

- Quick/early Production phase:
  - Flaring of the Gas
  - Operation of GEG/ DG sets

Assessment of Noise Impacts due to Site Activities

Driller rotors and the power generators and pumps would be the main sources of noise pollution during the drilling activity. Noise due to vehicular movement would be intermittent but would also add to the background noise levels. The well site during excavation phase of the site preparation where heavy earth moving machinery would be in operation, noise level of the vehicle would not be more than the 90 dB (A).

Typically, the noise generating sources for the onshore drilling activity are provided below (in the immediate vicinity)

- GEG/Diesel Generator: 75 dB(A)
- Pumps at the Rig: 85 to 90 dB(A)
- Mud pumps: 73.3-80.5 dB(A)
- Control Room & Quarters: 50 to 60 dB(A)
- Drilling: 85-90 dB(A)
- Flaring: 86.0 dB(A)

In order to predict ambient noise levels due to the proposed drilling of exploratory wells. The preparative modeling has been done. For computing the noise levels at various distances with respect to the proposed site, noise levels are predicted using an user friendly model the details of which is elaborated below.

Mathematical Model for Sound Wave Propagation During Operation

For an approximate estimation of dispersion of noise in the ambient from the source point, a standard mathematical model for sound wave propagation is used. The sound pressure level generated by noise sources decreases with increasing distance from the source due to wave divergence. An additional decrease in sound pressure level with distance from the source is expected due to atmospheric effect or its interaction with objects in the transmission path.

For hemispherical sound wave propagation through homogenous loss free medium, one can estimate noise levels at various locations, due to different sources using model based on first principles, as per the following equat

$$Lp2 = Lp1 - 20\log(r2/r1) \quad (1)$$

Where Lp2 and Lp1 are Sound Pressure Levels (SPLs) at points located at distances r2 and r1 from the source. The combined effect of all the sources then can be determined at various locations by the following equation.

$$Lp(total) = 10 \times LOG10\ (SUM[10^{(L1/10)} + 10^{(L2/10)} \ldots \quad (2)$$

Where, Lp1, Lp2, Lp3 are noise pressure levels at a point due to different sources. Based on the above equations an user friendly model has been developed. The details of the model are as follows:

Based on the above equations an user friendly model has been developed. The details of the model are as follows:

- Noise levels can be predicted at any distance specified from the source;
- Model is designed to take topography or flat terrain;
- Coordinates of the sources in meters;
- Maximum and Minimum levels are calculated by the model;
- Output of the model in the form of isopleths; and
- Environmental attenuation factors and machine corrections have not been incorporated in the model but corrections are made for the measured Leq levels.

Input for the Model

The incremental increase in noise levels due to the operation/ site preperation phase of the exploratory drilling has been done. Noise levels are mainly generated from DG sets, air compressors, pumps and transformers. The noise sources have been defined with respect to center of drill site. The input data pertaining to corresponding noise level are tabulated in Table 4.7

Table 4.7 Input Data for Noise Modelling

Sr. No.	Location	Noise Levels db(A) at 3m distance from source
1	Diesel Generator (2 DG set)	75
2	Pumps at the Rig	85
3	Mud pumps	70
4	Control Room & Quarters	50
5	Drilling	85
6	Flaring	86

Source:
https://www.cpcb.nic.in/displaypdf.php?id=SW5kdXN0cnktU3BlY2lmaWMtU3RhbmRhcmRzL0VmZmx1ZW50LzUwMS5wZGY=), www.vurup.sk/petroleum-coal

Presentation of Results

The model results are discussed below and are represented through line chart in

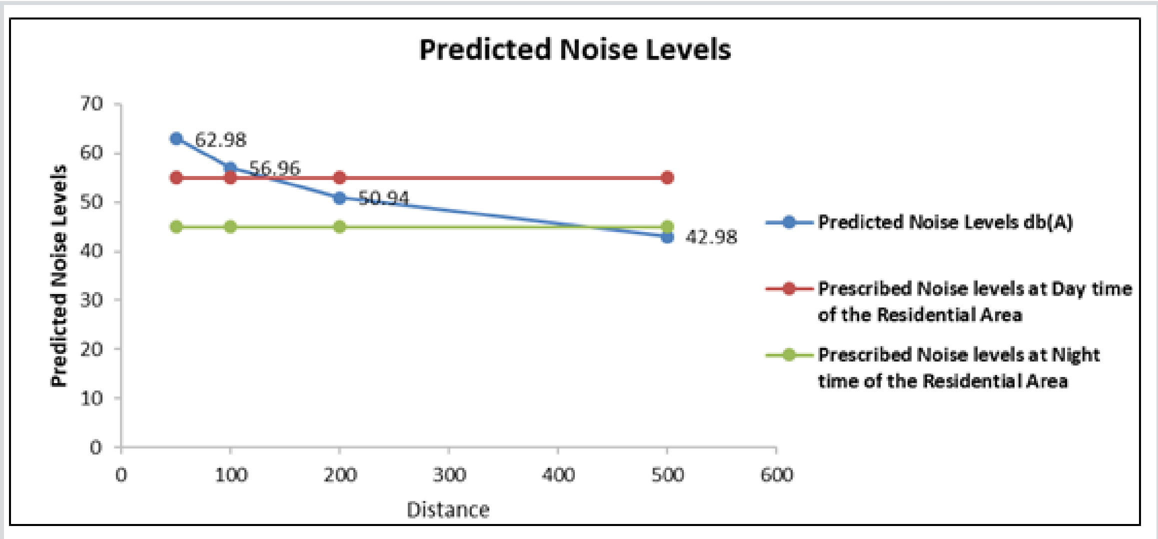


Figure 64The predicted noise level at 500 m distance from the boundary of well site is 42.98 dB (A) and are tabulated in Table 4.8

Table 4.8 Predicted Noise Levels

Name of Source	Noise Levels at 3m distance from source L1 [dB(A)]	X (Distance in m)	Noise Levels at X distance L2 [dB(A)]
Diesel Generator	75	50	56
		100	50
		200	44
		500	16
Diesel Generator	75	50	56
		100	50
		200	44
		500	16

Name of Source	Noise Levels at 3m distance from source L1 [dB(A)]	X (Distance in m)	Noise Levels at X distance L2 [dB(A)]
Pumps at the Rig	85	50	61
		100	55
		200	49
		500	41
Mud pumps	70	50	46
		100	40
		200	34
		500	26
Control Room & Quarters	50	50	26
		100	20
		200	14
		500	6
Drilling	85	50	61
		100	55
		200	49
		500	41
Flaring	86	50	62
		100	56
		200	50
		500	42

Table 4.9 Attenuated Noise Level

Distance (m)	Predicted Noise Levels dB(A)	Prescribed Noise levels at Day time of the Residential Area dB(A)	Prescribed Noise levels at Night time of the Residential Area dB(A)
50	62.98	55	45
100	56.96	55	45
200	50.94	55	45
500	42.98	55	45
Distance (m)	Predicted Noise Levels dB(A)	Prescribed Noise levels at Day time of the Residential Area dB(A)	Prescribed Noise levels at Night time of the Residential Area dB(A)

Further, considering drilling would be a continuous operation, noise generated from aforesaid equipment has the potential to cause discomfort to the local community residing in proximity of the rig facility. So settlements located close to majority of the wells would face discomfort due to drilling operation. Vedanta Limited. (Division Cairn Oil & Gas) would ensure that well location is located as far as possible from the nearest human habitation.

Occupational health and safety impacts viz. Noise Induced Hearing Loss (NIHL) is also anticipated on personnel working close to such noise generating equipment. However, drilling activities would be undertaken for short duration and necessary noise prevention and control measures viz. use of acoustic barriers, provisions for proper PPEs, regular preventive maintenance of equipment etc. would be implemented by the proponent to reduce the noise impact on the communities residing in proximity to the well sites.

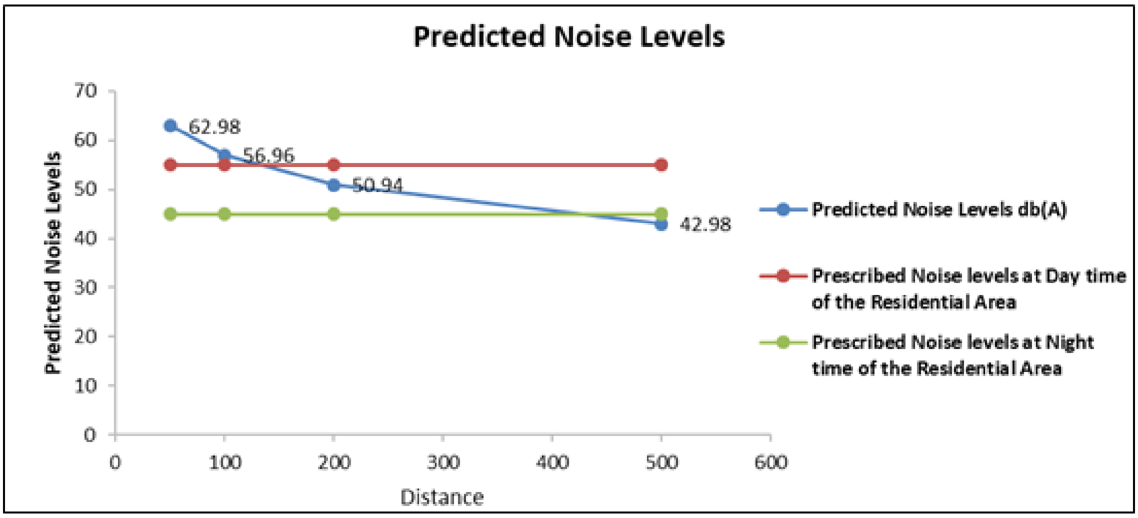


Figure 64. Predicted Noise Level

Severity of Impact	2	Extent of Impact	2	Duration of Impact	1
Impact Significance = 4 i.e. Medium					

Mitigation Measures:

Typical mitigation measures for noise would include the following:

- 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.
- Providing Personnel Protective Equipment (PPEs) like ear plugs/muffs to workers at site.
- The DG set would be designed with acoustic enclosure and noise conformance labelling as per CPCB standards.
- Undertaking preventive maintenance of vehicles to reduce noise levels

4.10 Potential Impact and Mitigation Measures on Surface Water Quality

Surface run-off discharge

Site clearance and stripping of top soil during construction/site preparation 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 unless precautionary measures are adopted. However, taking into account the provision of onsite drainage system, sediment control measures, provision of oil water separator would aid discharging of surface run off in compliance with the CPCB Inland Water Discharge Standards, the impact is considered to be of low significance.

Discharge of drilling mud and process wash water

Severity of Impact	2	Extent of Impact	1	Duration of Impact	2
Impact Significance = 4 i.e. Medium					

Mitigation Measures

- Adequate treatment of waste water to meet the CTE and CTO condition.
- 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.

4.11 Potential Impact and Mitigation Measures on Ground Water Resource

Source of Impact: Potential impacts on groundwater resources would be due to ground water abstracted for domestic needs and for civil construction activities. Potential impact on ground water resource could arise due to:

- Predrilling phase,
  - Water required for construction of drill sites
- Drilling phase

Embedded Control Measures

- All contractors to follow the protocols as set by Cairn regarding construction water management.

Potential impacts on groundwater resources that could arise as a result of the proposed drilling activities include the following:

Ground Water Extraction

However, 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 sources from locally available approved sources, ground water would be extracted after obtaining permission from CGWA/State Govt.

Considering drilling to be a temporary activity (approx 90 days) the impact on ground water resource is considered to be low. In case of QPU the water requirement would reduce and thus the impacts would reduce even though the duration of the activity would be longer.

Severity of Impact	**2**	**Extent of Impact**	**2**	**Duration of Impact**	**1**
Impact Significance = 4 i.e. Medium					

Mitigation Measures

- All water stored in the drill sites would be kept covered in leak proof tank ;

4.12 Potential Impact and Mitigation Measures on Soil Quality

Potential impact on soil quality is envisaged in the form of increase in soil erosion and loss of soil fertility resulting from site clearance and top soil stripping during well site preparation. The impact from accidental spillage resulting from storage and handling of mud chemicals is also envisaged.

Source of Impact: Soil quality impacts can result from:

- Pre-drilling Phase
  - Removal of top soil from the land procured;
  - Compaction of soil;
  - Disposal of construction waste/ MSW in non-designated area;

- Spillage of chemical/oil on open soil;
- Surface runoff from material & waste storage areas and oil spillage area.

- Drilling Phase/Operation of Production facilities:
  - Spillage of chemical, spent mud, hazardous waste, etc.;
  - Surface runoff from waste storage area and spillage area.
- Decommissioning Phase:
  - Disposal of decommissioning waste materials in open soil.

***Embedded Control Measures*:** The project embedded control measures are as follows:

- The drill cuttings and spent drilling mud would be generated at site per well during drilling operations. This would be stored in well-designed HDPE line pit. And would be disposed as per the guideline of GSR & HWM rules.

Topsoil would be removed and stored separately Soil quality impacts so identified have been assessed and evaluated in the section below.

Site clearance and stripping of top soil

As discussed in the baseline section, the soil of AA-ONHP-2017/1 block is characterized by Alluvial and flood plain s soil. This soil is good in terms of fertility. However, to preserve the topsoil stripping of topsoil has been planned before the start of construction activity at the drill site. It is estimated that about 1,35,00 m3 of topsoil would be removed per well site having an area of 9.0 ha considering 15 cm topsoil. However, such impact is considered to be temporary as the proper reinstatement of site would be undertaken by Vedanta Limited. (Division Cairn Oil & Gas) in case the wells are not indicative of any commercially exploitable hydrocarbon reserves. Necessary surface run-off control measures would be adopted by the proponent during construction phase to prevent sediment flow to abutting agricultural land. Further specific mitigation measures would be implemented by Vedanta Limited. (Division: Cairn Oil & Gas) to stabilize the topsoil and to preserve their fertility characteristics during site restoration. The impact is therefore considered to be of medium significance.

Sourcing of borrow material

The drill sites would also be raised. 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/ quarries the impact is considered to be of low significance.

Storage and disposal of drill cuttings and drilling mud

It is estimated that nearly about 250-750 tons/well of drill cuttings associated with WBM 500 - 1500 tons/well of drill cuttings associated with SBM, 250 - 500 tons/well of Spent/Residual Drilling Mud, 250 - 500 tons/well of Sludge containing oil & other drilling wastes are likely to be generated from each well during drilling operation., As an embedded mitigation measures HDPE lined impervious pits would be constructed at each of the drill sites for temporary storage of drill cuttings and drilling fluid. The disposal of the drill cuttings and the drilling mud would be carried out in accordance with "CPCB Oil & Extraction Industry Standard – Guidelines for Disposal of Solid Wastes" no significant impact to this regard is envisaged.

Storage and handling of fuel and chemicals

Fuels, lubricants and chemical used for the drilling operations (especially daily consumption) would be stored at site. In addition spent lube, and waste oil would also be stored temporarily at site before it is disposed as per the regulatory requirements. Improper storage and handling of the chemicals and fuels, spent lubricants can lead to contamination of soil. Accidentally, spillage of chemicals, oil and lubricants, either during transportation or handling, on soil may contribute to soil contamination. Considering the accidental nature of the event the impact is considered to be of low significance.

Embeded controls has been considered in the project design to reduce the impact on soil. Also, most of these impacts on the soil fertility is reversible as the drill sites would be reinstated after the drilling. The contamination of soil due to spillage of chemical and fuel is likely to happen only in case of accidents. Thus, the significance of the impact is medium

Severity of Impact	**2**	**Extent of Impact**	**2**	**Duration of Impact**	**2**
Impact Significance = 8 i.e. Medium					

Mitigation Measures:

The following mitigation measures are proposed for reducing impact on soil quality:

- The top soil would be stored properly.
- Manage spills of contaminants on soil using oil spill kits;
- Storage of construction waste/ 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.

4.13 Potential Impact and Mitigation Measures on Road & Traffic

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/ site preparation due to movement of machinery & manpower.

Vedanta Limited (Division Cairn Oil & Gas) would ensure that traffic management plan is implemented so that proper vehicular movement is done with minimal disturbance to nearby communities. The impacts would be for limited duration. Thus, the impacts are temporary in nature and limited mostly within the drill site.

Severity of Impact	2	Extent of Impact	1	Duration of Impact	2
Impact Significance = 4 i.e. Medium					

Mitigation Measures

- Speed limits would be maintained by vehicles involved in transportation of raw material and drilling rig.
- Road safety awareness programs/campaign would be organized in coordination with concerned authorities
- Entry of vehicles into the drilling site area is prohibited except for material movement.
- Adequate parking would be provided outside the drilling location.

4.14 Potential Impact and mitigation Measures on Terrestrial Ecological Environment

Potential impact on Ecological environment i.e impacts on existing Floral and faunal diversity is envisaged particularly during Site preparation phase and operation phase. The potential impacts on terrestrial Ecology in Site preparation and operational phase is given below.

Source of Impact:

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

4. Vegetation Clearance.
5. Illimitation from Site.
6. Generation of Noise.

Impact Assessment:

Vegetation Clearance

It is proposed to develop 20 exploratory and appraisal well in Block AA-ONHP-2017/01 which mainly agricultural land. Besides this some well locations are also located in tea garden. During primary survey, it has been observed that removal of ground vegetation is required for site preparation.

The vegetation observed in the study area is common to these climatological conditions and no endangered floral species is observed in the study area. Further the distribution of vegetation is scattered in nature. It is observed that approximately 3 ha land is required for each drill site and clearance of only shrubs and herbs are required. Therefore, the scale of Impact can be considered as low, extent of impact within site. The clearance of vegetation would initiate the change in land use. So, overall impacts would be low.

Generation of Noise and Illumination from site

It is anticipated that noise would be generated particularly during the construction /site preparation period and various operational activities from the drilling site. It is expected to get attenuated to baseline level of noise within 200-300 m from the proposed drilling locations. It is also found during the field visit and confirmed by the Forest Department of Government of Assam that there is no ecologically sensitive area such as National Park, Wild Life Sanctuary within the Block area, the potential impacts on existing wildlife due to generation of noise can be considered as low.

The drill site would be illuminated during both construction and operational phase as drilling would be conducted continuously for 24 hrs and thus may cause significant disturbance to local faunal population particularly avifauna.

Severity of Impact	2	Extent of Impact	1	Duration of Impact	2
Impact Significance = 4 i.e. Low					

Mitigation Measures

A range of measures would be adopted during construction and drilling phase to mitigate the potential impacts of terrestrial ecology and biodiversity which are described below:

- The working area always be kept minimum.
- For felling of trees prior approval from concerned department would be obtained;
- Appropriate shading of lights would be ensured to prevent unwanted scattering.
- Plantation of local trees would be undertaken;
- Fencing would be done on the camp site to avoid any unfortunate encounter with faunal species.

4.15 Potential Impact and Mitigation Measures on Socioeconomic Environment

The impacts on the socio-economic environment are both adverse as well as positive in nature. The adverse impacts are primarily due to: Inconvenience due to dust and noise. Disruption or damage to public infrastructure due to construction related activities

Assessment of Impact

The impact on different aspects of the socio-economic environment is discussed as under.

Loss of Livelihood

The proposed well sites would be located primarily on temporary fallow and would be at a distance from the well. Approximately, 9 ha land would be required per well for proposed drilling activity. Even though agricultural land would be used since the agricultural activities are poor due to scanty rainfall in the region. Thus, the severity of the impact would be low and loss of livelihood for the locals would be also low.

Addition Demand on Infrastructure

The width of some of the access and approach roads are not wide enough to support the movement of heavy vehicles to drill site, hence they have to be widened and strengthened. Transportation of drilling rig and associated facilities to drill and decommissioning of rig and associated structure would increase traffic movement. Increase in vehicular fleet may cause damage to road infrastructure if not properly maintained. The strengthening and widening of the existing road would reduce the significance of impact from medium to low.

Influx of Population

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. However, taking into account that majority of the unskilled workforce during construction phase is likely to be sourced from local villages chances of such conflicts are negligible.

Employment opportunities

Project would benefit people living in the neighbouring villages temporarily by creating opportunity for direct & indirect employment associated with the various project activities . Site preparation phase would involve certain number of laborers and there is a possibility that local people can be engaged for this purpose. Drilling process would involve a number of skilled and unskilled workers. Generation of short time employment opportunities during the project phase would improve the employment scenario of the area.

Cultural & Heritage Site

Impact on cultural environment may occur due to site preparation, operation of drilling rig and also during vehicular movement with respect to the proposed exploration activities. There is no designated historical or cultural spots close to the well sites or access roads hence; no impact in this regard is envisaged.

Corporate Social Responsibility

Vedanta Limited (Division Cairn Oil & Gas) has taken up various CSR initiatives in and around present operational areas for the benefit of the residents as per the CSR Act and Rules, Govt. of India.
CSR measures would be taken up by Vedanta Limited. (Division Cairn Oil & Gas) in case of commercially viable hydrocarbon discovery & further full-fledged development of the fields and production and associated facilities

Mitigation Measures

Agriculture and pasture-land would be avoided to the extent possible in site selection process for proposed

Mitigation Measures

- The shortest distance as far as available/feasible would be considered for access road, with additional care to avoid division of land parcels into agriculturally unviable fractions;
- 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;

Impact Significance = ++ i.e. POSITIVE

4.16 Potential Impact and Mitigation Measures on Occupational Health and Safety

Construction Phase

Source of Impact Occupational health and safety impacts during construction/site preparation phase are anticipated primarily from:

- Operation of construction machineries/equipment;
- Exposure to high noise generation areas.

Embedded Control Measures The project embedded control measures are as follows:
- Provision of proper PPEs for the contractor workers onsite;
- Provision of drinking water facility, sanitation and cooking facilities.

Assessment of Impact

Impact on occupational health and safety of contractor workers is anticipated from exposure to high noise generated from operation of heavy machinery/equipment and fugitive dust generated from material stockpiles, earth works and vehicular emission. It is estimated that about 50-60 workers would be deployed by the contractor at each drill site and 10-20 workers in the production facility. The outstation project workforce would be housed in labour camp located within the drill site. Continuous exposure of workers to high noise levels and fugitive dust and inadequate facilities and unhygienic conditions at such camps may lead to adverse health impacts *viz*. headache, asthma, allergy, hearing loss etc. indicating a *high* receptor sensitivity. However, extent of the impact would be limited to the well site and production facility only hence the impact would be *localized only*. Also considering the temporary nature of the construction phase activities, operation of machinery/equipment would be *short term* and with provision of proper PPEs and training for the workers scale of the impact would be *low*. Hence, the impact magnitude for occupation health and safety due to above mentioned construction activities have been assessed to be of *medium and* significance would be *moderate*.

Operational Phase

Source of Impact: The source of occupational health and safety could arise from:
- Operation of rig and machineries,
- Exposure in high noise generation area.

Embedded control measures: The control measures are as follows:
- All potential occupational health hazards would be identified;
- Permit to work system to be in place;
- Provision of PPEs to all workers.

Assessment of Impact:

Major occupational health hazards encountered in proposed drilling activity would include noise from drilling activity, operation of heavy vehicles and machinery, handling of chemicals etc. both in drill site and production facility.

Drilling Activity

Continuous exposure of workers involved in drill activity to high noise levels may lead to adverse health impacts viz. headache, hearing loss etc. which indicates a ***high*** receptor sensitivity. It is under stood that extent of the impact would be limited to the well site only hence the impact would be ***local***. As the drilling activity would be continuous of maximum period of up to 3 months and intermittent operation of machinery/equipment duration would be ***short term*** and with provision of proper PPEs and training of the workers scale of the impact would be ***low*** and magnitude of the impact would be small. Hence, the impact significance of occupation health and safety due to above mentioned construction activities is assessed to be ***moderate***

Quick Production Unit/Early Production Unit

Main impact on occupational health safety in production facility would limited to operation of heavy vehicles and machinery, handing of chemicals etc. However, involved of the personal in a production facility per shift is maximum up to 10 persons and it is understood that they would be trained. Hence, the resource sensitivity would be ***medium***. As all the activity of production facility would be carried out within secure premises extent of impact would be ***local***.. As the risk level of a production facility is high as it is handling highly inflammable hydrocarbon embedded control of any production facility is very strong so the scale of the impact would be ***medium***. Hence, the magnitude of the impact would be ***medium*** and significant of the impact is assessed to be ***Medium.***

Severity of Impact	2	Extent of Impact	2	Duration of Impact	2
Impact Significance = 8 i.e. Medium					

Mitigation measures: The mitigation measures are as follows:
- Periodic onsite surveillance to be conducted so that the workers use the designated PPEs all the time;
- Health surveillance would be conducted of personnel working in the aforesaid areas;
- Regular health and safety training to be provided to workers.

- Exposure of workers operating near high noise generating sources would be reduced to the extent possible;

4.17 Potential Impact and mitigation Measures on Community Health & Safety

Community health and safety of inhabitants residing close to the drilling site stands to get affected from frequent heavy vehicular movement along village access roads and due to noise from drilling rig operations.

Ensuring Public Safety

Since the project involves the movement of heavy vehicles and machinery in the area, the issue of public safety of the villagers, especially children, is an important concern. During the drilling phase and for the rest of the project activities proper safety measures would be undertaken both for transportation as well as the other operations. The drill site would be fenced and gates would be constructed so that the local people are refrained from straying into the site.

The movement of traffic is also likely to access conditions of the inhabitants residing close to the access road. The increase in traffic would have implications on their safety too, as well as create congestion, potential delays and inconvenience for pedestrians.

Health and safety impact arising from technological emergencies viz. well blow outs, explosions would be dealt separately in the Quantitative Risk Assessment (QRA) section.

Although the aforesaid activities are temporary in nature it may not adversely affect community health and safety in the long term. Mitigation measures would be taken as outlined in environmental management plan to reduce the impacts arising out of project activities.

Severity of Impact	2	Extent of Impact	2	Duration of Impact	2
Impact Significance = 8 i.e. Medium					

Mitigation Measures:

- Proper hoardings in English and local language would be displayed during construction and operation phase to prevent people from encroaching the fenced area or to make them aware of the danger associated with the construction
- Traffic management plan would be developed and implemented at site.

Table 4.10 Impact Significance Matrix (with mitigation)

Environment / Activity	Physical Environment											Biological Environment							Socio-economic Environment										
	Aesthetics & Visuals	Air Quality	Noise Quality	Transport & Traffic	Land Use	Soil Quality	Local Drainage & Physiography	Surface Water Resources	Surface water quality	Ground Water Resources	Ground water quality	Flora & Floral Habitat	Wildlife Habitat	Fauna	Threatened & Endangered species	Migratory corridor & Route	Aquatic Habitat	Aquatic Flora & Fauna	Loss of Livelihood	Conflict on Job opportunity	Disruption of Infrastructure	Common Property Resources	Dust & Noise Discomfort	Loss of Agricultural Productivity	Influx of Population	Cultural & Heritage Site	Job & Economic Opportunity	Occupational Health & Safety	Community Health & Safety
1. Pre-Drilling Activities																													
Site selection and land acquisition					M														M			L							
Site preparation	L	L	L			M						M		M									L	L			+	L	
Well site& access road construction	L	L	L	M			M																L				+	L	L
Sourcing & transportation of borrow material etc	L	L	L	M		L	L					M								M	M		L				+	L	L
Storage and handling of construction debris	L	L																										L	
Transportation of drilling rig and ancillaries		L	L	M																	M		L					L	L
Operation DG set		L	L											M	M														
Workforce engagement & accommodation at construction site																				M		L			M		+		L
Consumption of water for construction & domestic use for labourer										L												L							
Generation of domestic solid waste & disposal	L					L			L		L																		L
Generation of waste water & discharge from construction activity &labour camp									L		L																		L
Surface run-off from construction site						L			M		L											L							

Environment / Activity	Physical Environment											Biological Environment							Socio-economic Environment										
	Aesthetics & Visuals	Air Quality	Noise Quality	Transport & Traffic	Land Use	Soil Quality	Local Drainage & Physiography	Surface Water Resources	Surface water quality	Ground Water Resources	Ground water quality	Flora & Floral Habitat	Wildlife Habitat	Fauna	Threatened & Endangered species	Migratory corridor & Route	Aquatic Habitat	Aquatic Flora & Fauna	Loss of Livelihood	Conflict on Job opportunity	Disruption of Infrastructure	Common Property Resources	Dust & Noise Discomfort	Loss of Agricultural Productivity	Influx of Population	Cultural & Heritage Site	Job & Economic Opportunity	Occupational Health & Safety	Community Health & Safety
2. Drilling & Testing																													
Physical Presence at drill site	L													M	M														
Operation of DG sets and machinery		L	M									L		L	L													M	M
Operation of drilling rig			M									L		L	L								M					M	
Storage and disposal of drill cuttings and mud	L					L			L		L																		
Generation of process waste water & discharge									M		L						M	M											
Surface run-off from drill site						L			L								M	M											
Generation of domestic waste water & discharge						L			L		L						M	M											
Generation of Municipal waste & disposal	L					L			L		L																		
Workforce engagement & accommodation at drill site																				M		L			M		+		M
Flaring during well testing		L	M									M		L	L													M	M
Accidental events - blow out		L				M			M		M	M		L	L													M	M
Accidental events-spillage of chemical & oil						M			M		M						M	M											
3. Early Production		L										L						L											
4. Decommissioning and Reinstatement																													

Environment / Activity	Physical Environment											Biological Environment							Socio-economic Environment										
	Aesthetics & Visuals	Air Quality	Noise Quality	Transport & Traffic	Land Use	Soil Quality	Local Drainage & Physiography	Surface Water Resources	Surface water quality	Ground Water Resources	Ground water quality	Flora & Floral Habitat	Wildlife Habitat	Fauna	Threatened & Endangered species	Migratory corridor & Route	Aquatic Habitat	Aquatic Flora & Fauna	Loss of Livelihood	Conflict on Job opportunity	Disruption of Infrastructure	Common Property Resources	Dust & Noise Discomfort	Loss of Agricultural Productivity	Influx of Population	Cultural & Heritage Site	Job & Economic Opportunity	Occupational Health & Safety	Community Health & Safety
Dismantling of rig and associated facilities		L	L																									M	M
Transportation of drilling rig and ancillaries		L	L	M																									M
Removal of well site construction materials & disposal		L	L				M																						
Site Restoration						+						+															+		

5. Analysis of Alternative

Consideration of alternatives to a project proposal is a requirement of the EIA process. During the scoping process, alternatives to a proposal can be considered or refined, either directly or by reference to the key issues identified. A comparison of alternatives helps to determine the best method of achieving the project objectives with minimum environmental impacts or indicate the most environmentally friendly and cost effective options. The consideration of alternatives is most useful when the EIA is undertaken early in the projects cycle. The type and range of alternatives open for consideration include:

- Site alternatives (e.g. advantage of proposed site, details of any other sites, if explored, etc)
- Input or supply alternatives (e.g. use of raw materials, sourcing, etc)
- Technology alternatives (e.g. feasibility of different technologies available and advantage of proposed technology, etc)

After analysis of the various factors the most environmentally compatible alternative is selected. Reference may be made to available technologies, policy objectives, social attitudes, environmental and site constraints, projects economic etc.

This section provides an analysis of alternatives in relation to the conception and planning phase of the project. This includes the following:

5.1 No Project Scenario

The no project scenario has been analyzed to understand what would be reasonably expected to occur in the near future if the proposed development drilling of hydrocarbons and production of hydrocarbon are not conducted in the area. In such a scenario, there would not be any pressure on use of local resources and infrastructure, and no adverse effect on local ecology or incremental pollution to baseline environmental components (air, water and noise levels). At the same time, there would not be any positive impact on socioeconomic status of the area resulting from direct/ indirect employment and economic benefits that such a project can provide. With no project scenario, dependence of the country on import of crude oil and demand for foreign exchange would grow.

5.2 Alternatives for Project Site

The block is allocated by the Government of India under the Revenue Sharing Contract (RSC). Vedanta Limited. (Division Cairn Oil & Gas) is the Operator for this block. Drilling locations are proposed based on geo-scientific information and alternate sites cannot be considered for the proposed project facilities due to the following reasons:

The location is within the existing RSC boundary of the block. The surface locations of wells are selected considering the drilling configuration (reach to potential reservoirs).

5.3 Alternatives for Well Location

The seismic data interpretation of the seismic survey would decide the exact locations of the drilling well. The proposed exploratory well site have been identified based on the study and interpretation of the stratigraphy and already available seismic data. Within the identified location the actual well drilling site would be selected based on the following factors:

- Located as far as possible from the nearest human habitation or sensitive receptors
- Located at a safe distance from public road
- Ensure natural drainage channels are avoided or drainage channels rerouted to ensure unhindered flow of rain / flood water. Where necessary adequate erosion control measures would be provided

5.4 Alternative of Technology

The technical and process related alternatives are discussed in the section.

5.5 Use of Water and Synthetic Mud

During drilling operation, drilling mud would be used, which is essential to lubricate and cool drill bits, removal of drilled rock (i.e. cuttings) from the bottom of the hole and transporting it to the surface and maintaining hydrostatic head in the well to counter natural formation pressures.

Drilling mud is basically a suspension / mixture of solids suspended in a liquid phase, which is blended with clays, polymers, salts and weighting agents. The main component/ solvent of drilling fluid are water, oil or synthetic and accordingly they are called as oil-based, water-based, and synthetic muds (OBMs, WBMs, and SBMs). All the three types of muds have certain advantages and disadvantages discussed in Table 5.1 .

Though the WBMs is a least cost option and widely used but is not found efficient in high temperature and also for water sensitive substrata, i.e., shales and mud. To overcome these limitations, OBM and SBM are used and of the two, SBM is preferred choice and it may be used in different set of environment like high temperatures, hydratable shales, high-angle, extended-reach wells, high-density mud and drilling through salt.

Table 5.1 Ranks/Comparison of Different Types of Mud

Aspects	Water Based Mud	Oil Based Mud	Synthetic Based Mud
Least Cost	1	2	3
Quantity of Waste discharge	3	2	1
Least Quantity of Water Required for Preparation	3	2	1
Toxicity	1	3	2
Reduced drill time	3	2	1

Note:- 1: Preferable, 2: Less Preferable, 3: Least Preferable

The WBM produces large quantity of drill waste as the mud is not recyclable. Moreover, the clay in WBM absorbs water and expands to disperse into the drilling fluid. These fine clay particles increase mud viscosity and inhibit its upward flow. To lower the mud viscosity, water is added to lower the concentration of fine solids and mud products are added to give the drilling fluid the correct density and flow properties. As a result, large volumes of mud are produced to be discharged as waste. On the other hand, the OBM and SBM are recycled several times and only drill cutting are disposed off.

The water requirement of SBM is highest as compared to OBM and WBM. Though, OBM are considered more efficient and has wider application in different conditions but recently their use is restricted due to environmental considerations. OBM are considered toxic due to the use of hydrocarbons as solvents and need a proper disposal through land fill. The water based muds are considered safest in this regard followed by SBM.

If all the three types of mud are compared on the drill time, SBM is far superior then OBM and WBM. The less drill time mean shorter operation and hence less emissions from various drilling equipments and limited engagement of workforce.

The SBMs have the potential to drill wells more quickly and efficiently than WBMs, while avoiding some of the disposal costs and environmental difficulties associated with OBMs.

Water based mud would be used for initial, shallower sections where massive shales are not encountered. The deeper and difficult to drill formations would be drilled using synthetic base mud (SBM). Synthetic base mud unlike oil based mud (OBM) is biodegradable but can be re-used. At the end of drilling a well almost the entire amount of the SBM is collected for re-use in next drilling operation. SBM systems promote good hole cleaning and cuttings suspension properties.

5.6 Conclusion

This project is of national importance as it helps to achieve energy security. The project would have positive benefits in terms of revenue generation to state and central government, increase in job opportunity

Site selection would be carried out taking into consideration the nearest habitation, proximity to any sensitive receptor and natural drainage.

In addition, Vedanta Limited (Division: Cairn Oil & Gas) would ensure that the final site selection is made after due consideration to all environmental considerations mentioned. Also use of alternate method technology to avoid sensitive locations would be made to the extent possible. Consideration of these alternatives with strict compliance to the Environment Management and Monitoring Plans suggested would ensure minimal impact on the Environment.

6. Environmental Monitoring Programme

Periodic monitoring of environmental parameters is of immense importance to assess the status of environment during pre-drilling, drilling and post drilling stages. With the knowledge of baseline conditions, the monitoring programme would serve as an indicator for any deterioration in environmental conditions due to operation of the project, to enable taking up suitable mitigatory steps in time to safeguard the environment. Monitoring is as important as that of control of pollution since the efficiency of control measures can only be determined by monitoring.

Usually, as in the case of the study, an Impact Assessment study is carried over short period of time and the data cannot bring out all variations induced by the natural or human activities. Therefore, periodic monitoring programme of the environmental parameters is essential to take into account the seasonal variation and changes in the environmental quality due to project operations.

6.1 Object of Monitoring

The objectives of monitoring are to:

- Verify effectiveness of planning decisions;
- Measure effectiveness of operational procedures;
- Confirm statutory and corporate compliance; and
- Identify unexpected changes.

6.2 Monitoring Schedule

Periodic environmental monitoring schedules are prepared covering various phases of project advancement. This comprises the duration of proposed exploratory drilling as well as post-drilling phase, when the hydrocarbon is established in the wells and production program is undertaken as well as the Decommissioning/Closure Phase. In order to assess the extent and nature of impacts on environment due to drilling operations, the monitoring on various attributes of environment would be carried out during various phases of drilling as under:

Monitoring requirements have been described in the following Table 6.1. Frequency of monitoring and responsibility of carrying out the monitoring have also been presented in the table below.

Table 6.1 Proposed Environmental Monitoring Program

Monitoring	Locations	Frequency	Parameters
Ambient Air Quality (AAQ) monitoring	Adequate number of representative locations.	Pre-drilling, during drilling and post-drilling	As per NAAQS and HC, NMHC, H_2S and VOC
D.G. Stack		Once during operation	As per GSR 771 (E) or as specified by Consent to operate issued by State pollution control board (SPCB)
Ambient Noise Level at Fence/ Boundary	Adequate number of representative locations.	Pre-drilling, during drilling and post-drilling	Leq (night), Leq (day), Leq (24 hourly)
Work Place noise Monitoring	Monitoring at point sources of noise emissions	During drilling	8 Hourly (TWA)
Sewage Water Quality Monitoring	Treated domestic waste water	Once during operation	pH, TSS, TDS, BOD, COD, oil & grease, faecal coliform (MPN per 100 millilitre,

Monitoring	Locations	Frequency	Parameters
			MPN/100ml or as per CTE/CTO issued by SPCB
Ground water monitoring	Adequate number of representative locations.	Pre-drilling and post-drilling	As per IS 10500: 2012
Soil Quality	Adequate number of representative locations.	Pre-drilling and post-drilling	pH, conductivity, texture, bulk density, Ca, Mg, Na, K, P, N, organic matter, organic carbon, Cl, SO4, sodium absorption ratio, Al, Fe, Mn, Boron, Zn, Hg and PAH
Fresh Synthetic Based Mud (SOBM)	During drilling	One sample / well during drilling	Aromatic content, Toxicity, (LC_{50}, 96 hours)
Fresh Water Based Mud (WBM)	During drilling	One sample / well during drilling	(LC_{50}, 96 hours), Mercury
Barite used for mud preparation	During drilling	One sample / well during drilling	Hg, Cd
Drill cuttings associated with WBM	During drilling	One sample / well during drilling	Oil and grease, (LC_{50}, 96 hours), Hg and parameters for disposal of waste
Drill cuttings associated with SBM	During drilling	One sample / well during drilling	Oil and grease, (LC_{50}, 96 hours), Hg and parameters for disposal of waste
Spent WBM before disposal	During drilling	One sample / well during drilling	(LC_{50}, 96 hours), Hg and parameters for disposal of waste

7. ADDITIONAL STUDIES

Based on the TOR specified by the Ministry of Environment & Forest and Climate Change (MoEF&CC) issued vide letter no. F File No.IA-J-11011/95/2019-IA-II(I) dated 20th April, 2019 for preparation of EIA/EMP Report for proposed Greenfield project, several studies were conducted and planned to be conducted to provide a clear picture of the project area. The studies and activities suggested in EIA Notification includes: -

- Public Hearing and Consultation
- Risk Assessment Study including Disaster Management Plan
- Disaster Management plan

7.1 Public Hearing and Consultation

Public Hearing

This draft EIA report is prepared and submitted to Assam SPCB for conducting public hearing. After completion of the Public Hearing, the applicant shall address all the environmental concerns expressed during this process and make appropriate changes in the draft EIA and EMP Report. The final EIA report, so prepared, shall be submitted by the applicant to MoEF&CC for appraisal.

7.2 Risk Assessment

The objective of the RA study is to identify major risk contributing events, demarcate vulnerable zones and evaluate the nature of risk posed to nearby areas due to proposed drilling activity, in addition to ensure compliance to statutory rules and regulations. The scope of work for the study is described below:

- Identify potential risk scenarios that may arise from the proposed drilling and other associated activities
- Analyze the possible likelihood and frequency of such risk scenarios by reviewing historical accident related data.
- Predict the consequences of such potential risk scenarios and if consequences are high, establish the same by through application of quantitative simulations.
- Recommend feasible preventive and risk mitigation measures as well as provide inputs for drawing up of Emergency Response Plan (ERP) for the project.
- The assessments to be based on various existing documents including Emergency Response Plan (ERP), Disaster Management Plan (DMP).

Quantitative Risk Assessment

Risk" is defined as the combination of the expected frequency and consequence of accidents that could occur as a result of an activity. Risk assessment is a formal process of increasing one understands of the risk associated with an activity. The process of risk assessment includes answering three questions:

- What can go wrong?
- How likely is it?
- What are the impacts?

Qualitative answers to one or more of these questions are often sufficient for making good decisions about the allocation of resources for safety improvements. But, as managers seek quantitative cost/benefit information upon which to base their decisions, they increasingly turn their attention to the use of QRA.

QRA is the art and science of developing and understanding numerical estimates of the risk (i.e., combinations of the expected frequency and consequences of potential accidents) associated with a facility or operation. It uses a set of highly sophisticated, but approximate tools for acquiring risk understanding. The Overall approach for the Risk Assessment in brief has been given here with details in the further chapters.

The various steps in the QRA process are described below.

- Hazard Identification
- Consequence Analysis
- Initial Failure Frequency assessment
- Construction of Event Trees
- Calculation of Average Individual Risk
- Risk Assessment and preparation of Risk reduction recommendations

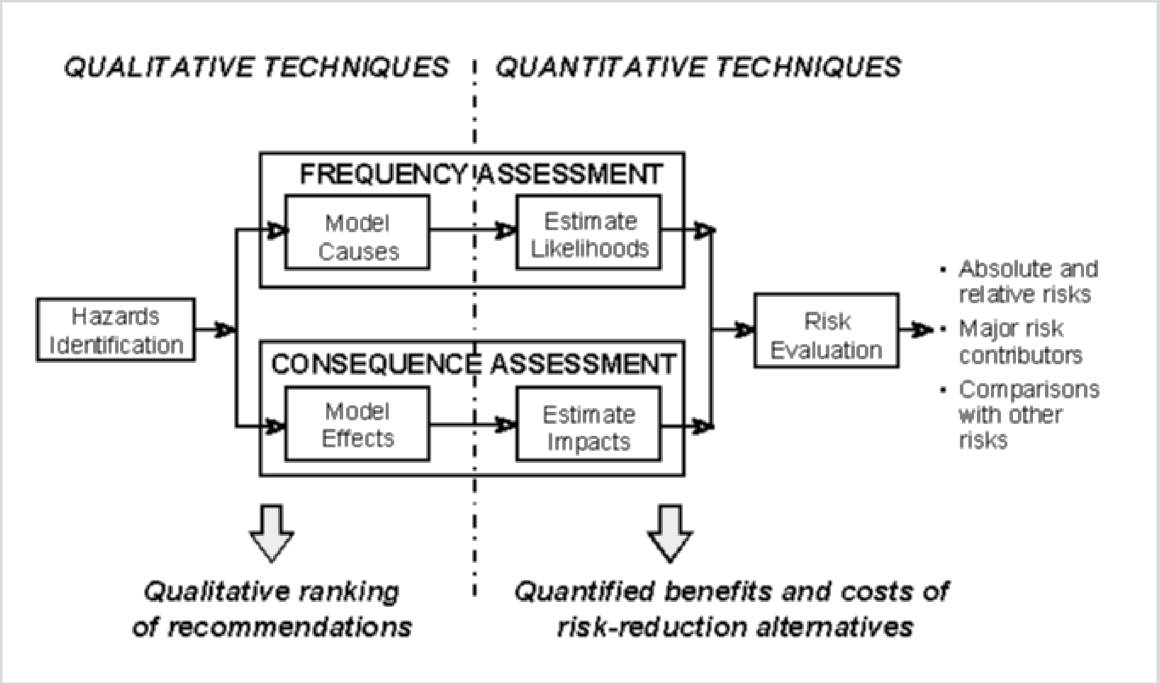


Figure 65. Risk Assessment

Hazard Identification

This most important section looks into all incidents, which could result in possible fatalities. For drilling, such incidents typically include the following:

- Well fluid releases - small, medium and large well fluid releases from exploratory/appraisal drilling wells. Possibilities include blowouts (due to either downhole or surface abnormality or possible cratering (a basin like opening in the Earth surface surrounding a well caused by erupted action of gas, oil or water flowing uncontrolled)) or other incidents involving drilling fluids, leakage from mud degassing stacks/ vents and others- these are the major category and are deliberated later.
- Possibility of dropped objects on the drilling platform due to lifting of heavy equipment including components like draw works, drilling pipe, tubing, drill bits, Kelly, mud equipment, shale shakers, BOP components, power generating equipment and others.
- Single fatality occupational incidents such as trips and falls. These are more likely in drilling rigs due to the hazardous nature of operations and general high congestion and large extent of the manual operation involved.
- Structural failure of the drilling rig due to excessive static or rotating loads, earthquake, design defect, construction defect etc. It may be noted that rotating loads are induced due to the specific rotating actions of the rotary drilling mechanism (Drill string rotated by means of rotary table etc.).
- Loss of containment of fuels (HSD) and consequent pool fire on encountering an ignition source

The HAZID would select the Scenarios for further modeling in the next sections. The HAZID is derived mainly from incidents in Similar drilling installations based on worldwide experience and includes generic data sources.

Table 7.1 Identification the Accident Event in Oil Well Drilling Activity

Type of Hazardous Event	Specific Accident Events included in QRA
Hydrocarbon Release	Uncontrolled Blow out-medium, large, small
	Release from diesel tanks- Catastrophic failure, medium and small risks
Occupational accidents	Single fatality accidents such as slips, trips, falls, dropped objectives etc.
Structural failure	Structural collapse of drilling rig due to static or rotating load, fatigue, construction defect, design defect, earthquakes etc

Source: Cairn

Hydrocarbon Release

The events of blowouts during drilling are divided in the databases according to the consequences and well control success. Such blow outs can be ignited or un-ignited. Blow outs are uncontrolled sudden expulsions of oil, gas, water or drilling fluids from wells to the surface which result in loss of control of the well.

Sources of hydrocarbon release during the drilling phase include the following:

- Dissolved gas which comes out of solution under reduced pressure often while drilling at near balance or under balance hydrostatically or as trip gas during a round trip to pull the drill string around from the hole. Such sources could include releases at bell nipple and around mud return flow line outlet, shale shakers and active mud pits.
- As a “kick”, which occurs as the down hole formation pressure unexpectedly exceeds the hydrostatic head of the circulating mud column. Significant releases can occur from the vent lines of the mud /gas separator and other locations.
- From residual mud on the surface of the drill pipe being racked in the derrick during the round trip, or on production of coil tubing being withdrawn from the hole, or from core samples laid out for inspection. Usually any liquid hydrocarbon system entering the down hole under normal circumstances are very much diluted by the mud system. However, under conditions of under balanced drilling, the proportion of hydrocarbons in mud returns may be significant with a potential for continuous release.
- Small hydrocarbon release from rotating equipment, pipes and pump work occurring during normal operations/ maintenance during drilling. These are not likely to be significant in open derrick or mast structures.
- Possible shallow gas blowout – these may occur at sumps or drainage tanks and be conveyed by vents or drains to areas of potential ignition sources resulting in fire/ explosion.
- Vapour present in oily drainage systems, vents, and ducting.
- Flammable materials used in drilling operations (oil based drilling fluids)- release points could include high pressure mud points, mud degassing equipment, shale shaker, mud pits and active tanks etc.

Protection against Blowouts

The primary protections against blow outs during drilling are the BOPs or Blow out Preventers. These are used to shut in and control the well in the event of gas or oil being encountered at pressures higher than those exerted by the column of mud in the hole.

BOPs typically consist of 2-3 ram preventers designed at high pressures- (ram preventer is basically a double operated valve with one ram or gate on each side of the bore hole). The BOPs are hydraulically operated with a second remote control panel situated someway away from the rig for use in emergencies when the rig is unapproachable. Connected to the side of the ram type preventers (usually below the blind rams) are the kill and choke lines which are used to control the well in the event of any imbalance between the drilling fluid column pressure and the formation pressure. Both lines are high pressure 2-3 inch hydraulic pipes, the kill line being connected to the mud circulation system and the high pressure cement pumps and the choke line leading to a back pressure control Manifold and the mud degasser unit.

In the event of the high pressure kick with the drill string in the hole, the BOP is closed around the drill pipe and the mud is circulated down the drill string and back to the mud tanks through the choke line and back pressure manifold. The manifold consists of a series of valves and chokes - the choke can be adjusted to give the orifice opening required such as to give a back pressure on the well in order to control it. There would be two chokes in order to allow maintenance on one.

If a kick or blow out occurs with the drill string out of the hole, the blind rams are closed and heavy mud is pumped into the well through the kill line. Any gas can be bled off through the choke line and fluids are usually squeezed back into the formation.

The correct installation of the drilling equipment and the operational reliability of the BOPs are essential for the safety of well drilling operation. In addition, initial and periodic testing of the BOPs, choke and kill manifolds, high pressure/ heavy mud system etc. before installation and periodically is absolutely essential. Most important is the presence of highly trained skilled personnel on the rig! In addition, the use of the correct drilling fluid in the circulatory system is extremely vital.

- The drilling fluid basically does the following:
- To cool and lubricate the drilling bit and the drill string
- To remove drill solids and allowing the release at their surface.
- To form a gel to suspend the drill cuttings and any fluid material when the column is static
- To control sub surface pressures
- To prevent squeezing and caving if formations
- To plaster the sides of the borehole
- To minimize the damage to any potential production zone.

Pressures associated with the sub surface oil, gas or water can be controlled by increasing the specific gravity of the fluid and thereby by reducing the hydrostatic head of the drilling fluid column. The squeezing of formations in the drilled hole can be checked by increasing the hydrostatic head of the drilling fluid. Special additives for the drilling fluid for controlling viscosity, lubricating properties, gelling properties etc. play an important role in the drilling fluid integrity. Sealing agents such as cellulose, mica can also be added to make up the drilling fluid loss into the porous and fractured formations.

The historical records show that the drilling of an exploration well has a higher chance of blow out occurring than does drilling a development well. A blow out can be expected for about 400 exploration wells drilled. As a well takes about 20-25 days to drill this equates to one blow out approximately every 50 years if drilling was continuous. Historically, ignited blowouts have caused an average of three deaths per blow out.

Release of the other flammable material

HSD is used in the mobile generators at the drill sites to cater to the power requirement of the drill equipment, area lighting, etc. The material would be stored in 180 MT vertical cylindrical tank. Spill containment system in the form of 1.2m high bund wall is envisaged to contain 110% of the tank volume. Storage of fuels would primarily pose fire hazard. The credible accident scenarios include:

- Catastrophic tank rupture (Large Leak)
- Leak from a 4” pipeline (Medium Leak)
- A 2” leak from the tank/pipe/flange (Small Leak)

The catastrophic Rupture (CR) of the tank would involve a large leak/big hole in the tank or disengagement of a joint/large leak from a flange sufficient enough to discharge tank inventory in a short time. The spilled material shall get filled into the dyke area. In presence of an ignition source, it may catch fire and result in Pool fire of the dyke area.

A 4” leak from a pipeline or a flange shall have similar consequences as to CR, only the time for loss of containment may be more. Fire being a surface phenomenon, the pool fire in the dyke area would pose similar heat radiation to the surrounding area.

A 2” leak from the tank or the pipeline would result in the loss of inventory at a much reduced rate. Counter-measures shall be available to arrest the leak within reasonable time. With a limited loss of inventory, the damage distances in such case would be less in comparison to the above two cases.

The tank design and construction takes into account the possible stress loads imposed due to exploration and appraisal activities at the drill site. Dyke with adequate capacity (110%) is being provided to contain the spill, if any. Standard well area inspection and maintenance procedures of Vedanta Limited (Division: Cairn Oil and Gas) shall be implemented at the exploratory and appraisal wells to identify any abnormalities.

CONSEQUENCE ANALYSIS/CALCULATIONS

Consequence analysis involves the calculation of the initial "release rate" and then predicting the consequence of the release through computer modeling- it forms an important ingredient in the QRA approach. Consequence analysis is a complex procedure involving numerous calculations. It must also be noted that a single starting incident could have numerous outcomes depending upon factors such as escalation, ignition and others.

The various factors of importance in this drilling rig study with respect to consequence analysis are described below.

Loss of Containment- leak sizes

It must be understood that there are an infinite range of possible releases of flammable material on the facilities For example, a hole could appear at any point in a well, at any time of the year and the hole could have any size (right from pinhole to catastrophic line guillotine rupture) and also possibly any shape! In order to allow management of the study, it is per force necessary to divide the infinite range into a number of smaller ranges through representation as a single event or a failure case.

In the study, only small, medium and large well fluid blowouts were considered.

Hydrocarbon Leaks due to Loss of Containment (Leak during Well Testing) were not taken into consideration since they are likely to be controlled about 95% of the time. The category includes releases that may be isolated from the reservoir fluids, typically release from the well testing equipment and mud line.

Inventory

Inventory can get discharged to Environment due to Loss of Containment. Inventory Analysis is commonly used in understanding the relative hazards and short listing of release scenarios and plays an important role in regard to the potential hazard. The larger the inventory of a vessel or a "system", the larger the quantity of potential release. The potential release depends upon the quantity of release, the properties of the materials and the operating conditions (pressure, temperature etc. described later).

Blowouts

A blowout on the topsides may take one of several forms and release locations. Any release not immediately ignited would give a flammable vapour cloud, which could cause a vapour cloud explosion in the drill floor or the mud pit areas.

A pressurized jet release could lead to a very large jet fire, producing high levels of thermal radiation. The flame could impinge on structural members in the derrick. These could then fail as they lose their mechanical properties at high temperature. This may lead to objects falling from the derrick and causing more damage below, especially if the derrick has already been weakened by the blast from a vapour cloud explosion. If the fire continues for a long period (say one to two hours) then the derrick may collapse causing serious damage to surrounding areas. However, evacuation is expected to have occurred by any available means before this time.

This scenario is a worst-case scenario, which is unlikely to happen in this situation as the bottom hole pressure is low.

Unburnt oil from a potential blowout would typically form running or evaporating pools, which could create a hazard from heat and smoke in all areas that the pools reach. If the blow out originates on the drill floor then the burning oil would run over the side of the drill floor.

Consequence Analysis for Blowouts

Blowout release rate is taken as 0.12 kg/s assuming 5 times the normal rate from the well. It is expected that the uncontrolled release of fluids on the drill floor would ignite almost immediately and that the resulting fire would engulf the drill floor. Higher ignition probabilities are expected for large releases compared to smaller releases. The flames are likely to impinge on structural members on the drill floor. These may fail as they lose their mechanical properties at high temperature. This may lead to objects falling from the derrick and causing more damage below. If the fire continues for a long period.

Weather Conditions

The weather stability class is normally Class D on sunny days and Class F for Night time. The average wind speed most of the time is 5 m/s for day time and 1.5 m/s. combining this with stability class D and F, consequence modeling is done for both the weather cases 5 D and 1.5 F. The ambient condition considered in this study is as under:

Average Ambient Temperature = 24˚C

Average Humidity = 80 %

The six representative weather classes on which the analysis is based are detailed in Table 7.2.

Table 7.2 . Pasquill Stability Class

Surface Wind Speed (m/s)	Daytime Conditions Strength of Sunlight			Night Sky	
	Strong	Moderate	Slight	Thin Overcast ≥ 4/8 Cloudiness**	≤3/8 Cloudiness
< 2	A	A-B	B	E	F
2-3	A-B	B	C	E	F
3-5	B	B-C	C	D	E
5-6	C	C-D	D	D	D
> 6	C	D	D	D	D

***Applicable to heavy overcast conditions day or night**

****Degree of Cloudiness = Fraction of sky above horizon covered by clouds.**

A- Extremely Unstable Conditions

B- Moderately Unstable Conditions

C- Slightly Unstable Conditions

D- Neutral Conditions*

E- Slightly Stable Conditions

F- Moderately Stable Conditions

In its original form, the Pasquill system contains seven categories (A to F) but joint categories are also common. Categories A (Very Unstable), D (Neutral) and F (Very Stable) are discussed next.

Category A (very unstable) occurs typically on a warm sunny day with light winds and almost cloudless skies when there is a strong solar heating of the ground and the air immediately above the surface. Bubbles of warm air rise from the ground in thermals. The rate of change (decline) of temperature with height (lapse rate) is very high.

Category D (neutral) occurs in cloudy conditions or whenever there is a strong surface wind to cause vigorous mechanical mixing of the lower atmosphere.

Category F (very stable) occurs typically on a clear, calm night when there is a strong cooling of the ground and the lowest layers of the atmosphere by long wave radiation. There is a strong inversion of temperature (i.e. warm air over cold air).

Table 7.3 Representative Weather Class 5D and 1.F

Weather Class	Wind Speed(m/s)	Pasquill Stability
I	3	B
II	1.5	D
III	5	D (used for modeling)
IV	9	D
V	5	E
VI	1.5	F (used for Modeling)

Source: Handbook of Chemical Hazard Analysis Procedure by FEMA, USEPA and USDOT

Damage Criteria

Jet Fire

The consequence caused by exposure to heat radiation is a function of:

- The radiation energy onto the human body [kW/m2];
- The exposure duration [sec];
- The protection of the skin tissue (clothed or naked body).

It can be assumed that people would be able to find a cover or a shield against thermal radiation in 20 seconds time. Furthermore, 100% lethality may be assumed for all people suffering from direct contact with flames, such as the pool fire, a flash fire or a jet flame. The effects due to relatively lesser incident radiation intensity are given below.

In the study, the following criteria were used for estimation of heat radiation due to fire fatalities:

Heat Radiation Selection Criteria:

- 4.73 kW/m2: Maximum radiant heat intensity in areas where emergency actions lasting 2 min to 3 min can be required by personnel without shielding but with appropriate clothing. Corresponds to of painful burns and blistering after 20 second exposure (0% lethality)
- 6.31 kW/m2: Indicative of second degree burns after 20 second exposure (1% fatality)
- 12.5 kW/m2: Indicative of piloted ignition for susceptible structures (50% fatality)
- 37.5 kW/m2: Indicative of total asset loss (100% fatality

Flash Fire Selection Criteria:

The consequence distances would be identified for the following Lower Explosive Limit:

- 50 % Lower Explosive Limit
- 100 % Lower Explosive Limit

Toxic Gas Dispersion Criteria:

No Toxic gas dispersion scenarios envisaged for this project.

Explosion Criteria:

Blast peak overpressure from explosion for buildings would not exceed the following levels provided in Table 7.4. Internationally recognized and globally accepted TNO Multi energy model was used for the explosion modeling for this Project.

Table 7.4 Overpressure Criteria

Level of Concern	TYPE OF DAMAGE
0.02068 bar	"Safe distance" (probability 0.95 of no serious damage1 below this value); projectile limit; some damage to house ceilings; 10% window glass broken.
0.070 bar	General buildings, offices
0.1379 bar	Partial collapse of wells, concreate Block wells, not reinforced, shattered
0.2068	bar
1 bar	Range for 1-99% fatalities among exposed population due to direct blast effects

Source: Report Number : 434 International Association of Oil & Gas Producers (OGP)- March 2010- Table 2.8 and PHL-S-100

Failure Frequency Analysis

Selection of Failure Scenarios

Potential release rates for a material from containment depend significantly on the initial operating conditions. Factors affecting the "release rate" include the initial pressure, temperature, hole size, hole roughness, hole orientation, gas properties, atmospheric conditions and many other parameters.

Both, the complexity of study and the number of incident outcome cases are affected by the range of initiating events and incidents covered. This not only reflects the inclusion of accidents and / or non-accident-initiated events, but also the size of those events. The following four scenarios have been quantitatively evaluated in the study:

- Small and medium size holes - these typically represent failures such as gasket leaks, flange leaks etc. This scenario has been considered as 2" leak for HSD
- Medium leaks – these typically represent disengagement of flanges, full bore failure of pipelines, large leaks from flanged joints, etc. This scenario has been considered as a 4" leak of HSD.
- Large holes– these typically represent "catastrophic" or "guillotine" rupture scenarios, possibly on account of factors such as soil inundation, earthquakes etc. This scenario has been considered as a Catastrophic Failure of HSD Tank.
- Well Blow out case. This has been considered as Well Blow out scenario involving crude oil

The selection of initiating events and incidents would take into account the goals or objectives of the study. The main reasons for including release sizes other than the catastrophic are to reduce the conservatism in an analysis and to better understand the relative contributions to risk of small versus large releases. Only leakage events leading to possibility of serious injury are considered in the study.

Calculation of Individual & Societal Risk

Individual Risk or IR represents the geographical distribution of risk to any individual.

Societal Risk is representing the risk the project poses to society as a whole. The Societal Risk or Group risk (F-N) curves indicate the cumulative frequency (F) of (N) number of fatalities. Society is typically not woulding to accept industrial installations that result in many fatalities, even with a low frequency rate!

The estimation of risks in the software is done through estimation of "risks" attributed to each failure case by determining the impact in terms of fatalities. In this step, the hazard or effect zone information, ignition source, population distribution, meteorological data and other relevant details are combined to determine risks.

In order to estimate risks (IR or SR), the number of fatalities for each incident outcome case is calculated and the frequencies of outcomes with equal fatalities summed up.

Comparison to Risk Acceptance Criteria

This penultimate step compares the estimated risk with respect to the Company's internal risk acceptability criteria or specific legislative or regulatory (as applicable in the country of operation) risk acceptability criteria. In this step, the risk "band" is determined- typically, the project risk band is determined to be negligible, acceptable, not acceptable are the risk assessment stage determines whether the risks are "Broadly Acceptable", "Intolerable" or "Tolerable if ALARP".

Vedanta Limited (Division: Cairn Oil & Gas) Risk Acceptability Criteria

Vedanta Limited (Division Cairn Oil & Gas) risk acceptability criteria are derived from interpretation of the risk acceptability criteria published by UK HSE-92 and is applied when assessing the tolerability of risk to persons for Vedanta Limited (Division Cairn Oil & Gas) facilities, sites, combined operations or activities. It broadly indicates as follows:

- Individual risk to any worker above 10-3 per annum shall be considered intolerable and fundamental risk reduction improvements are required.
- Individual risk below 10-3 for but above 10-6 per annum for any worker shall be considered tolerable if it can be demonstrated that the risks are As Low As Reasonably Practicable (ALARP).
- Individual risk below 10-6 per annum for any worker shall be considered as broadly acceptable and no further improvements are considered necessary provided documented control measures are in place and maintained.

- Individual risk to any member of the general public as a result of Vedanta Limited (Division Cairn Oil & Gas) Businesses activities shall be considered as intolerable if greater than10-4 per annum, broadly acceptable if less than 10-6 per annum and shall be reduced to As Low As Reasonably Practicable (ALARP) between these limits.
- For new facilities, Vedanta Limited (Division Cairn Oil & Gas) shall strive to achieve lower risks compared with that typical for existing facilities, down at least to an individual risk to any worker of 10-4 per annum, by the appropriate use of best practice including technology and management techniques.
- For existing facilities, higher risk levels may be tolerated provided that they are As Low As Reasonably Practicable (ALARP) and meet the minimum standards given herein. As facilities under Vedanta Limited (Division Cairn Oil & Gas) expansion may be considered as "new" facilities; it is proposed that individual risk to any worker above 10-4 per annum shall be considered intolerable.

The risk acceptability criteria are indicated in the following pages.

Figure 66. UK HSE-Individual Risk Criteria

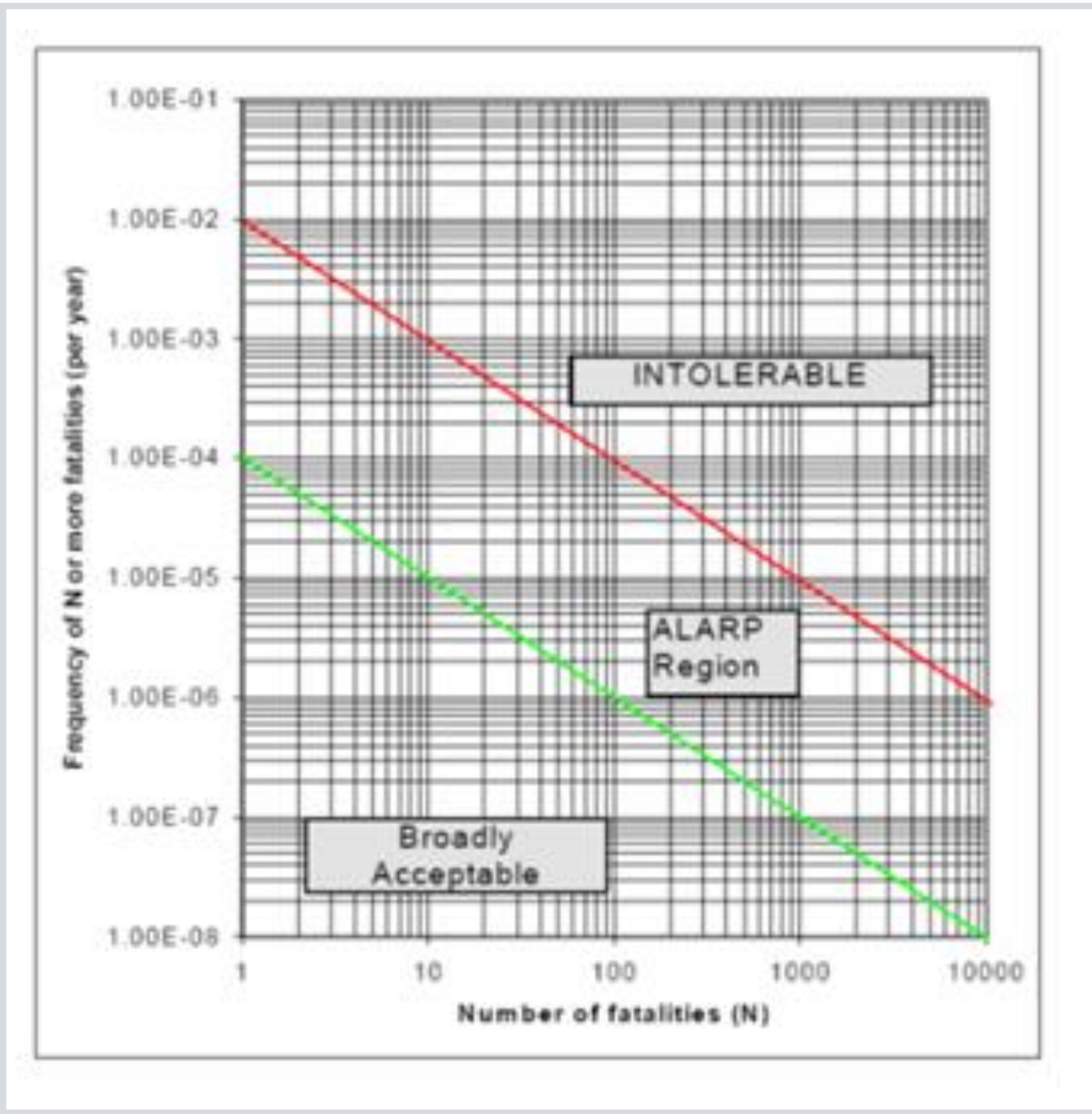


Figure 67. UK HSE-Offsite Group Risk Criteria

ALARP Demonstration

Wherever risks are found to lie in the ALARP region, this suggests existing risk mitigating measures must be sustained and Best Industry Practices used. Any specific new risk reduction options may be evaluated through Cost Benefit Analysis (CBA).

Risk Reduction Recommendations

This step analyses the risks estimated, their tolerability with respect to the risk acceptability criteria.

In case risks are found to fall in the "Unacceptable" region, risk reduction recommendations aimed at bringing risks to within the "Tolerable region if ALARP" are proposed. In such conditions, the Cost Benefit Analysis (CBA) is also carried out for specific risk reduction measures in order to "quantify" them or any other mitigative measures shall be recommended.

In case risks have been found to be the ALARP or Broadly Acceptable region, recommendations may still be suggested for generic risk reduction based on industry best practice. Such risk reduction recommendations are not "quantified" or mandatory but are nevertheless proposed for safer operation of the facilities.

Software Used

The Software, DNV PHAST was used for the study for assessing the Risk and Consequence calculations.

Population

Table 7.5 Population

S. No	Area	Population (Day)	Population (Night)
1	Process Area (Heater Treater, Fuel Gas, Coalesing Fiilter etc.)	25	25
2	Process Area (Oil Storage Area, Instrument Air etc.)	5	5
3	Loading, Unloading Area	2	2
4	Operator Bunker	2	2
5	Diesel Storage Area	2	2
6	Waster Area (Water, SBM etc.)	15	15
7	Toilet Block	2	2
8	Drilling/ Well Area	50	50

Hazard Identification (HAZID), Consequence Analysis and Risk Results for the Project

Hazard Identification is a very important and critical first step in the QRA process. The HAZID identifies process and non-process hazards affecting the project execution and operational stage. The main objective of the HAZID is to identify potential major accident events- it is important to ensure scenarios identified in the HAZID are factored into the QRA.

Shortlisting of Release Scenarios

The range of incidents possible in the facility is established through identification of “Isolatable sections”, from which the different categories of leakages/ releases may occur. The Isolatable Sections comprise those where Emergency Shutdown Valves are in place isolating the section, even in emergency. Assumption Meeting for the purpose of identifying such sections and estimating inventories, release rates and other details relevant to the quantitative analysis. Guideline was utilized for deriving failure scenarios, release rates, inventories etc. Isolatable Sections are identified as follows:

- The initial step is the identification of sources and their physical location
- Calculation of the hold-up volumes within isolatable sections with respect to fluid within equipment and associated piping.

The process isolation times, inventory release times etc. for the various leak sizes considered were taken at 5 minutes for small leaks (5 mm), 3 minutes for minor leaks (25 mm)- safe distance can be used for layout purpose 2 minutes for large leaks and 1 minute for catastrophic rupture.

Appendix 7.1 shown provides information on leak sizes, inventories and hazardous chemicals within the isolatable sections.

Consequence Analysis Results

Events originating from within the facility may, depending upon the nature and quantity of hazardous chemical and the location of accident have the potential of affecting personnel within the installation or at times the general population in the surrounding area.

Table 7.6 : Pool Fire Results

Jet fire						
			Incident Heat Radiation (KW/m2)			
SECTION	LEAK SIZE	Weather Class	4.73	6.31	12.5	37.5
			Distance in Meter (m)			
IS-01 - From Well Fluid from Well to Inlet of Heater Separator	5mm	DAY TIME (5/D)	19	18.5	17.4	-
		NIGHT TIME (1.5/F)	18.5	17	13.5	-
	25mm	DAY TIME (5/D)	79	76	71	65
		NIGHT TIME (1.5/F)	88	80	65	47
	100mm	DAY TIME (5/D)	282	270	243	218
		NIGHT TIME (1.5/F)	310	232	222	160
	CR	DAY TIME (5/D)	545	505	455	395
		NIGHT TIME (1.5/F)	590	530	415	308
IS-02 Heater Treater Separator – Oil Case	5mm	DAY TIME (5/D)	-	-	-	-
		NIGHT TIME (1.5/F)	-	-	-	-
	25mm	DAY TIME (5/D)	37	36.5	36	26
		NIGHT TIME (1.5/F)	25	24.8	23	11
	100 mm	DAY TIME (5/D)	96	93	89	83
		NIGHT TIME (1.5/F)	72	69	65	59
	CR	DAY TIME (5/D)	150	145	135	120
		NIGHT TIME (1.5/F)	112	110	98	86
IS-03 Heater Treater Separator – Gas Case	5mm	DAY TIME (5/D)	-	-	-	-
		NIGHT TIME (1.5/F)	-	-	-	-
	25mm	DAY TIME (5/D)	-	-	-	-
		NIGHT TIME (1.5/F)	-	-	-	-
	100mm	DAY TIME (5/D)	22.1	21.1	17.9	-
		NIGHT TIME (1.5/F)	20.4	18.4	14.3	-
	CR	DAY TIME (5/D)	42	41.2	39	35.2
		NIGHT TIME (1.5/F)	38.8	36.2	28.9	13.8
IS-04 Oil from Heater Treater Separator to inlet of Oil Storage Tanks including coaleser separator	5mm	DAY TIME (5/D)	-	-	-	-
		NIGHT TIME (1.5/F)	-	-	-	-
	25mm	DAY TIME (5/D)	32.8	32	31	-
		NIGHT TIME (1.5/F)	24.2	23.5	22.5	20.5
	100mm	DAY TIME (5/D)	95	93	88	83
		NIGHT TIME (1.5/F)	70	67	63	58
	CR	DAY TIME (5/D)	110	107	102	97
		NIGHT TIME (1.5/F)	85	81.5	76.5	71
IS-05- From XSV of tank inlet to pump inlet including oil storage tank	5mm	DAY TIME (5/D)	-	-	-	-
		NIGHT TIME (1.5/F)	-	-	-	-
	25mm	DAY TIME (5/D)	30.6	32	30.6	28.4
		NIGHT TIME (1.5/F)	23	22	-	-
	50mm	DAY TIME (5/D)	50	49.5	47	43.2
		NIGHT TIME (1.5/F)	38	37	35	31.2
	CR	DAY TIME (5/D)	103	100	96	90

Jet fire

SECTION	LEAK SIZE	Weather Class	Incident Heat Radiation (KW/m2)			
			4.73	6.31	12.5	37.5
			Distance in Meter (m)			
		NIGHT TIME (1.5/F)	78	74	70	64
IS-06 From Oil Transfer pump outlet to tanker loading Facility	5mm	DAY TIME (5/D)	-	-	-	-
		NIGHT TIME (1.5/F)	-	-	-	-
	25mm	DAY TIME (5/D)	60	58	55	52
		NIGHT TIME (1.5/F)	39.2	37.5	33	23.5
	100mm	DAY TIME (5/D)	135	132	124	116
		NIGHT TIME (1.5/F)	112	107	92	78
IS-07 Tanker Failure	CR	DAY TIME (5/D)	60	58	56	55
		NIGHT TIME (1.5/F)	46	45	43	41
IS-08 Diesel Storage Tank	5mm	DAY TIME (5/D)	-	-	-	-
		NIGHT TIME (1.5/F)	-	-	-	-
	25mm	DAY TIME (5/D)	-	-	-	-
		NIGHT TIME (1.5/F)	-	-	-	-
	50mm	DAY TIME (5/D)	15.7	-	-	-
		NIGHT TIME (1.5/F)	-	-	-	-
	CR	DAY TIME (5/D)	24.3	23.3	-	-
		NIGHT TIME (1.5/F)	16.2	14.4	-	-
IS-09 Fuel Gas System	5mm	DAY TIME (5/D)	-	-	-	-
		NIGHT TIME (1.5/F)	-	-	-	-
	25mm	DAY TIME (5/D)	-	-	-	-
		NIGHT TIME (1.5/F)	-	-	-	-
	100mm	DAY TIME (5/D)	22.1	21	17.7	-
		NIGHT TIME (1.5/F)	20.4	18.4	14.3	-
	CR	DAY TIME (5/D)	42.8	41.2	39.1	36.2
		NIGHT TIME (1.5/F)	38.9	35.2	29	13.8
IS-10-Flare System	5mm	DAY TIME (5/D)	-	-	-	-
		NIGHT TIME (1.5/F)	-	-	-	-
	25mm	DAY TIME (5/D)	-	-	-	-
		NIGHT TIME (1.5/F)	-	-	-	-
	100mm	DAY TIME (5/D)	14.6	-	-	-
		NIGHT TIME (1.5/F)	13.8	12.1	-	-
	CR	DAY TIME (5/D)	31	30.2	28.5	-
		NIGHT TIME (1.5/F)	29	26.5	21	-

Table 7.7 Flash Fire Result

FLASH FIRE

Section	Leak Size	Level of Concern	Weather Class	
			(5/D)	(1.5/F)
IS-1 - From Well Fluid from Well to Inlet of	**5mm**	50% LEL-5102 ppm	12.2	25
		100 % LEL- 1.02e+004ppm	8.5	11
	25 mm	50% LEL-5102 ppm	145	259

FLASH FIRE

Section	Leak Size	Level of Concern	Weather Class	
			(5/D)	(1.5/F)
Heater Separator		100 % LEL- 1.02e+004ppm	88	100
	100 mm	50% LEL-5102 ppm	400	420
		100 % LEL- 1.02e+004ppm	320	320
	CR	50% LEL-5102 ppm	475	478
		100 % LEL- 1.02e+004ppm	390	380
IS-2 - Heater Treater Separator – Oil Case	5mm	50% LEL-3123 ppm	6.5	6.5
		100 % LEL- 6245 ppm	5	6.4
	25 mm	50% LEL-3123 ppm	20	26
		100% LEL- 6245 ppm	19	14
	100 mm	50% LEL-3123 ppm	70	65
		100 % LEL- 6245 ppm	40	42
	CR	50% LEL-3123 ppm	102	90
		100 % LEL- 6245 ppm	68	60
IS-03- Heater Treater Separator – Gas Case	5mm	50% LEL-1.769e+004 ppm	1.25	1.72
		100% LEL- 3.538e+004 ppm	0.82	0.98
	25 mm	50% LEL-1.769e+004 ppm	4.8	6.9
		100% LEL- 3.538e+004 ppm	3.3	4.4
	100mm	50% LEL-1.769e+004 ppm	14.5	22.2
		100% LEL- 3.538e+004 ppm	10	14.4
	CR	50% LEL-1.769e+004 ppm	29	43
		100% LEL- 3.538e+004 ppm	17.5	27.5
IS-04 - Oil from Heater Treater Separator to inlet of Oil Storage Tanks including coaleser separator	5mm	50% LEL-3123 ppm	6.3	6.6
		100 % LEL- 6245 ppm	5	6.4
	25 mm	50% LEL-3123 ppm	14	23.9
		100% LEL- 6245 ppm	13.9	12.2
	100mm	50% LEL-3123 ppm	58	55
		100 % LEL- 6245 ppm	27	31
	CR	50% LEL-3123 ppm	73	64
		100 % LEL- 6245 ppm	44	44
IS-05 - From XSV of tank inlet to pump inlet including Oil Storage Tank	5mm	50% LEL-3123 ppm	7	7.6
		100 % LEL- 6245 ppm	5.3	6.9
	25 mm	50% LEL-3123 ppm	15.2	21
		100 % LEL- 6245 ppm	15	12.3
	50 mm	50% LEL-3123 ppm	35	44
		100 % LEL- 6245 ppm	15	25.8
	CR	50% LEL-3123 ppm	70	64
		100% LEL- 6245 ppm	43	46
IS-06 - From Oil Transfer pump outlet to tanker loading Facility	5mm	50% LEL-3123 ppm	9.5	13.2
		100% LEL- 6245 ppm	7.2	9.5
	25 mm	50% LEL-3123 ppm	58	35
		100% LEL- 6245 ppm	44	34.5
	100 mm	50% LEL-3123 ppm	73	75
		100% LEL- 6245 ppm	71	58

FLASH FIRE

Section	Leak Size	Level of Concern	Weather Class	
			(5/D)	(1.5/F)
	CR	50% LEL-3123 ppm	191	0.57
		100% LEL- 6245 ppm	165	0.57
IS-07 - Oil Tanker Failure	CR	50% LEL-3123 ppm	42	32.5
		100% LEL- 6245 ppm	24	22
IS-08 - Diesel Storage Tank	5mm	50% LEL-3500 ppm	6.6	5.9
		100 % LEL- 7000ppm	5	5.4
	25 mm	50% LEL-3500 ppm	10.4	9.5
		100% LEL- 7000ppm	10.3	9.5
	50 mm	50% LEL-3500 ppm	11.8	12.2
		100 % LEL- 7000ppm	11.8	11.8
	CR	50% LEL-3500 ppm	13.9	13
		100 % LEL- 7000ppm	13.9	13
IS-09 - Fuel Gas System	5mm	50% LEL-1.769e+004 ppm	1.25	1.71
		100 % LEL- 3.538e+004ppm	0.82	0.98
	25 mm	50% LEL-1.769e+004 ppm	4.9	6.8
		100% LEL- 3.538e+004ppm	3.3	4.4
	100mm	50% LEL-1.769e+004 ppm	14.5	22.4
		100% LEL- 3.538e+004ppm	10	14.3
	CR	50% LEL-1.769e+004 ppm	29	43
		100 % LEL- 3.538e+004ppm	17	27.5
IS-10 - Flare System	5mm	50% LEL-1.769e+004 ppm	1.04	1.2
		100 % LEL- 3.538e+004ppm	0.56	0.62
	25 mm	50% LEL-1.769e+004 ppm	3.7	5
		100 % LEL- 3.538e+004ppm	2.48	3.2
	100mm	50% LEL-1.769e+004 ppm	11.3	16.5
		100 % LEL- 3.538e+004ppm	8.4	10.8
	CR	50% LEL-1.769e+004 ppm	19.2	32
		100% LEL- 3.538e+004ppm	13.9	20

Table 7.8 Fireball Result

Fireball

SECTION	LEAK SIZE	Weather Class	Incident Heat Radiation (KW/m2)			
			4.73	6.31	12.5	37.5
			Distance in Meter (m)			
IS-02	CR	DAY TIME (5/D)	365	312	215	95
		NIGHT TIME (1.5/F)	365	312	215	95

TNO Multi energy model has been used for the study and explosion is not envisaged for the desired overpressure levels (0.0268, 0.070, 0.1379,0.2068 and 1 bar)

Risk Calculation

Risk Calculation is done by combining the Consequence Analysis results given vide section 7.2.17with the estimated failure frequency and estimates of population within and outside the facility. However, other key study assumptions were discussed with Vedanta Limited (Division: Cairn Oil & Gas).

Population

The following plant population has been assumed for the study: -

Table 7.9. Population

S. No	Area	Population (Day)	Population (Night)
1	Process Area (Heater Treater, Fuel Gas, Coalesing Fiilter etc.)	25	25
2	Process Area (Oil Storage Area, Instrument Area etc.)	5	5
3	Loading, Unloading Area	2	2
4	Operator Bunker	2	2
5	Diesel Storage Area	2	2
6	Waster Area (Water, SBM etc.)	15	15
7	Toilet Block	2	2
8	Drilling/ Well Area	50	50

FN Curve

The FN Curve drawn for this project is presented Figure 66. The FN Curve represents combined risk (during 5/D and 1.5 F) covering all the identified scenarios.

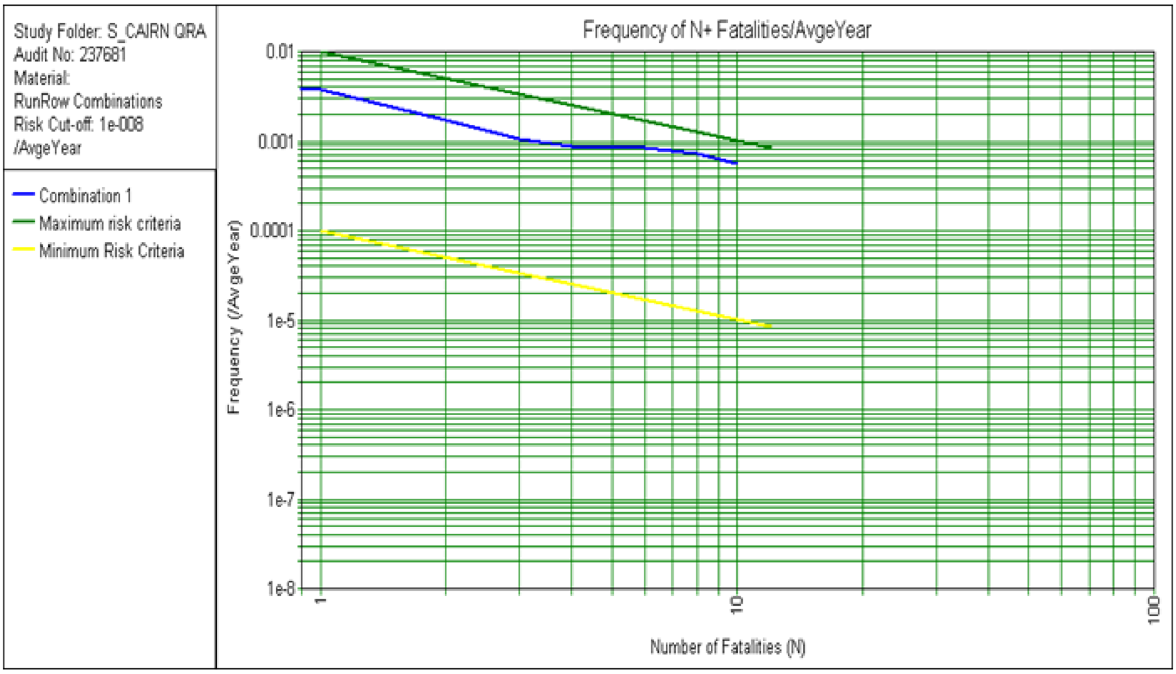


Figure 68. FN Curve

From the above F-N Curve, it may be seen that the maximum line starts at 1E-02 and 1E-04 and it is observed that the integrated risks lie within the 1E-02 and 1E-04, Hence the risk is in “ALARP” range. -this suggests that existing risk mitigating measures must be sustained and other Best Industry Practices shall be used. Any specific new risk reduction options may be evaluated through Cost Benefit Analysis (CBA) or any other suitable means.

Location Specific Individual Risk (LSIR)

LSIR is the risk for a hypothetical individual who is positioned at that location for 24 hours a day 365 days per year. Since in reality people do not remain continuously at one location, LSIR is a notional risk measure.

From the Figure 69 (combined during 5/D and 1.5 F) it can be seen that the maximum risk level lies in the band of 1E-003 /Avge year (within the fence) and 1E-004 /Avge year –this risk band extends towards the west for a distance of approx. 20 meters from the plot boundary. It may be noted that this risk level is on the higher side for public areas (normally acceptable risk level is 1E-006/Avge year). It is suggested that either heater treater unit, Coalescing filter skid and Fuel gas unit may be shifted 20 meters towards east to prevent any outside risk or to ensure there are no vegetating in this area.

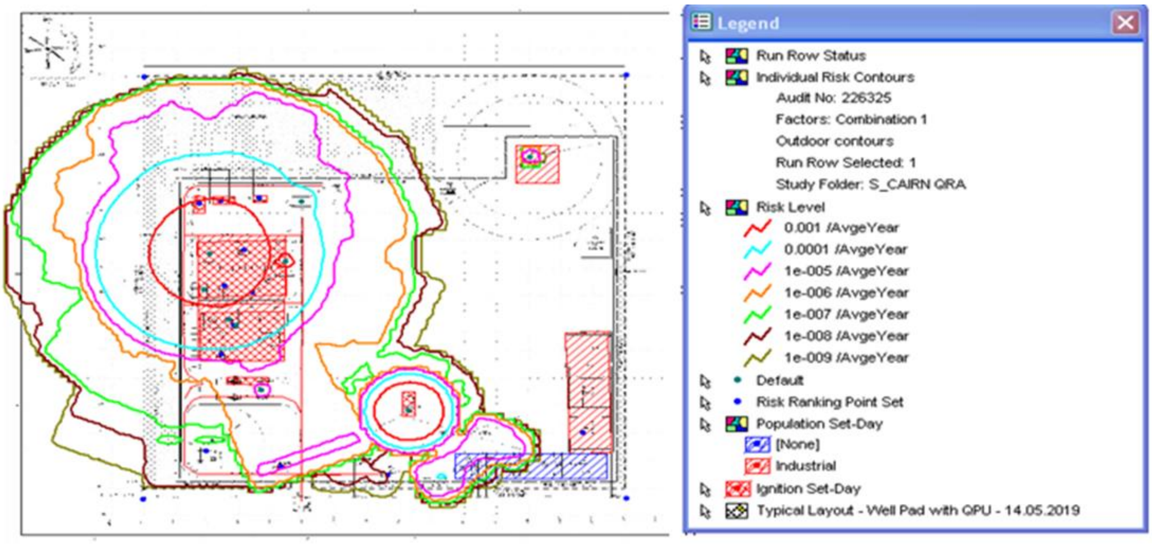


Figure 69. Overall ISO Risk Contour

Individual Specific Individual Risk (ISIR)

The Location Specific Individual Risk is the risk to a person who is assumed to be at the specific location 365 days a year and 24 hours a day. A more representative risk measure is the "Individual Specific Individual Risk (ISIR). This is the risk estimated accounting for the time fraction a person actually spent at a specific location. The calculation for this is done based on the consideration of Personnel working. An average working period of 12 hours per day are considered and the results are presented Table 7.10 and Table 7.11.

- ISIR= LSIR×1/2×1/2×Time Spent/12

Table 7.10 Total ISIR Operations/Maintenance Staff

S. No	Area	LSIR	Time Spent in hrs	ISIR
1	Coaleser Area	2.12E-03	6	2.65E-04
2	Control Room	1.14E-03	9	2.14E-04
3	DG Area	7.12E-04	1	1.48E-05
4	Diesel Area	3.87E-04	3	2.42E-05
5	Flare Area	1.12E-04	0.5	1.17E-06
6	Heater Treater Area	5.64E-03	6	7.05E-04
7	Loading Area	1.99E-05	2	8.28E-07
8	Oil Storage Area	6.71E-04	5	6.99E-05
9	Well Area	5.86E-03	4	4.88E-04
10	Fuel Gas Area	2.02E-03	5	2.10E-04
	Total			3.44E-06

Table 7.11 Total ISIR Non-Operation/ Maintenance Staff

S. No	Area	LSIR	Time Spent in hrs	ISIR
1	Fire Water Area	1.29E-08	2	5.38E-10
2	Toilet Block	1.29E-08	1	2.69E-10
3	Security Cabin	1.00E-07	10	2.08E-08
4	Operator Block	1.00E-07	4	8.33E-09
	Total	3.00E-08		

From the above values it is seen that the operation/maintenance ISIR value is in ALARP range for operation person and broadly acceptable for Non-operation. The following measures are available to address the same.

- Safeguarding of human life is Vedanta Limited (Division: Cairn Oil & Gas) top most priority. To this effect, Vedanta Limited (Division Cairn Oil & Gas) has issued and implemented a comprehensive HSE POLICY backed up with appropriate safety management systems and procedures.
- Vedanta Limited (Division Cairn Oil & Gas) operating procedures lay a strong focus on hazard identification and risk assessment covering each and every hazardous operation, procedure and equipment. Risks and mitigating measures for each are clearly carried out and measures implemented and monitored. This ensures risk minimisation to the worker group.
- The facility is built based on the highest international standards and global best practice. Individual equipment is of highest quality, certified and of highest safety integrity. This ensures risk minimisation to the worker group through operational and maintenance periods. In addition, equipment hazard identification has to be carried out for each of the equipment time to time.
- Mock drills would be carried out periodically to ensure the highest state of emergency response in case of any incident.

Risk Reduction Measures

The main conclusions drawn from the Consequence Analysis and Risk calculations are given below- critical actions for safeguarding against the incidents are also mentioned below: -

- From the F-N Curve, it is observed that the integrated risks lie within the “ALARP” range. -this suggests existing risk mitigating measures must be sustained and Best Industry Practices be used. Any specific new risk reduction options may be evaluated through Cost Benefit Analysis (CBA).
- From the figure 43 to figure 47 it can be seen that the maximum risk level lies in the band of 1E-003 /Avge year (within the fence) and 1E-004 /Avge year –this risk band extends towards the west for a distance of approx. 20 meters from the plot boundary. It may be noted that this risk level is on the higher side for public areas (normally acceptable risk level is 1E-006/Avge year). It is suggested that either heater treater unit, Coalescing filter skid and Fuel gas unit may be shifted 20 meters towards east to prevent any outside risk or to ensure there are no vegetating in this area.
- It is seen that the control room is falls under 1E-03 /Avge year it advised to shift the Control room to a safe location.
- Living area are likely to be affected due to large incidents on the Rig Floor, it is essential to ensure the upkeep of the safety devices (Smoke Detection, Fast Rescue Craft (FRC), escape routes and it must be ensured that Mock evacuation drills are carried out periodically.
- Escape routes for personnel on the Drill Floor towards the LQ must be properly protected and kept free of any debris/obstructions etc. to ensure minimum loss of life.
- The correct installation of Safety Critical Equipment and their operational reliability are essential for the safety of the facility. In addition, initial and periodic testing of the Safety Critical Equipment before installation and periodically is absolutely essential and the same must be ensured.
- Storage tank enclosures must be drained periodically during the rainy season in particular.
- As hydrocarbon related risks exist at the facility, ignition source control must be ensured during routine and non routine operations.
- Ensuring that the public in vicinity of the facility is made aware of the hazards and also the hazards of unplanned and irregular third-party activities- this may be done through frequent safety awareness programmes, warning signage, explicit display of Do’s and Don’ts etc.
- Emergency Response Drills must be carried out frequently both internally within Vedanta Limited (Division Cairn Oil & Gas) and also involving external authorities. Lessons learnt must be assimilated and disseminated to concerned persons.
- The correct installation of the Safety Critical Equipment and their operational reliability are essential for the safety of the facility. In addition, initial and periodic testing of the Safety Critical Equipment before installation and periodically is essential and the same must be ensured.

- For Jetfire scenarios for small leaks may be safeguarded against through proper fire protection means (Fire and gas Detectors, Passive and Active firefighting systems. Proper firefighting system design and implementation and fire drills, training etc. are essential and must be sustained through the project life cycle.
- The damage distance arises due to the Flash Fire mitigated by ensuring the that the area must be kept free of ignition sources to the extent possible and the same must be ensured even during maintenance activity. Non-sparking tools must be used and personnel entering the area must be "de-earthed" before entering. A hazardous area classification study is suggested for placement of electrical equipment in the classified area.
- The damage distance for pool fire arising due the pool fire for small leaks shall be safeguarded against through proper fire protection means.
- The Fireball result is provided for Catastrophic rupture case of IS-02.
- Key non-routine activities must be preceded by a Job Safety Analysis and Job or Task Risk Assessment involving key personnel that would be working on the facility.
- Work Permit System must be implemented during the construction and operational phases of the project to safeguard against any accidents. It must subsequently also cover the operational phase.
- Trips and falls hazard, electrical hazards etc. must be minimized through periodic safety audits and site inspections using third party and Internal audit teams. Actions arising out of the audits must be implemented in a time bound manner and followed up for closure.
- Vedanta Limited (Division Cairn Oil & Gas) must ensure suitable training to all personnel (Company as well as Contractor personnel) to help prevent incidents/ accidents- such training must be refreshed periodically, and a list of trained personnel must be maintained by Vedanta Limited (Division Cairn Oil & Gas)
- the facility and connected equipment/ systems must be ensured to minimize failure potential.
- As ignition related risks exist at the facility, ignition source control must be ensured during routine and non-routine operations.
- Apart from the process risks assessed, another very important category of incidents possible are those associated with well operations. These risks could include uncontrolled blowouts, incidents associated with rig movement/rig walk, wireline risks during wireline operations, well bore clean out risks, risks associated with specific chemicals during drilling/well repair/ activation/other activities.
- On-site personnel are subject to standard occupational risks and Vedanta Limited (Division Cairn Oil & Gas) must direct effort and resources into reducing these risks. Incidents connected with well operations, dropped objects, personnel falls from height, electrocution incidents etc. are top priorities which Vedanta Limited (Division Cairn Oil & Gas) would concentrate significant effort to prevent, prepare for and respond to. This must be implemented through the Vedanta Limited (Division Cairn Oil & Gas) HSE Management System.
- HAZOP to be done once design is reasonably complete and before start up. In addition, a basic safeguarding must be in place during the testing/early production phase- well shut/ surface facilities basic shut down must be possible. A basic functioning F&G system too must be put in place with well shut down incase of F&G activation. Initial phase well behavior could be unpredictable and necessary safeguarding must be in place- essentially, the EPS must be equipped with basic shutdown facilities, typically "fit for purpose". It is also necessary that initial well operations are manned continuously- this of course, would be the case, since data logging/monitoring would also be taking place.
- Storage Tank vents to be routed at safe height and location to acvoid toxic/sudden vapour egress with toxic/flammable hazard.
- Heater Treater BMS to be checked thoroughly before being put on line and necessary leak and performance tests to be ensured properly. Burner light up sequences would be properly established and necessary site verification tests etc. carried out
- Choke internals to be of suitable anti abrasive material-= this would be able to cater to possible sanding issues, well debris etc.
- Specific procedures to address sanding operations/ sand flushout must be in place.
- It must be ensured that Storage Tanks and Road Tankers are NOT overfilled (not more than 80%)- set points/ SOP to capture the same

- Road Tanker Bottom filling option is preferred- in case of top loading, OISD 157 (https://oilweb.oilindia.in/OISD_Standard/oisd%20standard_old/Std-157.doc) guidelines to be followed for critical points
- Ensure proper (metallic/ metal braided) hoses, gaskets etc. and Road tanker earthing is properly executed.
- F&G system periodic testing and maintenance to be ensured to prevent major escalation scenario.
- Periodic cleaning to be ensured for flame arrestors of storage tanks to prevent any Blockage/LOC scenario.

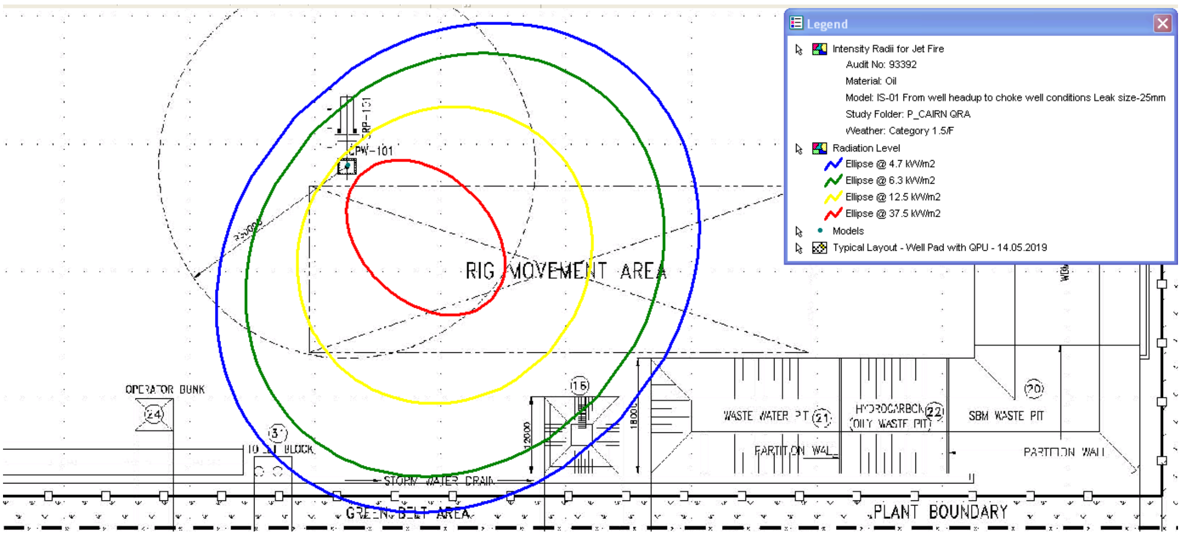


Figure 70. Jet fire Results (1.5/F) – IS-01 -25 mm Leak Size

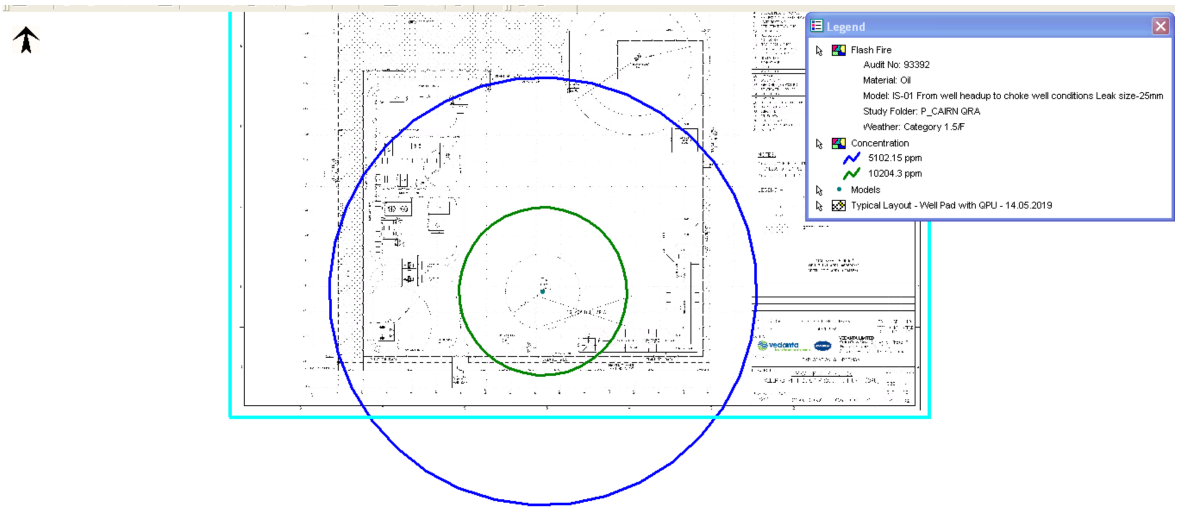


Figure 71. Flash Fire Result (1.5/F-IS-01-255 mm Leak Size)

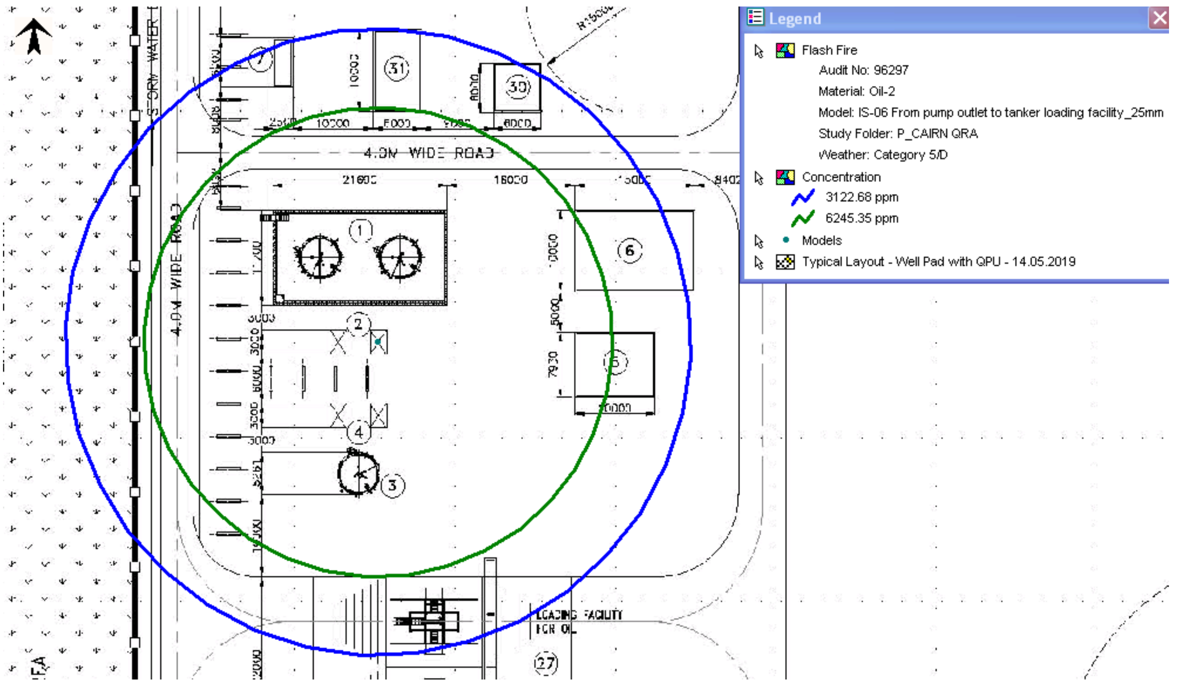


Figure 72. Flash Fire Results (%/D0-IS-06-25 mm Leak Size

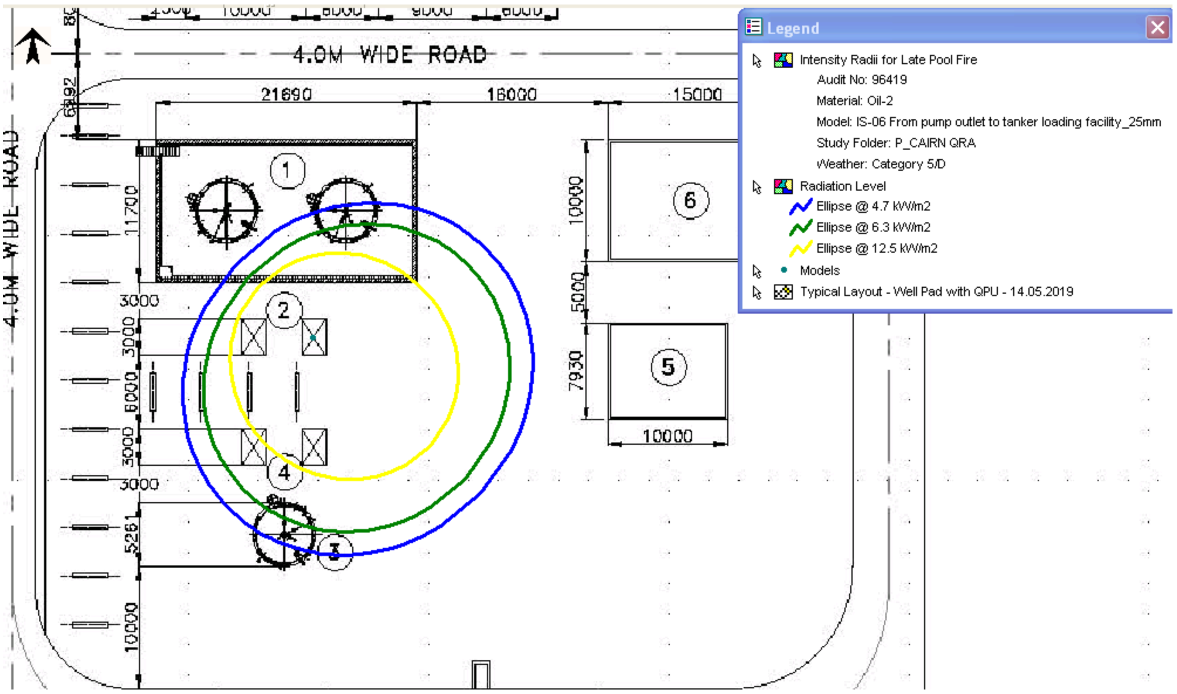


Figure 73. Pool fire Results (5/D) – IS-06 -25 mm Leak Size

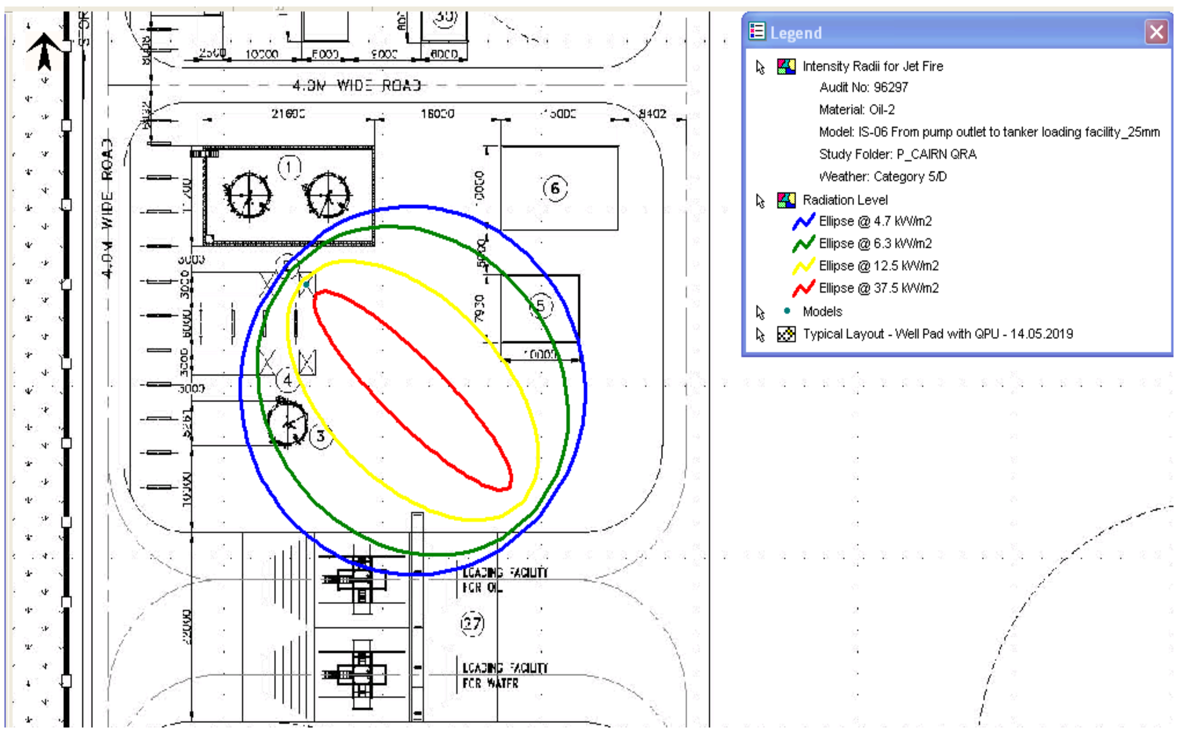


Figure 74. Jet fire Results (5/D) – IS-06 -25 mm Leak Size

7.3 Disaster Management Plan

In view of the hazardous nature of products / process handled in the project, Disaster Management Plans (DMPs) has been prepared. These plans are based on various probable scenarios like Well Blow Out, Fire, Explosion, Natural Calamities, etc. The consequence arising out of such incidents are accurately predicted with the help of latest technique available by various Risk Analysis Studies. To minimize the extent of damage consequent to any disaster and restoration of normalcy is the main purpose of DMP. The on site Emergency Plans would deal with handling of the emergency within boundary of the plants mainly with the help of industry's own resources. Also, when the damage extends to the neighbouring areas, affecting local population beyond boundaries of plant, Off-site Emergency plans would be put into action in which quick response and services of many agencies are involved e.g. District Authorities, Fire Services, Civil Defence, Medical, Police, Voluntary Organizations etc.

Objective of DMP

The following are the main objective of Disaster Management Plan:

- Safeguarding lives both at installations and in neighbourhood.
- Containing the incident & bringing it under control.
- Minimizing damage to property & environment.
- Resuscitation & treatment of causalities.
- Evacuating people to safe area.
- Identifying persons and to extend necessary welfare assistance to causalities.
- Finally, when situation is controlled, efforts are to be made to return to normal or near normal conditions.

Emergency Identified

Typical emergency situations which the Vedanta Ltd. (Cairn Oil & gas) business has identified that could occur within its field of operations are:

- Well Blowout
- Fire / Explosion

- Gas Leakage (H2S, Natural Gas, etc.)
- Natural disaster such as earthquake, floods, storms, etc.
- Human injuries from accidents, falls, etc.
- Motor vehicle, road incidents
- Security incidents such as hold-ups, kidnapping, bomb threats, etc

Emergency Classification - Tiers of Emergency Response

Response strategies shall be commensurate with the nature, scale and associated hazards and risks for relevant emergency event.

The emergencies are classified as Tier 1, 2 & 3. The examples of Tier 1, 2 and 3 incidents are given in table Table 7.12.

Table 7.12 Emergency Classification & Response Team

Emergency Levels	Category	Response	Health & Safety	Environment	Security / Community
Tier 1 Local Reactive	– A minor Incident where site / location team requires no external assistance and can control the incident with local resources – Incident Controller must notify the leader of the ERT or EMT as applicable	– Emergency Response Teams – (IRT)/(ERT)	– Minor medical or injury case requiring no external support – Equipment damage with loss of production – Minor fire with minor injury or plant damage – Rescue of trapped and injured personnel	– Minor oil spill < 100T(700b bls) – Onsite environmental Exposure contained with internal efforts e.g. chemical spill – Notification of cyclone within 72 hrs	– Minor security breach – Theft from site – Local unrest
Tier 2 Tactical	– Substantial Incident – EMT leader decides to activate EMT – EMT leader must notify CMT Leader	– Emergency Management Team – (EMT)	– Any incident requiring additional / external resources – Fire or Explosion – Injury or illness requires evacuation – Traffic accident requires external assistance – Well blow out	– Oil spill from >100T but <1000T (700–7000bbls) – Environmental exposure requiring outside help – Earthquake – Flood or Cyclone warning Yellow alert –within 12 hours	– Community protest or security breach – Major criminal activity
Tier 3 Strategic	– Crisis situation – CMT leader decides to activate CMT CMT leader must notify the Chief Executive Officer	– Crisis Management Team (CMT)	– Incident leading to loss of facility – Incident leading to significant financial loss – Incident leading to multiple injuries or fatality – Total loss of marine vessel / vessel hitting platform – Helicopter crash – Well blowout – Incident which could lead to international media interest – Major traffic incident with multiple casualties	– Oil spill more than 1000T (7000bbls) – Major Earthquake	– Terrorist activities /bomb threat – Kidnap or extortion /threat – Major civil unrest /community protest

On-site Emergency Response Plan

The Onsite & Offsite Disaster Management Plan (DMP) and Emergency Response Plan (ERP) are planned for facilities, which are also extended to proposed activities. The scope of the DMP On-site Emergency Preparedness Plan is to evaluate the various types of emergencies that can occur at rig installations and processing/production facilities (Drilling and Production activities) and to formulate emergency plans, procedures that can be implemented by Vedanta Ltd. (Cairn Oil & Gas) in house. In case the contingency exceed in dimension or geographical coverage beyond Vedanta Ltd. (Cairn Oil & Gas)'s capability, the offsite Emergency plan shall be activated concurrently with the help of District administration

Based on the incident classification and response team matrix mentioned above, Incident Response Team, Emergency Response Team and Emergency Management Team gets involved.

Tier 1 Incident Response Team (IRT):

- The emergency or incident can be effectively and safely managed, and contained within the site, location or facility by local staff.
- Emergency or incident has no impact outside the site, location or facility. IRT may provide support through effective interaction with local stakeholders.
- Loss of life or severe environmental damage or material loss of asset or organisation's reputation is not a consequence of event / emergency.

Tier 1 incidents are managed by Site IRT, each site has own IRT.

Tier 1 Emergency Response Team (ERT):

- The ERT provide assistance and local support to the IRT's in relevant area.
- The ERT have access to local outside site / external emergency services.
- For tier 2 emergency events.

Tier 2 Emergency Management Team (EMT)

- The incident cannot be effectively and safely managed or contained at the site location or facility by operational local staff and additional support is required.
- The incident is having or has potential of impact beyond the site, location or facility and external support may be required.
- Loss of life or severe environment damage or loss of asset or organisation's reputation is possible consequence of event / emergency.
- IRT may provide support through effective interactions with local stakeholders.
- ERT acts as interface between EMT and IRT for Midstream pipeline operations.

Tier 2 EMT is primarily for tactical response to the incident but may on occasions required to act in reactive mode.

Tier 3 Crisis Management Team (CMT):

- The incident has escalated to a level having potential of loss of life, adverse effect on public or company's operations / reputation.
- Incident may have requirement of immediate action / guidance from Top Management.

Tier 3 incidents are incident escalating to the point requiring involvement of CMT

Responsibilities of the Individual Response Organisations

The Incident Response Team is responsibility for managing all incidents and emergencies which may occur at or in close proximity to their operational area. For emergencies where additional / external support is required the person in charge of the incident response, the Incident Controller at a remote location, site or facility must notify and request support and assistance from the next level in the emergency management organisation. The ERT / EMT would be notified of all incidents within 30 minutes of the IRT activation at a remote location, site or facility.

The key role and responsibilities of the IRT Leader would be

- To manage the response to any and all incident or emergencies at the Site, Plant or Field Location
- To Control the incident by preventing escalation and minimizing risk to personnel
- Direct and coordinate the activities of the Incident Control and Forward Response Teams.
- Ensuring sufficient trained and competent personnel are available to support the Response Teams.
- Ensuring the safety of all personnel working at the Site, Plant or Field location
- Evaluate and initiate immediate actions, to contain and mitigate effects of the incident or emergency. Monitor the situation & determine need for evacuation.
- Establish head count and potential whereabouts of any missing personnel and if necessary prepare search, rescue and recovery plan.
- Follow Incident Response Plan and if required develop a plan of action to deal with the incident or emergency and communicating this plan to the IRT members

Emergency Management Team (EMT) – Tactical/Strategic Response
In the event of an incident or emergency the Emergency Management Team Leader would make a decision whether or not to mobilise the EMT. If the decision is taken to mobilise the EMT then all EMT duty personnel are required to proceed promptly to the Emergency Management Team Room and manage emergency in accordance with their role, responsibility and as directed by the duty EMT Leader. DOA shall be nominated for absence.

The EMT organisation has following roles and responsibilities:

- EMT Leader – In overall in-charge / team leader, responsible for Company's tactical response to all emergency situations in respective SBU. They are also responsible for reporting incidents to the regulating authorities.
- Human Resources Coordinator – Responsible for providing HR services advice and support
- Logistics Co-ordinator – Responsible for providing transport and logistics support as required
- Operation and Technical Coordinator – Responsible for providing operational and technical support and advice
- Finance – Responsible for providing financial support and advice.
- HSE Coordinator – Responsible for providing health, safety, environmental support and response.
- Recorder – Responsible for maintaining a timed log of key events and actions
- Security Coordinator – Responsible for providing security support advice and assisting others as required by EMT Leader

The above list identifies a number of key EMT roles, following additional supporting roles may be called on when as and when required, typical roles being:

- Air Medevac Nodal Officer – Responsible for facilitating air medevac.
- IT/Telecommunication Co-ordinator – Responsible for providing the EMT with technical support associated with the communications hardware and software
- Company Medical Officer – Responsible for providing advice and assistance on health and medical issues.
- Legal – Responsible for providing support on legal / regulatory aspects.
- Public Relation / Corp Com – Responsible for communication with media and external stake holders.
- Contractor's representatives – who may be called in to assist the EMT would the incident involve members of their organisation

Crisis Management Team (CMT) Roles
The Crisis Management Team is comprised of small core of senior executives. The CMT would collectively have responsibility for all major actions taken before; during, and after the crisis situation has occurred.

The role and responsibilities of the CMT would be:

- Select additional specialist resources to join the CMT or to advise the CMT during a crisis, depending on the nature of the crisis
- Develop and implement crisis management strategy
- Develop and communicate the operating mandate of the CMT to those with responsibility for the on-scene activities
- Nominate spokesperson to cover media interviews
- Establish contact and communicate with appropriate government or other agencies
- Prepare to coordinate business continuity and recovery strategy

Emergency Response Strategies / Evacuation Plan

Emergency response strategies (ERS) are the documented decisions on required emergency response measures for identified emergencies, based on risk evaluation and assessment process. It shall consider all statutory requirements applicable to the installations.

The objective of ERS is to identify the means to be used to secure adequate emergency response. It provides basis for monitoring of the adequacy of the emergency response measures so that they can be modified when essential. ERS would include appropriate standard of performance for response measures associated with each type of identified major accident hazard and installation specific factors.

ERS would include the following elements:

- Organisation
- Procedures
- Equipment
- Information
- Competency building measures (Training & refresher courses and Drills & exercises)
- The role of any other measure essential for achieving successful emergency response

Emergency response measures shall consider the available resources as below:

- Installation resources: They are immediately available on the installation and are under control of installation Manager / In-charge. These include personnel and equipment that can be assigned emergency role.
- Area resources: These resources are available on the installations in the vicinity, within same area and are not under control of Installation In-charge. The resources may be available within the Vedanta Ltd. (Cairn Oil & Gas) or available by a mutual aid or cooperation agreement.
- External resources: These resources are available by a mutual aid or cooperation agreement at regional, national or international level and include organisations, professional bodies and resource persons.

The general requirements as per Vedanta Technical Standard VED/CORP/SUST/TS 13 on Emergency and Crisis Management are:

- Crisis situations shall be managed centrally by Cairn Oil and Gas business, in accordance with the requirements outlined in the standard.
- SBU operations shall also have procedures in place to ensure crisis situations are escalated to Cairn Oil and Gas business and Vedanta Group as appropriate.
- Emergency situations shall be managed by SBU operations and reported to Cairn Oil and Gas business and Vedanta Group as appropriate.
- Incidents shall be managed at the SBU operation level and reported in accordance with SBU operations, Cairn Oil and Gas business, Vedanta Group and regulatory reporting requirements. Also refer Management Standard MS11 on Incident Reporting, Escalation and Investigation.
- Emergency Preparedness and Response Plans shall be developed, implemented and maintained at the SBU operation, Cairn Oil and Gas business and Group level to deal with incidents, emergencies and crisis situations.

Additional Vedanta Ltd. (Cairn Oil and Gas) requirements are:

- The objective of emergency response planning is to have clear written procedures for expected actions during anticipated emergencies. Emergency response plan includes operational and procedural requirements for various emergency scenarios that are relevant for the installation.
- Ensure that appropriate resources and incident / emergency response plans are prepared, practiced and available. The procedures shall include provision for emergency arrangements with contractors.
- Critical resources of emergency response would include:
  - Emergency power systems
  - Fire and gas detection systems
  - Active fire protection
  - Passive fire protection
  - Shutdown system
  - Explosion mitigation and protection systems
  - Evacuation, escape and rescue arrangements
- Business continuity and recovery programme (BCP) to be developed, implemented, tested and maintained. The BCP shall be risk-based, documented and communicated.
- Every Cairn business unit (including projects and offices) shall be covered by trained Incident and Emergency Management Teams who would manage and execute the emergency plans.
- All members of the emergency organisations would be trained and competent to perform their assigned role within the incident response (IRT) / emergency response (ERT) / emergency management (EMT).
- Arrangements for emergency medical treatment shall consider injuries to persons as a result of minor accidents & major accidental events, illness of persons on installation, transportation & evacuation of sick and injured personnel.
- Controlled medicines shall be stored in a secure place accessible only to those who are trained to administer these.
- The level of medical facilities and trained personnel provided would be in line with the requirements identified in emergency response strategy. Key points to be considered is identification of medical facilities / hospitals
- Emergency response plans shall comply with all relevant legislative and regulatory requirements to ensure emergency capabilities are maintained and achieved.
- Procedure for designing emergency response measures would be based on:
- Integration of emergency response with / into design and operations
- Automatic or remotely operated safety systems to mitigate the effects of an incident
- Emergency response organisation structure
- Wherever applicable offsite emergency response / disaster management plans shall be ensured.
- Essential safety system (such as control stations, temporary refuge, muster areas, fire pumps) shall be located where they are least likely to be affected by fires and explosions.
- Emergency shut down (ESD) system shall be designed such, that it is capable of fulfilling its function under the conditions of incident. If installation is in operation, the essential shutdown functions shall be available during maintenance activities, which affect the operation of the ESD system. ESD system shall contain facilities for testing of both input / output devices and internal functions.
- Evacuation and escape routes shall be provided from all areas of an installation where personnel may be expected to be present during their normal activities. Alternative means to allow persons to safely leave the installation in an emergency shall be provided.
- Evacuation and escape routes shall have adequate illumination with emergency lighting and shall be marked to ensure that 'they can be used during emergency conditions'. All escape routes shall be unobstructed (including vertical clearance) and readily accessible.

- Personal protective equipment for use in major accident hazards would be suitable for the circumstances in which it may have to be used and the individuals who may have to use it.
- PPE for use in an emergency would be for all persons on the installation for use in condition of fire, heat, gas release or smoke to enable them to reach muster areas, temporary refuges and evacuation or escape points. Those with specific emergency duties shall also be provided appropriate PPE for use like fire suits and breathing apparatus etc.
- During an emergency, security arrangements shall ensure that unauthorised persons do not enter the incident site by controlling assess and if need arises the area around the site can be evacuated and cordoned to ensure safety of the persons.
- Environmental emergency response would consider:
  - Oil-pollution control equipment that would be located on the installation
  - Environmental conditions that may be present when the equipment is deployed
  - Capacity of the oil recovery system
  - Characteristics of the oil / emulsion to be recovered
  - Means to identify the extent of the spill
  - Facilities to handle any recovered oil.
- International conventions have introduced the requirements to develop national plans for oil-spill response in offshore, and Offshore Assets / SBUs / Operations would ensure that their installations' emergency response plans are aligned with the national requirements.

Responsibilities of the Employees

The establishment and maintenance of best possible conditions of work is, no doubt, the responsibility of the Project Management. It is also necessary that each employee follows prescribed safe methods of work. He would take reasonable care for the health and safety of himself, or his fellow employees and of other persons who may be affected by his action at work. With this in mind, employees shall be trained to be health and safety conscious in the following aspects:

Report	Potential Hazards
Observe	Safety rules, procedures and codes of practice
Use	Tools and equipments with all care and responsibility
Participate	In safety training course when called upon to do so.
Make	Use Of safety suggestion schemes.
Take	An active and personal interest in promoting health and safety

Each unit shall identify and document the resources required to ensure the effective implementation of the emergency and crisis management procedures. Resource requirements shall meet the requirements of the Vedanta Management Standard MS01 on Leadership, Responsibilities and Resources. The following resources shall be considered and made available as necessary:

- Trained and competent personnel;
- Equipment and other materials including Personal Protective Equipment (PPE);
- Warning devices;
- Medical services, including personnel trained in first aid, and medical equipment that is appropriate to the type of operation;
- Emergency services support; and
- Emergency funding, along with an appropriate mechanism for delivering funds.

The capacity of external resources, such as local firefighting capacity, shall be assessed, and additional resources acquired and maintained at the operation where external resources are deemed insufficient.

The resources identified shall be maintained and tested on a regular basis, and their adequacy reviewed periodically.

Communication Systems

Emergency response relies upon effective and reliable communication between all personnel involved in response. Communication systems shall:

- Provide sufficient reliable information / alarm to personnel on the installation to enable them to take the appropriate emergency actions.
- Provide means for those on the installation to communicate with the person in overall charge.
- Provide reliable arrangements to allow the person in overall charge to communicate with all personnel on the installation regarding the nature of any emergency and the actions they are required to take.
- Provide reliable means to allow the person in overall charge to communicate with area and external resources who have a role in emergency response.
- Suitable equipment, information processing and procedures shall be in place to enable effective communications. The means of communication shall be selected based on the need for communication in likely scenarios including operational conditions under which they are to function like, noise, ambient conditions and susceptibility to damage. So far as reasonable, communication arrangements would remain available throughout the emergency
- Alarm signals used and their meanings would be described in the emergency response plan along with the procedures to be followed in the event of an alarm. Persons would be provided with adequate information to allow them to, initiate alarms where necessary, distinguish between alarms and respond to alarms.
- Adequate alarms and warning devices, along with other forms of communication, shall be maintained to reliably alert persons across the whole site in the event of an emergency.
- Independent secondary / back-up communications systems shall be provided in case the emergency incident makes the normal communication system inoperable.
- Ensure that the means are in place to alert to the connected installations, the local community / neighboring businesses in the event of an emergency that has the potential interface with them.

Training and Emergency Response Drills / Mock

All persons on the installation or in connected activities (including contractor's personnel) shall be trained periodically for emergency response and evacuation procedures. Training for employees having assigned roles in emergency response shall be completed before they are called upon to perform in real emergencies. Emergency response organisation structure (IRT/ERT/EMT/CMT) shall ensure command by competent persons, which can be maintained, so far as is practicable, throughout an emergency.

- Key persons such as the Installation Incharge and Shift Incharge / control room operator shall be assessed for required competence to perform emergencies duties before assigning of duties. As far as possible, assessment would be under simulated emergency conditions.
- Competency and training needs shall meet the requirements of the Vedanta management Standard MS06 on Competency, Training and Awareness
- An emergency response table top exercise / emergency response drill is a focused activity that places the participants in a simulated situation requiring them to function in the capacity that would be expected of them in a real event. Its purpose is to ensure preparedness by testing policies and plans and by training personnel. One objective of an exercise is to be able to identify problem areas for resolution/ corrective action before an actual emergency occurs.
- The drills need to address the readiness of personnel and their familiarity / proficiency with emergency equipment and procedures. All personnel on the installation involved including contractor's employees would participate in the drills.
- The drills and table top exercises shall be carried out as often as appropriate, against documented schedule. To be scheduled regularly, at least once a year for full drills and six monthly for desk-based exercises, although the exact frequency and type of drills may depend on the nature and scale of the operations, and the associated risks.

- Emergency response plan shall be reviewed and revised as appropriate in line with the findings from drills and table top exercises.
- Involve external emergency response agencies and other external stakeholders, where appropriate.

Performance Measures

- Key elements of functionality, survivability, reliability and availability shall be included in performance standards. Achievability of performance standards would be validated.
- Effective operations, inspection, testing and maintenance procedures shall be established to ensure that the functional requirements of the equipment and systems provided for emergency escape, evacuation and rescue response are maintained.
- A written scheme shall be prepared, detailing the inspection, testing and maintenance routines and frequencies to be followed. All emergency equipment and systems shall be thoroughly inspected, following established procedures. Adequate records of the results of the inspection, testing and maintenance shall be kept and shall be periodically reviewed to confirm that the written scheme is appropriate and is being adequately implemented.

Monitoring, Evaluation and Review

Documented reviews would be carried out after all drills and actual emergency responses to determine the effectiveness of the Emergency Preparedness and Response Plans, with a full debrief to identify what worked well and what aspects require improvement.

Lessons learned following exercises or actual emergency situations/incidents shall be documented, and any gaps in planning and implementation shall be addressed in revised versions of the Emergency Preparedness and Response Plans. Lessons learned shall be shared across Vedanta's operations where appropriate.

All Emergency Preparedness and Response Plans shall be reviewed and updated periodically, at least on an annual basis, to ensure they remain appropriate and relevant. Reviews shall also meet the requirements of the Vedanta Management Standard MS14 on Management Review and Continual Improvement.

Preventive and Mitigation Measures for Well Blow out

Blow-out (uncontrolled gushing of oil & gas) is the worst situation, which may arise at oil wells during drilling, work-over operations, perforation, and reservoir studies at active wells, etc. or due to some unforeseen reasons.

A blow out, though rare, in a drilling operation is often accompanied by fire and explosion exposing workers to serious danger to their lives, burns and poisoning. To understand the failure modes resulting to formation of kick and subsequent blow outs, one has to understand the safety systems installed for blow out prevention.

Prevention of blow outs rests primarily on control of any kick in the well bore. A kick means entry of formation fluids into well bore in large enough quantity to require shutting in the well under pressure. Once a kick is detected, steps can be taken to control entry of formation fluids into the well bore by over balancing the expected bottom hole pressure with properly conditioned mud and operation of safety valves i.e. Blow Out Preventer (BOP), whereby the space between the drill pipes and the casings can be closed and well itself shut off completely. Several instruments are provided on a drilling rig for detection of kicks.

Instrumentation in Mud System

Continuous monitoring of condition of mud in the well provides information useful for well control. The following processes are used in the drilling mud system for this purpose:

- A pit level indicator registering increase or decrease in drilling mud volume. It is connected with an audio-visual alarm near the drillers control panel.
- A trip with float-marking device to accurately measure the volume of mud going in to the well. This is useful to keep the well fed with required quantity of mud at all times.
- A gas detector or explosive meter installed at the primary shale shaker together with an audio-visual alarm at the drillers control panel to indicate the well presence of gas-cut mud in the well.
- The kick in the well is prevented by keeping the hydrostatic head of the drilling fluid greater than the formation pressure. The primary control can be lost in the following situations:

- If there is reduction in hydrostatic pressure in the well due to swabbing, which maybe caused if the drilling string is pulled out too fast or by a balled-up or clogged bit, which is indicated by insufficient filling of mud.

Preventive Measures for Handling Natural Gas

The natural gas is a colourless, odourless, flammable gas, mainly methane which may cause flash fire. Electrostatic charge may be generated by flow, agitation etc. No occupational exposure limits have been established for natural gas. The preventive measures to be taken to avoid impact due to leakages are

- Provide local exhaust ventilation system: Ventilation equipment would be explosion-resistant if explosive concentrations of material are present.
- Gloves: Wear appropriate chemical resistant gloves.
- Respirator: Under conditions of frequent use or heavy exposure, respiratory protection may be needed.

Leakage of H2S Gas

Hydrogen sulphide is a colourless, flammable, extremely hazardous gas with “rotten egg” smell. Low concentrations of H2S irritate the eyes, nose, throat and respiratory system e.g. burning / tearing of eyes, cough, and shortness of breath. Repeated or prolonged exposures may cause eye inflammation, headache, fatigue, irritability, insomnia, digestive disturbances and weight loss.

The preventive measures to be taken up in case of leakages are:

- Stop the source of leakage (i.e. close the well)
- Remove victim, if any to fresh air, if breathing, maintain victim at rest & administer oxygen, if available, if person is not breathing, start artificial respiration immediately or start mechanical/ automatic resuscitator. Call ambulance and sent victim to hospital or doctor.
- Avoid & extinguish all naked flames
- Pull out all inflammable material i.e. HSD, Gas Cylinders, Chemicals etc. from the premises of well / installation.
- Pull out all possible equipment to safe distances.
- Call for fire tender and start spraying water on the sources of leakage to dissolve H2S in water.
- Evacuate personnel in 500 mts area from down wind direction.
- Warn nearby inhabitants, if required.
- Cordon off the area & do not allow entry of any unauthorized person.

Vedanta Ltd. (Division Cairn Oil & Gas)’s operations in the Block have indicated that there is no naturally occurring H2S in the reservoir and therefore release of H2S during drilling operations is not expected.

Preventing Fire and Explosion Hazards

Fire is one of the major hazards, related to oil and natural gas well. Fire prevention and code enforcement is the area of responsibility of the fire service. Safe operating practices reduce the probability of an accidental fire on a platform. Personnel would understand their duties and responsibilities and be attentive to conditions that might lead to fire. The following precautions are recommended:

- Fire control cannot be achieved until the source of fuel and ignition is isolated. Fire control cannot be achieved until the source of fuel and ignition is isolated. An emergency shut down (ESD) system shall be provided to isolate the installation from the major hydrocarbon inventories within pipelines and reservoirs, which if released on failure, would pose an intolerable risk to personnel, environment and the equipment / assets.
- There would be provision for safe handling and storage of dirty rags, trash and waste oil. Flammable liquids and chemicals spilled on platform would be immediately cleaned.
- Containers of paints and HC samples, gas cylinders would be stored properly. Gas cylinders would be transported in hand-carts
- Cutting and welding operations would be conducted in accordance with safe procedures
- Smoking would be restricted to designated platform areas and “no smoking” areas would be clearly identified by warning signs

- Platform equipment would be maintained in good operating condition and kept free from external accumulation of dust and hydrocarbons. Particular attention would be given to crude oil pump, seals, diesel and gas engines which could be potential source of ignition in the event of a failure
- The Disaster Management Plan would address the issue of a fire event at any location on the well and the procedure to be adopted in the very unlikely event of this occurring. If a fire starts in any well, that section of the well would be isolated by closing the section (block) valves, as quickly as possible and surrounding facilities would be cooled with water.

Off-site Emergency Plan

The Off-Site Emergency Plan is a compilation of various emergency scenarios and also includes the probable impact off-site locations due to emergency and the action plan to combat / mitigate the consequences of a disaster situation. Emergency is a sudden unexpected event, which can cause serious damage to personnel life, property and environment as a whole, which necessitate evolving off-site emergency plan to combat any such eventuality. Emergencies can be handled by an organized multi-disciplinary approach. If it becomes necessary to evacuate people, then this can be done in orderly way.

Under the Environmental (Protection) Act 1986, the responsibility of preparation of Off-Site Emergency Plan lies with the State Government. The Collector/ Deputy Collector by virtue of their occupation are normally nominated by the concerned State Government to plan Off-Site Emergency Plan. The different agencies involved in evacuation of people are civil administration (both state and central) and police authorities.

Purpose

- To save life and prevent/reduce loss of properties
- To make explicit inter related set of actions to be undertaken in the event of an accident posing hazards to the community
- To plan for rescue and recuperation of casualties and injuries. To plan for relief and rehabilitation
- To plan for prevention of harms, total loss and recurrence of disaster. It would be ensured that absolute safety and security is achieved within the shortest time

The activities of the government, Non-Government organizations and concerned personnel involved in off-site disaster management plan are as follows:

These would include the safety procedures to be followed during emergencies such as posters, talks and mass media in different languages including local language. Leaflets containing do's/ don'ts would be circulated to educate the people in vicinity

Medical Help consisted of doctors and supporting staff for medical help to the injured persons because of disaster would be formed. Functions and duties of the committee include, providing first Said treatment for injured at the spot or at some convenient place and shift those to nearby hospitals for further treatment if required

The police would assist in controlling of the accident site, organizing evacuation and shifting of injured people to nearby hospitals.

The fire brigade shall organize to put out fires other than gas fires and provide assistance as required. Approach roads to accident site and means of escape would be properly identified. Chief fire officer would co-ordinate entire fire control measures. Routine training of fire fighting equipment and special rescue equipment would be carried out. Concerned officer would ensure adequate supply of fire water and fire fighting agents at the site of emergency. Maintenance of standby equipment / personnel for fire fighting would be ready at any given time.

Mutual Aid

Disaster / emergency / risk, when becomes difficult to control by in house team / management, help from nearby industries, institutions, etc. can be taken. A group of mutual aid can be formed where emergency control systems like ambulance, fire fighting equipments, medical & fire-fighting team, etc. can be shared in the event of need.

Post Emergency Relief to the Victims

The Public Liability Insurance (PLI) Act, 1991 provides for the owner who has control over handling hazardous substances to pay specified amount of money to the victims as interim relief by taking insurance policy for this purpose. The District Collector has definite role in implementation of this act. After proper assessment of the incident, he shall invite applications for relief, conduct an enquiry into the claims and arrange payment of the relief amount to the victims.

General Health and Safety

The project would adhere to health & safety norms of The Factories Act, 1948 and Assam Factory Rules, 1950, as applicable along with Best Industry Practices.

General health and safety issues during various project activities are similar to those of most large infrastructure and industrial facilities and their prevention and control. These issues include among others, exposure to dust and hazardous materials, hazardous materials components, and physical hazards associated with the use of heavy equipment, etc.

Specific health and safety issues primarily include the following:

- Physical hazards
- Chemical hazards
- Confined spaces

Physical Hazards - The main sources of physical hazards are associated with machinery and vehicles. General electrical equipment safety, working in confined spaces, hot work, high temperature areas are expected to be present.

Chemical Hazards - workers may be exposed to chemical hazards especially if their work entails direct contact with fuels or chemicals, flare & DG set emission or depending on the nature of activities. Work with fuels may present a risk of exposure to volatile organic compounds (VOC) via inhalation or skin contact during normal use or in the case of spills.

Noise - Noise sources include drilling, DG operations, including vehicular traffic, and boats. In order to evaluate the impacts of proposed project on the health of workers, baseline health studies would be carried out on every worker before joining their duties.

The hierarchy of control specific for health & safety (in order of priority):

- Eliminate the use of a harmful product or substance and use a safer one;
- Substituting wherever reasonably practicable, a non-hazardous material which presents no risk to health, where a hazardous material is used intentionally, i.e. use a safer form of the product;
- Modifying a process to eliminate the use of risk, the production of a hazardous by-product or waste product, including reducing the quantities of the hazardous material which are used & stored, i.e. change the process to emit less of the substance;
- Enclose the process so that the product does not escape;
- Extract emissions of the substance near the source;
- Provide personal protective equipment (PPE) such as gloves, coveralls and a respirator. PPE must fit the wearer.

Personal Protective Equipment

Often it is not possible, or practicable, to eliminate exposure to materials hazardous to health completely. In such cases, operations would consider how to prevent employees being exposed and the prevention of exposure would be achieved by measures other than the use of PPE or Respiratory Protective Equipment (RPE), which is the last line of defence.

Situations where PPE/RPE would normally be necessary include:

- where adequate control of exposure cannot be achieved solely by good practice and the application of operational or engineering measures;
- where new or revised assessment shows that PPE/RPE is necessary until adequate control is achieved by other means;
- where there is temporary failure to achieve adequate control of the process, e.g. because of plant failure, and the only practicable solution to maintain adequate control in the time available may be the provision and use of suitable PPE/RPE; and
- where maintenance operations have to be carried out.

Key personal protective equipments would include:

- Body suit
- Hand gloves
- Helmet
- Safety shoes
- Safety harness
- Breathing apparatus
- Eye shield
- Ear muffs

First Aid

Medical services, including personnel trained in first aid, and medical equipment that is appropriate to the type of operation would be provided at project.

All persons on an installation would have at least basic training in emergency response, basic first aid, use of life saving appliances and firefighting. Individual competencies shall be periodically tested to identify further requirement of training and knowledge to perform emergency duties.

It would be ensured that any auxiliary medical teams e.g. nurses and first aid personnel are fully trained and conversant with their roles and responsibilities.

Contact details & capacities of nearby medical facilities and medical experts would be made available at strategic locations.

Disaster Management Plan for Natural Hazard

A disaster is an event that causes the sudden disruption to the normal life of a society and causes damage to property and lives, to such an extent that normal social and economic mechanisms available to the society are inadequate to restore normalcy. Preparedness for natural disaster alleviates human misery. Though no amount of preparedness is enough, an attempt is made through this plan to negotiate with all the probable hazards in the district and their aftermath.

Vulnerability of the Golaghat District towards disasters, both natural and man- made is widely recognized. The district is vulnerable towards natural disasters like; Earthquakes and floods, and man-made disasters such as fire.

Earthquake

The study area falls in the Earthquake Hazard Zone V (reference Vulnerability Atlas of India; 2nd Edn), which indicates the highest risks zone that suffers earthquakes of intensity MSK IX or greater. The region has experienced a large number of earthquakes of tectonic origin. The risk probabilities of earthquake are less over the entire Brahmaputra valley. The region of Northeast India is seismically very active. Though Golaghat district has not experienced any major earthquake in recent past causing damage to lives or infrastructure, the possibility can never be ruled out as it can happen any time. Two major earthquakes have been recorded in the region. The first is in 1897 of magnitude 8.7 and in 1950 of magnitude 8.6 causing large scale damage of lives and properties in this region.

Occurrence of earthquakes leads to loss of human life, livestock and infrastructure. The vulnerable areas in the region are structural damage at town areas and probability of flood in villages near banks of river Brahmaputra & Dhansiri if damage occurs at embankments or change in river course.

General awareness and wide dissemination of do’s and don’ts through electronic and print media issued by state disaster management agency would be followed.

Floods

During rainy seasons, all the major rivers in the district carry water which pose potential threat of flood. The heavy rainfall in the catchment areas of the district causes the rising of water level above the danger level. The floods are caused by the runoff of extremely heavy rainfall during the monsoon and high sediment loads from upper watersheds that are geologically unstable and degraded because of deforestation and changing land use. The flood combined with river erosion has significant impacts each year.

IMD and other government department warnings would be monitored and in case of any such warning, relevant steps as guided by on site disaster management plan would be followed. Instruction given by key departments like IMD, district disaster management center, etc. to be followed

Storms

Golaghat district is highly vulnerable to storm and is a regular occurance. Storms generally bring in their trail heavy rains with hailstones causing damage to property and crops. Storms cause heavy damage to crops and vegetations. Secondary hazards like snapping of electric poles due to uprooting of trees, disruption of communication links, etc. are also attributed to hailstorms. Frost is a regular feature in many parts of Assam. Measure like avoiding travelling, clearing of area, etc. would be taken along with on site disaster management plan.

Natural hazards can be minimized by the presence of a well functioning communication / warning system. A well prepared administration needs to have its communication/early warning system in place to enable precautionary & mitigation measures on receiving warning for impending disasters and in the process minimise loss of life & property.

Data from different reliable sources would collected and monitored in real or near real time and analysed to generate a warning alert in the event of likelihood of a disaster.

- The Indian Meteorological Department (IMD) would be the nodal agency for the monitoring of seismic activity, flood, etc.
- Tie up / contacts / communication with Assam State Disaster Management Authority (ASDMA), District Disaster Management Centre would be maintained. There is an office of DDMC at Golaghat who has to be contacted as part of off-site DMP.
- Local Search and Rescue Team at the local level comprising of retired Army and Police personnel, Civil Defence and Home Guard, volunteers can be identified and trained to perform initial search and rescue operations.
- Apart from the above, Community volunteers/ representatives would be identified and trained on search and rescue operations through Community Based Disaster Management programme.
- Disaster Management and Relief Department website/ communication along with other line departments like fire, police, health, etc. would be checked

8. PROJECT BENEEFITS

The proposed project would establish the potential of hydrocarbons in the Block. The development of the oil Block would result in considerable growth of service sector and would also generate direct/indirect employment and business opportunities in the area. The major benefits of the project include reduction of the oil import bill of the nation as well as reduction of the imbalance in oil production and consumption.

The commercial development would also lead to investment in Assam, bringing oil and gas revenues both to the State and to the Central Government. The presence of Vedanta Limited (Division: Cairn Oil & Gas) in the region would substantially improve the socio-economic conditions of the region. Employment opportunity for local people as contract/daily wages in nearby areas.

8.1 Revenue Earning of central & State Government

Vedanta Limited (Division Cairn Oil & Gas) has been alloted with an exploration Block in Assam Basin, namely AA-ONHP-2017/01 by Government of India under the Revenue Sharing Contract (RSC) for exploration and exploitation of hydrocarbon. A Revenue Sharing Contract (RSC) was signed between the Government of India (GoI) and Vedanta Limited on 1st October 2018.

Due to hydrocarbon discovery and then its production, use & sell, central as well as state government would get benefited.

8.2 Employment Potential

The employment of local people in primary and secondary sectors of project shall upgrade the prosperity of the region. This in-turn would improve the socio-economic conditions of the area.

- In case the hydrocarbon is established in the Block, considerable number of people would be benefited by provision of services to the residents including hotels, restaurants, transport services etc. Thus, the direct and indirect employment generation by this project.

8.3 Corporate Social Responsibility

- Vedanta Limited (Division Cairn Oil & Gas) has taken up various CSR initiatives in and around its present operational areas as per the CSR Act and Rules, Govt. of India.
- CSR measures would be taken up by Vedanta Limited. (Division Cairn Oil & Gas) in case of commercially viable hydrocarbon discovery & further full-fledged development of the hydrocarbon block and production and associated facilities.

8.4 Proposed CER Strategy

The company would comply with the 1st May 2018 OM w.r.t. CER and the cost would be assessed on actual project capex expenditure of that particular financial year.

9. ENVIRONMENT MANAGEMENT PLAN

This section describes the Environmental Management Plan(EMP) for the proposed project.

- The EMP is aimed at managing the environmental parameters in a sustainable manner. The EMP section is organized as follows:
- Organizational structure for HSE management– This subsection describes the current HSE organization in Vedanta Limited (Division Cairn Oil and Gas) which would be responsible for implementing this EMP.
- Proposed Environmental Management Plan – This Plan consists of a detailed description of the positive and negative environmental impacts anticipated from the proposed project, mitigation/ management measures and the persons/ parties responsible for ensuring implementation of such measures.
- Additional Plans - Additional plans such as Waste Management Plan, Oil Spill Response Plan have also been provided.
- EMP implementation review process – This subsection describes the requirements for periodic review and updating of the EMP to address any new impacts due to change or modification of the project.
- Budgetary allocation for EMP implementation – Provides the details of budget allocation for the various mitigation measures proposed for the Project.

9.1 Organization Structure for HSE Management

Vedanta Limited (Division Cairn Oil & Gas) has formulated a Health, Safety and Environment (HSE) Policy for its operations. Through the HSE Policy, Vedanta Limited (Division: Cairn Oil and Gas) is committed to protect the health and safety of everyone involved in its operations, and the sustainability of the environment in which it operates. Vedanta Limited (Division Cairn Oil & Gas) strives for continual improvement and the adoption of international codes and standards. Vedanta Limited (Division Cairn Oil & Gas) aims at ensuring that all its operations comply with applicable health, safety and environmental laws, regulations and other requirements. Organizational structure and HSE policy of Vedanta Limited (Division Cairn Oil and Gas) is presented in Figure 73 and Figure 75.

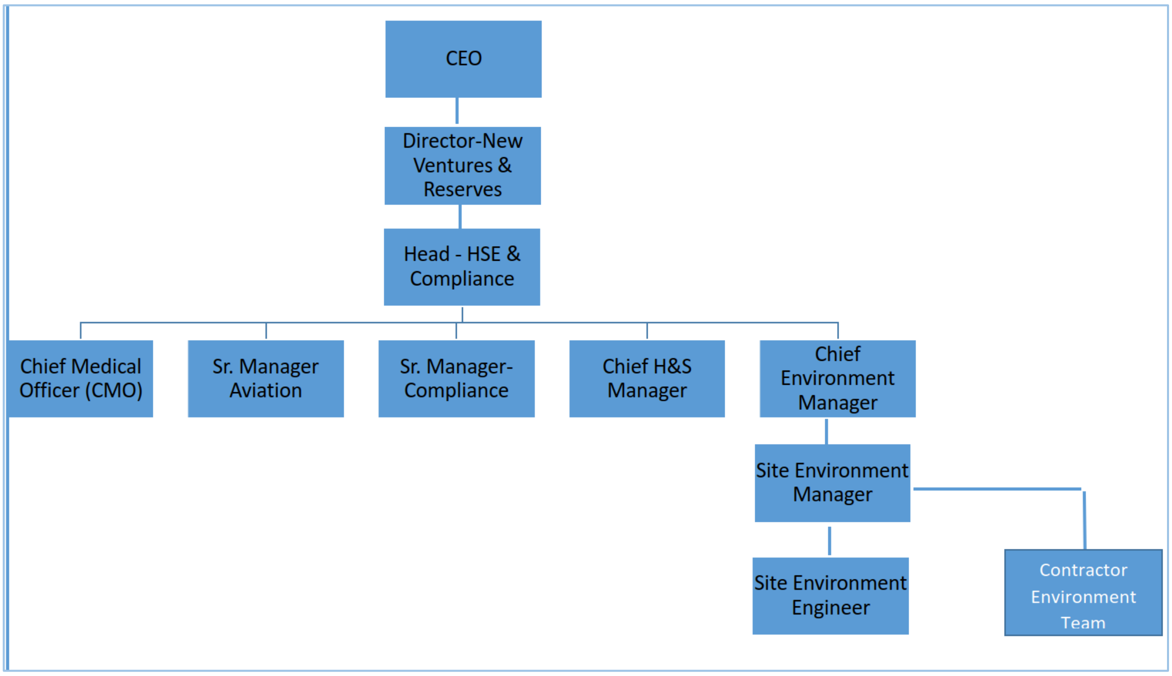


Figure 75. Vendanta Limited (Division: Cairn Oil and Gas) HSE organizational structure for implementation of EMP.

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HSE Policy

At Vedanta Resources Plc, we believe in sustainable development and are committed to effective management of health, safety and the environment as an integral part of our business. The health and safety of our employees and stakeholders who may be impacted by the company's operations is of paramount importance and our aim is zero harm to people and to the environment.

Vedanta Resources and its subsidiaries strive to:

- Comply with applicable national, regional and local Health, Safety and Environment ('HSE') regulations and statutory obligations and other requirements as appropriate. The company develops, implements and maintains HSE management systems aligned with our sustainable commitments and beliefs and consistent with world-class standards. We will drive continuous improvement in HSE through setting and reviewing targets, assessing and reporting HSE performance, using appropriate best available practices and providing all employees with appropriate training;
- Prevent injury and ill health to the company's employees and contractor' s employee's by providing a safe and healthy work environment and by minimising risks associated with occupational hazards;
- Improve and enhance environmental conditions and avoid, reduce, mitigate or compensate the environmental impacts to neighbouring communities in which we operate including air, water emissions and noise;
- Conserve natural resources, through adopting environmentally friendly and energy efficient technology and process improvements. The Company is committed to managing waste of our operations and we adopt the principles of waste avoidance, reuse, recycling and beneficial utilisation to minimise discharge and disposal to the environment;
- Promote a positive HSE culture within our organisation through effective communication, participation and consultation with employees in the workplace;
- Implement regular health surveillance and risk-based monitoring of all employees;
- Influence our contractors and suppliers to adopt principles and practices adopted by us and in accordance with our own policies;
- Communicate with all our stakeholders on the progress and performance of HSE management.

Vedanta Ltd. and Konkola Copper Mines (KCM) the wholly owned subsidiaries of Vedanta Resources sign this policy, which is implemented throughout their businesses. The content and robustness of implementation of this policy will be reviewed periodically and revised accordingly, and includes sharing best practices throughout the group.

We will also measure progress against this policy and review performance on a periodic basis to ensure ongoing management of Health, Safety and Environment.

Signed by:

Tom Albanese
Group CEO, Vedanta Resources plc

Date: *1st April 2014*

Figure 76. HSE Policy of Vedanta Limited

Ensure effective implementation of the Environmental Management Plan (EMP) through review and periodic updation;

Vedanta Limited (Division: Cairn Oil and Gas) would have the ultimate responsibility of implementing the environment management plan along with drilling contractor. The drilling contractor would have an HSE management system, which would be reviewed by Vedanta Limited (Division: Cairn oil and Gas) prior to implementation.

9.2 Air Quality Management Plan:

The Air Quality Management Plan (AQMP) encompasses both constructions, drilling and early production phase activities for the proposed project that has the potential to adversely affect ambient air quality due to the proposed project.

The AQMP establishes specific measures and guidelines aimed at effectively addressing and mitigating the air quality impacts that may arise as result of construction of well sites and Early production, drilling operations, operation of early production unit and decommissioning/site closure of well sites. The plan also details out roles and responsibilities of Vedanta Limited (Division: Cairn Oil & Gas) and the contractors to ensure effective implementation of the plan.

Mitigation Measures:

Phase	Mitigation Measures
Construction/ drill Site Preparation	**Designing, Planning & Procurement** • Storage and handling of construction material and debris to be carefully managed to prevent generation of fugitive dust; • All vehicles use in transportation of raw material and personnel would have valid Pollution under Control Certificate (PUC). Vehicular exhaust would be complying with the CPCB specified emission norms for vehicular Emission; • The top soil stripped from site preparation activities would be stored suitably; • Adequate stack height will be provided to DG sets in accordance with CPCB standards. **Dust Suppression** • Sprinkling of water on earthworks, material haulage and transportation routes on a regular basis, especially in dry season.
Drilling and early production facilities	**Operation of Machineries, Vehicle & Drilling Rig** • Exhausts of diesel/Gas generators would be positioned at a sufficient height to ensure dispersal of exhaust emissions; engines would not be left running unnecessarily; • Vehicles involved in the transportation of project personnel would have valid PUC Certificate and would be subjected to periodic preventive maintenance; Periodic Maintenance of Machinery and Vehicles • Preventive maintenance of GEG/DG sets would be undertaken; • Flaring would be undertaken in accordance with the CPCB Guidelines for Gaseous Emissions for Oil & Gas;

9.3 Waste Management Plan

The Waste Management Plan (WMP) is applicable for all process and non-process waste streams which are generated during various phases of Vedanta Limited (Division: Cairn Oil & Gas) proposed drilling and testing of hydrocarbons in this block. The major waste streams covered under this plan includes drill cuttings, waste drilling mud, drilling wash water, kitchen waste and sewage. In addition, waste oil and lead acid batteries generated from the proposed project operations have also been dealt in this plan.

The WMP establishes specific measures to ensure proper collection, storage, treatment and disposal of the identified process and non-process waste streams in accordance with the applicable national regulations and guidelines and also to ensure compliance with Vedanta Limited (Division: Cairn Oil & Gas) corporate HSE Policy. The plan also outlines roles and responsibilities of both Vedanta Limited (Division: Cairn Oil & Gas) and the contractors involved in the implementation of the plan.

Mitigation Measures

The following mitigation measures need to be adopted and implemented by Vedanta Limited (Division: Cairn Oil & Gas) and its contractors for the major waste streams identified in the plan.

Waste	Quantity	Mitigation Measure
Drill Cuttings	Drill cuttings associated with WBM: 250-750 tons/well, Drill Cuttings associated with SBM (500-1500 tons/well)	• Drill cuttings separated from drilling fluid would be adequately washed and temporarily stored and disposed in an impervious pit lined by High Density Poly Ethelyn (HDPE) • All drill cuttings would be disposed as per Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016;
Spent WBM	250 – 500 tons/well	• The mud would be disposed as per CPCB standard prescribed for Oil and Gas industry or as specified by Assam SPCB
Waste oil/ Used oil	1-2 tons/well	• Hazardous waste (waste and used oil) would be managed in accordance with Hazardous Waste (Management, Handling & Transboundary Movement) Rules, 2008. • This oil would be sent to authorized recyclers.
Municipal Solid Waste	25-30 kg/well	• The waste would be segregated at source (organic/inorganic) and disposed accordingly. • All kinds of waste would be disposed in accordance with the requirement of CPCB/Assam SPCB
Sewage	16-25 m^3/day per well	• Sewage generated from campsite would be treated through mobile STP. • Treated waste water would be used for dust suppression, green belt, landscape, etc
Recyclables *viz*. paper, plastic, packaging waste etc.	Depending on usage	• Proper segregation and storage of recyclable waste in designated bins. • Recyclables would be periodically sold to local waste recyclers.
Non-combustible waste containing metallic residues	1000-1200 kg/well	• To be analysed for the trace/heavy metals content before disposing suitably
Left over chemicals and materials, scrap metal	250 - 500 kg/well	• Scrap metal and recoverable material to the salvages before dispose of balance material through the registered vendors
Cement, grit, blasting and painting wastes	500 - 600 kg/well	• To be disposed of their registered vendors on periodic basis.

9.4 Soil Quality Management Plan

Soil Quality Management Plan is applicable for construction of well sites, drilling operations, operation of early production facilities and decommissioning/site closure that has the potential to adversely impact the soil quality.

Mitigation Measures

Project Phase	Mitigation measures
Site Preparation	• Use appropriate machinery and/or protective boarding during top soil stripping to ensure minimum compaction. • Top soil would be stored properly. • Drip trays would be used during vehicular/equipment maintenance and during refueling operations. • In case of a spill, the spilled soil is would be removed and disposed as per rule.
Drilling	• Fuel and chemical storage areas would be paved and properly bunded. • Spill kits would be made available at all fuel and chemical storage areas. • Drip pans/trays would be used in areas identified having spillage potential but not limited to drill rig engine; electric generator engine; pumps or other motors; maintenance areas; fuel transfer areas. • In case of a spill, the spilled soil is to be removed • Management of drill cuttings, waste drilling mud, waste oil and domestic waste would be made in accordance with "*Waste Management Plan*"
Decommissioning/Site Closure	• Decommissioning at the end of project life/drilling would have some adverse impacts in terms of increase in soil erosion and would require adequate mitigation measures to minimize any adverse impacts. The mitigation measures would be similar to those outlined for construction /site preparation phase activities as discussed earlier.

9.5 Spill / Release Management Plan

Potential spill / release scenarios

The following section details the potential spill scenarios associated with the drilling activities as well as the oil spill incident responses. Spill incidents from drilling activities can be classified into three types based on the level of response required. A description of the three types are as follows:

Type 1

A small oil or chemical spill incident which can respond to and can be controlled with the existing resources, equipment and resources at the site and without any further escalation. Most of the potential drill stage spill risks are Type 1. As the spill / release incident as the volumes involved are limited due to the extent of hydrocarbons or chemicals used or stored at site. Such possible incidents are likely to include:

- Diesel spills from refuelling i.e., drill rig - hose leaks, overfilling or connection/disconnection incidents.
- The use of liquid chemicals i.e., during drilling the volumes are limited by the storage containers used, drums etc.

- Hydraulic oil spill resulting from a split hydraulic hose or failed connector (moderate pressure, low volume lines).
- Drilling fluid leaks from tanks, pumps or other associated equipment within the closed loop recirculation system.

Type 2

Type 2 spill / release incidents are those that are beyond capability of the immediate resources on-site to effectively manage and contain, requiring additional external resources to assist with the response to the spill incident. Type 2 spill incidents may require initiate Emergency operations and would involve call out of the Fire Service (in the event of danger to people) and/or regional resources. For such potential spill incidents, the resources of the local administration or suppliers may be required. Such possible incidents are likely to include:

- Transportation incidents associated with the delivery of diesel or drilling fluids to site i.e., truck rollover or collision from external suppliers (drilling fluids and diesel).
- Complete failure of an on-site drilling fluid (base oil) storage tank(s).

Type 3

Type 3 spill / release incidents are significant spill incidents that escalate from a Type 1 or 2 and exceed the capabilities of the on-site and local administrative resources to respond, requiring a State /National response. An uncontrollable well blow out scenario would fall into this category.

Spill / Release Response Strategies

Spill / release response strategies for combating spill / release incidents include:

- Prevent or reduce further spillage.
- Monitoring and evaluation (no active intervention but the spill is under observation).
- Mechanical containment and recovery.
- Any combination of the above strategies.

A brief explanation of these various response strategies is provided in the following sections.

Prevent or reduce a spill / release incident

One of the first response actions, if safe to do so, is the isolation or prevention of the source of the spill / release in an attempt to limit any further discharge. Such first response actions can involve an emergency shutdown of the particular equipment, isolation of a valve or line causing the spill or providing some immediate containment to prevent the further spread of a spill / release. Such measures are only a first immediate response prior to a more coordinate effort being planned and undertaken.

Monitoring and Evaluation

Knowing the position of spillage / release source and having the ability to forecast its movement or direction is an essential component of spill response. Monitoring and evaluation is used to:

- Determine the location and movement of the spill / release (if any).
- Describe its appearance.
- Estimate the size and quantity of the spill / release
- Note changes in the appearance and distribution of the spill over time.
- Assess the potential threat to the environment and the resources required to combat the spill / release (more effective and coordinate response)

Mechanical Containment and Recovery

Mechanical containment and recovery is the restriction of a spill / release movement through the use of booms or some other form of physical barriers and its subsequent removal using skimmers and other mechanical means.

These operations may be required for large spills or spills / release which may impact environmentally sensitive areas. This response option would be used if the spill / release:

- Threatens environmental sensitive areas, or
- The spill is unlikely to be removed by natural processes.

The feasibility of a containment and recovery response is dependent upon having surface pollution that is capable of being contained and recovered and having suitable conditions for equipment deployment. The spill containment plan shall be addressed in line with the recommendation of QRA analysis as prescribed in chapter 7.

Waste Management

Spill response operations have the potential to generate liquid and solid wastes, if there are clean-up operations. The types and quantities of waste material largely depend on the amount of liquid material spilt and the specific clean-up methods employed. Disposal options for oily wastewater may include high temperature incineration, bioremediation or disposal at secured landfill sites. Any disposal option selected would need to comply with the the Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016.

9.6 Noise quality Management Plan

The noise control plan is applicable for construction of well sites, early production system, drilling operations and decommissioning/site closure of well sites.

The noise control plan to ensure specific measures to minimize noise levels in the project site as 75 dB(A) per CPCB noise rules. The plan also outlines roles and responsibilities of both Vedanta Limited (Division Cairn Oil & Gas) and the contractors involved in the implementation of the plan.

Mitigation Measures

Project Phase	Mitigation measures
Site Preparation	• Selection and use of low noise generating equipment equipped with engineering controls *viz*. mufflers, silencers etc. • All vehicles utilized in transportation of raw material and personnel would have valid Pollution under Control (PUC) Certificate • Periodic preventive maintenance of vehicles • All high noise generating equipment would be identified and subjected to periodic preventive maintenance. • Engines of vehicles and construction equipment would be turned off when not in use for long periods.
Drilling	• Siting of drilling rig and facilities at safe distance from sensitive receptors *viz*. schools, settlements etc • Installing acoustic enclosures and muffler on engine exhaust of DG sets to ensure compliance with generator noise limits specified by CPCB.

Project Phase	Mitigation measures
Decommissioning/Site Closure	• Management measures to address noise impacts with respect to operation of heavy equipment/machinery and movement of vehicles during decommissioning/site closure phase are similar to those discussed in the "Construction Phase"/site preparation of this section

9.7 Surface Water Quality Management

The Surface Water Quality Management Plan is applicable during construction of well sites, early production system, drilling operations, operation of early production facilities and decommissioning/site closure of well sites that has the potential to adversely affect the surface water quality.

The Surface Water Quality Management Plan establishes specific measures and guidelines aimed at addressing and mitigation of surface water quality impacts that may arise at different phases of the project.

Project Phase	Mitigation measures
Site Preparation	• During site preparation surface water run-off would be managed through implementation of proper drainage system.
Drilling	• Drip trays would be used during preventive maintenance of rig installations, vehicles and machinery. • Hazardous chemicals and fuel container would be stored in bunded and lined area equipped with proper spill control equipment and secondary containment.
Decommissioning/Site Closure	• No significant impacts to surface water quality can be associated with activities during decommissioning/site closure phase. Any possible impacts that may arise due to surface run-off would be mitigated in manner similar to that discussed during construction / site preparation phase activities.

9.8 Ground Water Quality Management Plan

Ground Water Quality Management Plan is applicable for construction of well sites and drilling operations, operation of early production facilities and decommissioning/site closure of well sites that has the potential to adversely affect the ground water quality.

Project Phase	Mitigation measures
Construction/site preparation	• No significant impact on the ground water quality can be associated with the construction phase/ site preparation activities
Drilling	• Proper casing and cementing of well would be done. • Periodic monitoring of ground water quality would be carried out

Project Phase	Mitigation measures
	• Storage and disposal of drill cutting and waste mud to be planned in accordance with "*Solid & Hazardous Waste Management Plan*"
Decommissioning/Site Closure	• No significant impacts to ground water quality can be associated with activities during decommissioning/site closure phase

9.9 Storm Water Management Plan

The following mitigation measures need to be adopted and implemented by Vedanta Limited (Division Cairn Oil & Gas) and its contractors in construction, operation and decommissioning phase.

- Necessary measures would be undertaken during construction/ site preparation phase to prevent earth and stone material from blocking cross drainage structures.
- Periodic cleaning would be undertaken to cross drainage structures and road drainage system to maintain uninterrupted storm water flow.

9.10 Road Safety & Traffic Management Plan

Road Safety & Traffic Management Plan outlines specific measures would adopted and implemented by Vedanta Limited (Division: Cairn Oil & Gas) to mitigate any potential impact on community health and safety that may arise out of movement of vehicles and transportation of drilling rig and other heavy equipment during construction, drilling and decommissioning of well sites.

Mitigation Measures

- Proper signage would be displayed at important traffic junctions along the predefined access routes.
- Traffic flows would be scheduled wherever practicable during period of increased commuter movement;
- Adequate training on traffic and road safety operations would be imparted to the drivers of project vehicles.

9.11 Occupational Health & Safety Management Plan

The Occupation Health & Safety Management Plan (OHSMP) has been formulated to address the occupational health and safety related impacts that may arise from proposed project activities viz. drilling and testing, operation of construction machinery/equipment, storage and handling of fuel and chemicals, and decommissioning/site closure.

Mitigation Measures

The following mitigation measure need to be adopted and implemented by Vedanta Limited (Division: Cairn Oil & Gas) and its contractors in construction, drilling, and early production and decommissioning phase.

- All workers would be provided with proper PPEs viz. safety boots, masks, protected glass etc.
- Provision of ear plugs/ear muffs etc. and rotation of workers operating near high noise generating areas, would be ensured.
- Hazardous and risk prone areas, installations, materials, safety measures, emergency exits, etc. would be appropriately marked in every conspicuous location.
- All chemicals and hazardous materials storage container would 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.

- Workplace to be equipped with fire detectors, alarm systems and fire-fighting equipment as per the requirement. Equipment shall be periodically inspected and maintained to keep in good working condition.
- Adequate sanitation facilities would be provided.
- Garbage bins would be provided in the camp and regularly removed and the garbage disposed of in a hygienic manner.
- Training programs would be organized for the operational workforce regarding proper usage of PPEs, handling and storage of fuels and chemicals etc.

9.12 Flare & Illumination Management Plan

The glare from the flare and illumination not only cause visual impacts but also causes ecological impacts.

Work Zone Illumination

Low height (less than 8 m), sodium vapour lamp that are most energy efficient can help to reduce the ecological impacts. Further, illumination would be provided only in required locations and has placed UV filters on lamps. Such UV filtered lights have been found to be less distractive to migrating birds.

9.13 Site Closure Plan

The site closure plan would identify all the activities which would be performed during the restoration of a well site in case the well is not economically viable, and no further use of that particular well bore is envisaged. Along with the well site the approach road connecting the well would be restored accordingly.

The following activities would be considered in the closure plan:

- Plugging & Abandonment of well: Close the well head properly to prevent any further leakage
- Decommissioning Phase: Removal of the materials form the site
- Waste/mud pit closure and reclamation
- Reinstatement Phase: regeneration of the land
- Handover Phase : Returning the land to the original owner

Plugging & Abandonment of well

As and when the well would be declared as non-productive, plugging of the well would be performed to close and abandon the well to prevent any leakage of oil or gas.

Decommissioning

The decommissioning phase includes activities dismantling and removal of surface facilities from the well site and storage in the Material Dumping Area. The activities which are envisaged during this phase are:

- Waste Management: clean up the site and remove all waste materials e.g. HDPE liners, any waste material etc. The waste would be dumped in the designated area as per the guidelines of Assam State pollution control board.
- Road Restoration: The fill materials would be removed, and the site would be restored to previous conditions or as per recommendation of administrative department of Tehsil.

Waste and Mud Pit Closure and Reclamation

Following decommissioning and abandonment of the well site the waste and mud pits would be subject to closure through onsite burial of solids in accordance with lease and obligations and with local, state and national regulations. Reclamation of closed pits or any other temporary retaining pits, including reserve pits, would be carried out within a period of one year from well closure/abandonment. All such reclamation activities would be carried out based on the climatic conditions.

Reinstatement

The reinstatement phase includes all activities for preparation of the soil for plantation of trees at the concerned site. The preparation of topsoil and fertility regeneration of topsoil would be same as referred earlier. Site restoration shall be taken up matching to the surrounding land use pattern. Selection of plants for plantation would be undertaken based on the species that were cut down at the time of site preparation activities.

Environmental Management plan for proposed project is presented in Table 9.1.

Table 9.1 Environmental Management Plan

S.No	Activity	Potential Impact	Management / Mitigation Measures	Responsibility
1.	Land Procurement	• Loss of Income • Issues pertaining to compensation	• If the identified lands are of private landowners then land lease mode would be applied and in case of govt. land, land allotment from Govt. would be applied. Initially temporary and 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 till life of the project. For sites selected are having any settlements, Resettlement & rehabilitation (R&R) plan would be developed and implemented as per the applicable State/ Central Govt. policy. Compensation to affected landowners for any loss of land would be ensured by Vedanta Limited. (Division Cairn Oil & Gas). Vedanta Limited (Division Cairn Oil & Gas) would ensure the livelihood of local community, if any affected by the proposed land take, are identified and compensated through adequate compensation and other livelihood restoration activities directly or indirectly through CSR activities.	• Vedanta Limited (Division: Cairn Oil & Gas)
2.	Site Clearance and Grading	• Dust Generation • Loss of top soil • Increased runoff	• Top soil would be properly stored for future use. • Water sprinkling would be carried out while working in proximity of agricultural fields or settlements/habitations;	• Vedanta Limited (Division: Cairn Oil & Gas)
3.	Construction of Drill Site	• Handling of excess earth material; • Noise generation • Increase in traffic volumes • Health & Safety risks	• Temporary storage sheds would be provided for construction material such as cement; • Excavated soil would be used during site preparation; • Provision and usage of adequate PPEs to workers as applicable and identified for the respective activity.	• Vedanta Limited (Division: Cairn Oil & Gas) • Civil Contractors
4.	Constriction Camp of Site	• Crane overturning/Collapse • Falling Objects • Health & Safety risks	• Surface conditions would be examined prior to movement of crane; • Provision and usage of adequate PPEs to workers as applicable and identified for the respective activity.	• Vedanta Limited (Division: Cairn Oil & Gas) • Civil Contractors
5.	Transportation of Drilling Components and Rig	• Congestion of roads • Road accidents • Vehicular emissions • Damage to road conditions • Oil leaks	• Only trained drivers with knowledge of on defensive driving would be involved in the movement of rigs. • All movement of major equipment would be scheduled in the lee hours keeping consideration of the traffic movement in the connecting major arterial road. • Local administration and village administration as applicable would be informed during movement of rigs through village roads; •	• Contractor - HSE • Vedanta Limited (Division: Cairn Oil & Gas)
6.	Drilling and Well Testing	• Additional stress on the local water resources;	• Water would be sourced from the locally approved source or ground water would be withdrawn prior approval of CGWA	• Vedanta Limited (Division: Cairn Oil & Gas)

S.No	Activity	Potential Impact	Management / Mitigation Measures	Responsibility
		• Potential for contamination due to handling, storage and transportation of wastes	• Two separate Drill cutting disposal pits would be provided for WBM and SBM cuttings; • Drill waste pits would be provided with HDPE lining on bottom and side surfaces; • Used hazardous chemical barrels, used oil and other hazardous waste would be sent to Assam SPCB authorized recyclers; • Vedanta Limited (Division: Cairn Oil & Gas) to also explore disposing drill cuttings containing for co-processing as alternate fuel and or raw material (AFR) in cement industry based on suitability and availability.	• Vedanta Limited (Division: Cairn Oil & Gas) • Drilling contractor- HSE
		• Generation of noise	• Equipment upkeep and regular maintenance to minimise noise generation from all rotary equipment; • PPE's such as ear plugs, muffs would be provided to workers at site; • Periodic maintenance of vehicles and machinery would be undertaken; • DG sets would be provided with acoustic enclosures as per requirements under CPCB guideline.	• Vedanta Limited (Division:Cairn Oil & Gas) • Drilling contractor- HSE
		• Air emissions	• All the emitting stacks including the flare pit shall be positioned orthogonal direction to the prevailing wind direction; • Cold venting of gas not would be carried out. • Adequate stack heights would be provide for generators, adhering to the CPCB standards for diesel generators;	• Vedanta Limited (Division: Cairn Oil & Gas) • Drilling contractor- HSE
		• Influx of migrant labour • Conflict with local community	• Migrant labour would be sensitized towards customs and traditions of the local population;	• Vedanta Limited (Division: Cairn Oil & Gas) • Drilling contractor- HSE
		• Occupational Health & Safety Risks	• Blowout preventers would be provided; • Flare pit would be placed at a safe distance from the well head and fuel storage areas; • Firefighting measures would be provided near all welding operations;	• Vedanta Limited (Division: Cairn Oil & Gas) Project Team Drilling contractor- HSE
7	Operation of Campsites	• Stress on water resources; • Potential contamination from generation of biomedical waste • Wastewater generation • Waste generation	• Safe drinking water to be provided at campsites; • All waste would be collected in bins located near each set of porta cabins. Segregation of waste at the source of generation would be put in practice. • All hazardous waste would be collected and stored on secure and paved area, and subsequently sent to authorised recyclers • Food waste would be stored in a closed container; • STP would be provided for campsites. • Waste generation would be separated and disposed of as per the regulatory requirements.	• Vedanta Limited (Division: Cairn Oil & Gas) • Drilling contractor- HSE

S.No	Activity	Potential Impact	Management / Mitigation Measures	Responsibility
8	Operation of WMB and SBM mud plant and warehouses	• Waste generation • Potential contamination due to mud preparation • Dust due to stacking of the materials • Emission due to the forklifts and crane usages	• Effective stacking of the materials would be followed to protect from the environmental situations such as wind, rain and sunlight • If area not paved, then periodic sprinkling shall be carried out • All diesel operated generators shall have acoustic enclosures and effective stack heights • Waste shall be effectively segregated at the source of generation and disposed as per the waste management plan • All the vehicles would be operated inside the mud plant and warehouse shall follow all the HSE requirements to protect environment and have safety operations such as load test, proper maintenance etc.	• Drilling Warehouse Manager • Drilling Logistics Manager
9	Decommissioning and Abandonment	• Demolition of drill cutting pits;	• A site restoration approved plan shall be prepared with the detailed checklist; • All drill cuttings, spent mud, waste oil and other waste would be completely removed from the site and sent to designated disposal place prior to commencement of demolition work; • All concrete or steel installations would be removed to at least 1 m below ground level, so as to ensure that there would be no protruding surface structures. The casing wellhead and the top joint of the casings would be cut below the ground level and capped with a cement plug. • 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 to suitably.	• Vedanta Limited (Division: Cairn Oil & Gas) • Drilling contractor- HSE

9.14 EMP BUDGET

Detail of cost breakup is provided at the Table 9.2.

Table 9.2 Tentative Budget for EMP Implementation for Each Well

Sl. No.	Particulars of Work	Budget (in lakh Rs.)
1	**Air Quality Management Plan**	
a.	Dust suppression through water sprinkling in the internal unpaved roads (@Rs. 10000 per month x 6 months)	0.6
b.	Ambient Air Quality Monitoring -4 monitoring location x 2 weeks per location x 2 times during drilling (@ Rs.7500 x 16 samples)	1.2
c.	Stack emission monitoring (@ 5000 per sample x 3 DG sets x twice during drilling) @5000 X 6 samples	0.3
2	**Noise Monitoring**	
a.	Ambient Noise Monitoring – 3 locations, 2 times during drilling (@Rs. 2500 X 6 samples)	0.15
b.	Workplace noise monitoring -5 locations per well, twice during drilling (@Rs.2500 per location x 5 locations x 2 times)	0.25
3	**Water Quality**	
a.	Surface Water Quality Monitoring (@ Rs. 5000 x 3 samples from natural drainages once during drilling)	0.15
b.	Ground Water Quality Monitoring (@ Rs. 5000 x 3 sites once during drilling)	0.15
4	**Soil Quality Monitoring (@ Rs. 5000 x 3 samples x once during site construction and drilling)**	0.3
5	**Road Safety & Traffic Management**	
a.	Signage in the transport route & its maintenance (Rs. 100,000 + Rs. 10,000)	1.1
b.	Deployment of traffic personnel in sensitive area – 10 persons (@ Rs. 6000 per month x 6 months)	3.6
7	**Municipal Solid Waste**	
a.	Provision of collection bins at well site – 2 nos	0.2
b.	Transport arrangement of waste from well sites to dumping area	0.25
8	**Hazardous waste management**	
a.	Construction of dedicated hazardous storage area and record maintenance (construction included under project cost; only maintenance included in this budget)	0.1
b.	Drill Cutting, waste mud and wash water pits; HDPE lined (budgetary provision in operation cost of drilling)	0
9	**Surface and Ground Water Protection and Management**	
a.	Surface runoff control measures for chemical storage area, fuel storage area (budgetary provision is already taken care in earlier section)	0
b.	Paved /impervious storage area for chemical storage area, fuel & lubricant storage area (Budgetary provision is already included in the infrastructure development cost)	0
c.	Domestic waste water treatment facility through septic tank & soak pits at the drill sites (budgetary provision in operation cost of drilling)	0

Sl. No.	Particulars of Work	Budget (in lakh Rs.)
10	**Occupational Health & Safety Management**	
a.	Provision of appropriate PPE to all workers and its maintenance (budgetary provision is included in operational cost of drilling)	0
b.	Provision of drinking water, sanitation facility for all workers (budgetary provision is included in operational cost of drilling)	0
c	Provision First aid facility (budgetary provision is included in operational cost of drilling)	0
d	Regular occupational health & safety training	0.5
	Total Cost of Implementation of EMP	**8.85**

9.15 Corporate Environment Responsibility

The company would comply with the 1st May 2018 OM w.r.t. CER and the cost would be assessed on actual project capex expenditure of that particular financial year

10. Conclusion and Recommendation

AA-ONHP-2017/1 block is located in Karbi Anglong and Golaghat districts of Assam & Wokha district of Nagaland. Total area of block is 715 sq. km. Vedanta Limited (Division: Cairn Oil & Gas division) propose to carry out Exploration and Appraisal Drilling activities in the Block, wherein 20 new drilling (exploratory and appraisal) wells are proposed would be drilled over 10-12 years. In case of successful discovery of crude oil, setting up of Early Production Units (EPUs)/ Quick Production Units (QPUs) for produced well fluid processing and production of up to 12000 BOPD crude oil and 2.4 MMSCFD of associated natural gas for captive power generation.

ToR has been approved by MoEF&CC dated on 20th April, 2019 and MoEF&CC vide File No. IA-J-11011/95/2019-IA-II(I). The baseline monitoring and all primary data collection was conducted for the summer season (from March to May), of 2019, as per the requirements of the ToR. Draft EIA report has been prepared for conducting the public hearing.

The draft EIA report has assessed the overall significance of environmental impacts likely to arise from drilling of proposed exploratory and appraisal wells and addressed the concerns and suggestions of the community during the public hearing. The overall impacts from the individual drilling sites have been assessed and are found to be of moderate to minor in nature when appropriate mitigation measures would be implemented with proper planning and design.

To adequately address the impacts, mitigation measures and management plans suggested are as per the best practices followed in the Oil & Gas exploration Industry. These plans include environmental management plan, monitoring plan, labour management plan, traffic management plan. Vedanta Limited (Division: Cairn Oil & Gas) shall put in place a robust mechanism with adequate resources to implement the suggested mitigation measures and management plans. The measures would help to prevent any deterioration of quality of air, soil, groundwater and surface water beyond the prevailing status. Adequate safety measures would be adopted along with suitable emergency response and disaster management plan to safeguard against all man-made and natural disasters. Environmental monitoring of ambient air quality, noise levels, surface & groundwater etc. would be carried out at regular intervals to monitor and prevent any deterioration of baseline environmental quality due to the proposed project.

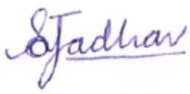
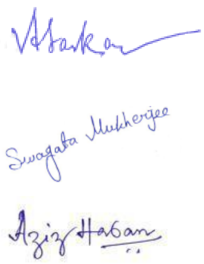
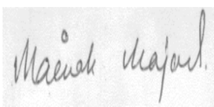
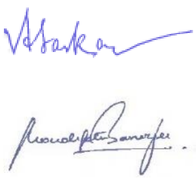
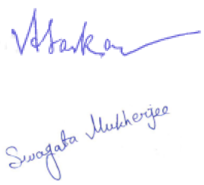
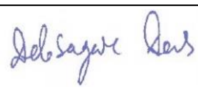
Compliance to all legal requirements and adherence to the suggested mitigation measures and plans would also enable Vedanta Limited (Division: Cairn Oil & Gas) in minimizing its impact on environmental and social parameter. This Report in the final form is being submitted to MoEF&CC for obtaining Environmental Clearance (EC) of the proposed project before commencement of site activity.

11. Disclosure of Consultants

AECOM has been accredited as EIA consultant for various sectors including Offshore and Onshore Oil and Gas Exploration and Development Projects from the National Accreditation Board for Education and Training (NABET) of Quality Council of India (QCI) under the Accreditation Scheme for EIA Consultant Organisations as per MoEF&CC requirements.

The following approved consultants and experts were engaged for preparation of the EIA report for the proposed study. QCI NABET certificate Of AECOM India Private Limited is presented in Figure 77.

Table 11.1 EIA Team

S. No.	EIA Coordinator/ Functional Area	Professionals Environment Coordinator/FAE	FAA and Team Members	Signature
1	EIA Coordinator –Onshore Oil and Gas Exploration and Development Projects	Shubhangi Jadav		
Core Functional Areas				
2	Water Pollution Monitoring, Prevention & Control (WP)	Avijit Sarkar	Swagata Mukherjee Aziz Hasan	
3	Ecology & Biodiversity (EB)	Mainak Majumdar		
4	Socio- Economic Aspects (SE)	Souvik Basu		
Significant functional areas				
5	Solid and Hazardous Waste Management (SHW)	Avijit Sarkar	Moudipta Banerjee	
6	Meteorology, Air Quality Modelling & prediction (AQ)	Avijit Sarkar	Swagata Mukherjee	
7	Risk and Hazards Management (RH)	Atul Kumar	Debsagar Das	

S. No.	EIA Coordinator/ Functional Area	Professionals Environment Coordinator/FAE	FAA and Team Members	Signature
8	Air Pollution Monitoring, Prevention & Control (AP)	Avijit Sarkar	Swagata Mukherjee Shivnath Chalka	Swagata Mukherjee
9	Hydrology, Ground Water & Water Conservation (HG)	Shiv Pratap Unya		
10	Noise &Vibration (NV)	Atul Kumar	Swagata Mukherjee	Swagata Mukherjee
11	Land Use (LU)	Laxmi Reddy	Moumita Dey	Moumita Dey
12	Soil Conservation (SC)	Chetan Zaveri	Moumita Dey	Moumita Dey

.

Quality Council of India

National Accreditation Board for Education & Training

QCI NABET

CERTIFICATE OF ACCREDITATION

AECOM India Private Limited

9/F, Infinity Tower – 'C', DLF Cyber City, DLF Phase – II, Gurgaon – 122002

Accredited as **Category - A** organization under the QCI-NABET Scheme for Accreditation of EIA Consultant Organizations: Version 3 for preparing EIA-EMP reports in the following Sectors:

Sl. No.	Sector Description	Sector (as per)		Cat.
		NABET	MoEFCC	
1	Mining of minerals including Open cast/ Underground mining	1	1 (a) (i)	A
2	Offshore and onshore oil and gas exploration, development & productions	2	1 (b)	A
3	River Valley projects	3	1 (c)	A
4	Thermal power plants	4	1 (d)	A
5	Metallurgical industries - ferrous only	8	3 (a)	A
6	Cement plants	9	3 (b)	A
7	Coke oven plants	11	4 (b)	A
8	Chemical Fertilizers	16	5 (a)	A
9	Synthetic organic chemicals industry	21	5 (f)	A
10	Oil & gas transportation pipeline	27	6 (a)	A
11	Air ports	29	7 (a)	A
12	Industrial estates/ parks/ complexes/ Areas, (EPZs),	31	7 (c)	B
13	Ports, harbours, break waters and dredging	33	7 (e)	A
14	Highways	34	7 (f)	A
15	Common municipal solid waste management facility (CMSWMF)	37	7 (i)	B
16	Building and construction projects	38	8 (a)	B
17	Townships and Area development projects	39	8 (b)	A

Note: Names of approved EIA Coordinators and Functional Area Experts are mentioned in RAAC minutes dated October 05, 2018 posted on QCI-NABET website.

The Accreditation shall remain in force subject to continued compliance to the terms and conditions mentioned in QCI-NABET's letter of accreditation bearing no. QCI/NABET/ENV/ACO/18/0799 dated November 19, 2018.The accreditation needs to be renewed before the expiry date by AECOM India Private Limited, Gurgaon, following due process of assessment.

Sr. Director, NABET
Dated: Nov. 19, 2018

Certificate No.
NABET/ EIA/1821/ RA 0108

Valid till
13.01.2021

For the updated List of Accredited EIA Consultant Organizations with approved Sectors please refer to QCI-NABET website.

Figure 77. QCI-NABET Certificate

APPENDIX

List of Appendix

Appendix 1.1: ToR Letter

No.IA-J-11011/95/2019-IA-II(I)
Goverment of India
Minister of Enviroment,Forest and Climate Change
Impact Assessment Division
***

Indira Paryavaran Bhavan,
Vayu Wing,3rd Floor,Aliganj,
Jor Bagh Road,New Delhi-110003
20 Apr 2019

To,

M/s Cairn India Limited
Cairn Oil & Gas, Vedanta Limited, DLF Atria, DLF Phase-2, DLF City, Gurgaon, Haryana - 122002Gurgaon,
Gurgaon-122002
Haryana

Tel.No.124-4594176; Email:dilipkumar.bera@cairnindia.com

Sir/Madam,

This has reference to the proposal submitted in the Ministry of Environment, Forest and Climate Change to prescribe the Terms of Reference (TOR) for undertaking detailed EIA study for the purpose of obtaining Environmental Clearance in accordance with the provisions of the EIA Notification, 2006. For this purpose, the proponent had submitted online information in the prescribed format (Form-1) along with a Pre-feasibility Report. The details of the proposal are given below:

1. Proposal No.:	IA/AS/IND2/99665/2019
2. Name of the Proposal:	Onshore Oil and Gas Exploration and Appraisal in AA-ONHP-2017/1 block in Karbi Anglong and Golaghat districts of Assam & Wokha district of Nagaland
3. Category of the Proposal:	Industrial Projects - 2
4. Project/Activity applied for:	1(b) Offshore and onshore oil and gas exploration, development & production
5. Date of submission for TOR:	18 Mar 2019

In this regard, under the provisions of the EIA Notification 2006 as amended, the Standard TOR for the purpose of preparing environment impact assessment report and environment management plan for obtaining prior environment clearance is prescribed with public consultation as follows:

1(b):STANDARD TERMS OF REFERENCE FOR CONDUCTING ENVIRONMENT IMPACT ASSESSMENT STUDY FOR OFFSHORE AND ONSHORE OIL AND GAS EXPLORATION, DEVELOPMENT AND PRODUCTION PROJECTS AND INFORMATION TO BE INCLUDED IN EIA/EMP REPORT

B. STANDARD TOR FOR ONSHORE OIL AND GAS EXPLORATION, DEVELOPMENT & PRODUCTION

1. Executive summary of a project.
2. Project description, project objectives and project benefits.
3. Cost of project and period of completion.
4. Site details within 1 km of the each proposed well, any habitation, any other installation/activity, flora and fauna, approachability to site, other activities including agriculture/land, satellite imagery for 10 km area. All the geological details shall be mentioned in the Topo sheet of 1:40000 scale, superimposing the well locations and other structures of the projects. Topography of the project site.
5. Details of sensitive areas such as National Park, Wildlife sanctuary and any other eco-sensitive area alongwith map indicating distance.
6. Approval for the forest land from the State/Central Govt. under Forest (Conservation) Act, 1980, if applicable.
7. Recommendation of SCZMA/CRZ clearance as per CRZ Notification dated 6th January, 2011 (if applicable).
8. Distance from nearby critically/severely polluted area as per Notification, if applicable. Status of moratorium imposed on the area.
9. Does proposal involve rehabilitation and resettlement? If yes, details thereof.
10. Environmental considerations in the selection of the drilling locations for which environmental clearance is being sought. Present any analysis suggested for minimizing the foot print giving details of drilling and development options considered.
11. Baseline data collection for air, water and soil for one season leaving the monsoon season in an area of 10 km radius with centre of Oil Field as its centre covering the area of all proposed drilling wells.
12. Climatology and Meteorology including wind speed, wind direction, temperature rainfall relative humidity etc.
13. Details of Ambient Air Quality monitoring at 8 locations for PM2.5, PM10, SO2, NOx, CO, VOCs, Methane and non-methane HC.
14. Soil sample analysis (physical and chemical properties) at the areas located at 5 locations.
15. Ground and surface water quality in the vicinity of the proposed wells site.

16. Measurement of Noise levels within 1 km radius of the proposed wells.
17. Vegetation and land use; flora/fauna in the block area with details of endangered species, if any.
18. Incremental GLC as a result of DG set operation, flaring etc.
19. Potential environmental impact envisaged during various stages of project activities such as site activation, development, operation/ maintenance and decommissioning.
20. Actual source of water and 'Permission' for the drawl of water from the Competent Authority. Detailed water balance, wastewater generation and discharge.
21. Noise abatement measures and measures to minimize disturbance due to light and visual intrusions.
22. Details on wastewater generation, treatment and utilization /discharge for produced water/ formation water, cooling waters, other wastewaters, etc. duringallprojectphases.
23. Details on solid waste management for drill cuttings, drilling mud and oil sludge, produced sand, radio activematerials, other hazardous materials, etc. including its disposal options during all project phases.
24. Disposal of spent oil and lube.
25. Storage of chemicals and diesel at site. Hazardous material usage, storage and accounting.
26. Commitment for the use of water based mud (WBM) only
27. Oil spill emergency plans for recovery/ reclamation.
28. H2S emissions control.
29. Produced oil/gas handling, processing and storage/transportation.
30. Details of control of air, water and noise pollution during production phase.
31. Measures to protect ground water and shallow aquifers from contamination.
32. Whether any burn pits being utilised for well test operations.
33. Risk assessment and disaster management plan for independent reviews of well designed construction etc. for prevention of blow out. Blowout preventer installation.
34. Environmental management plan.
35. Total capital and recurring cost for environmental control measures.
36. Emergency preparedness plan.
37. Decommissioning and restoration plans.
38. Documentary proof of membership of common disposal facilities, if any.
39. Details of environmental and safety related documentation within the company including documentation and proposed occupational health and safety Surveillance Safety Programme for all personnel at site. This shall also include monitoring programme for the environmental.
40. A copy of Corporate Environment Policy of the company as per the Ministry's O.M. No. J-11013/ 41/2006-IA.II(I) dated 26th April, 2011 available on the Ministry's website.
41. Any litigation pending against the project and or any direction/order passed by any court of law against the project. If so details thereof.

***

Appendix 2.1: Revenue Sharing Contract

REVENUE SHARING CONTRACT

BETWEEN

THE GOVERNMENT OF INDIA

AND

VEDANTA LIMITED

UNDER

HYDROCARBON EXPLORATION AND LICENSING POLICY

WITH RESPECT TO CONTRACT AREA IDENTIFIED

AS BLOCK

AA-ONHP-2017/1

K.K. Asokan
US(E.II), MoPNG

(Sudhir Mathur)
Vedanta Limited

Ranjit Banerjee
DGH

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RB

APPENDICES

RB

REVENUE SHARING CONTRACT
FOR ONLAND AREAS

This Contract made on this **1st October**, Two thousand and Eighteen between:
The President of India, acting through the **Joint Secretary (E)**, Ministry of Petroleum and Natural Gas (hereinafter referred to as "the Government") of the FIRST PART;

AND

Vedanta Limited, a company incorporated under the laws of India (hereinafter referred to as "**Vedanta**" or "**Contractor**") having its registered office at 1st Floor, C wing, Unit 103, Corporate Avenue Atul Projects, Chakala, Andheri (East) Mumbai, Mumbai City Maharashtra-400093 India which expression shall include its successors and such assigns as are permitted under Article 26 hereof, of the SECOND PART;

WITNESSETH:

WHEREAS

(1) The Oilfields (Regulation and Development) Act, 1948 (53 of 1948) (hereinafter referred to as "the Act") and the Petroleum and Natural Gas Rules, 1959, made there under (hereinafter referred to as "the Rules") make provisions, inter alia, for the regulation of Petroleum Operations and grant of Licenses and Leases for exploration, development and production of Petroleum in India;

(2) The Rules provide for the grant of Licenses and Leases in respect of land vested in a State Government by that State Government with the previous approval of the Central Government;

(3) Rule 5 of the Rules provides for an agreement between the Government and the Licensee or Lessee containing additional terms and conditions with respect to the License or Lease;

(4) The Government desires that all types of Petroleum resources which may exist in India, whether within territorial waters (ultra-deep, deep or shallow water), exclusive economic zone, the continental shelf of India, or Onland, be discovered and exploited in accordance with Good International Petroleum Industry Practices (GIPIP) with utmost expedition in the overall interests of India;

(5) The Government has formulated and approved a new exploration and licensing policy named 'Hydrocarbon Exploration and Licensing Policy' ("HELP") vide Resolution dated 30.03.2016, whereby it has been determined to provide a uniform license to enable E&P operators to explore and extract all hydrocarbon resources including conventional and unconventional oil and gas resources including CBM, Shale Gas/Oil, Tight Gas, Gas Hydrates and any other resource to be identified in future which fall within the definition of 'Petroleum" and "Natural Gas" under the Rules;

(6) The Government, pursuant to HELP, invited companies to submit competitive bids to obtain the right to undertake exploration, discovery and commercial production of Petroleum resources within India, which would also be governed by Applicable Laws governing Petroleum Operations within India formulated by the Government;

(7) **Vedanta** has committed that it has, or will acquire and make available, the necessary financial and technical resources and the technical and industrial competence and experience necessary for proper discharge and / or performance of all obligations required to be performed under this Contract in accordance with Good International Petroleum Industry Practices (GIPIP) and will provide guarantees as required in Article 27 for the due performance of its obligations hereunder; and

(8) As a result of discussions between representatives of the Government and **Vedanta** on the bid submitted by **Vedanta**, the Government has agreed to enter into this Contract with **Vedanta** with respect to the Contract Area identified as Block **AA-ONHP-2017/1** and detailed in Appendix A and Appendix B (hereinafter referred to as "the Block") on the terms and conditions herein set forth.

NOW, THEREFORE, in consideration of the premises and covenants and conditions herein contained, IT IS HERE BY AGREED between the Parties as follows

IN WITNESS WHEREOF, the representatives of the Parties to this Contract being duly authorized have hereunto set their hands and have executed these presents this 1st October, Two thousand and Eighteen.

Signed for and on behalf of the President of India

By: ____________________

अमर नाथ / AMAR NATH
संयुक्त सचिव/Joint Secretary
पेट्रोलियम एवं प्राकृतिक गैस मंत्रालय
Ministry of Petroleum & Natural Gas
भारत सरकार/Govt. of India
नई दिल्ली/New Delhi

In presence of ____________________

संजय कुमार जैन / SANJAY KUMAR JAIN
निदेशक / Director
पेट्रोलियम एवं प्राकृतिक गैस मंत्रालय
Ministry of Petroleum & Natural Gas
भारत सरकार / Govt. of India
नई दिल्ली / New Delhi

Signed for and on behalf of Vedanta Limited

By: ____________________

In presence of ____________________

APPENDIX A

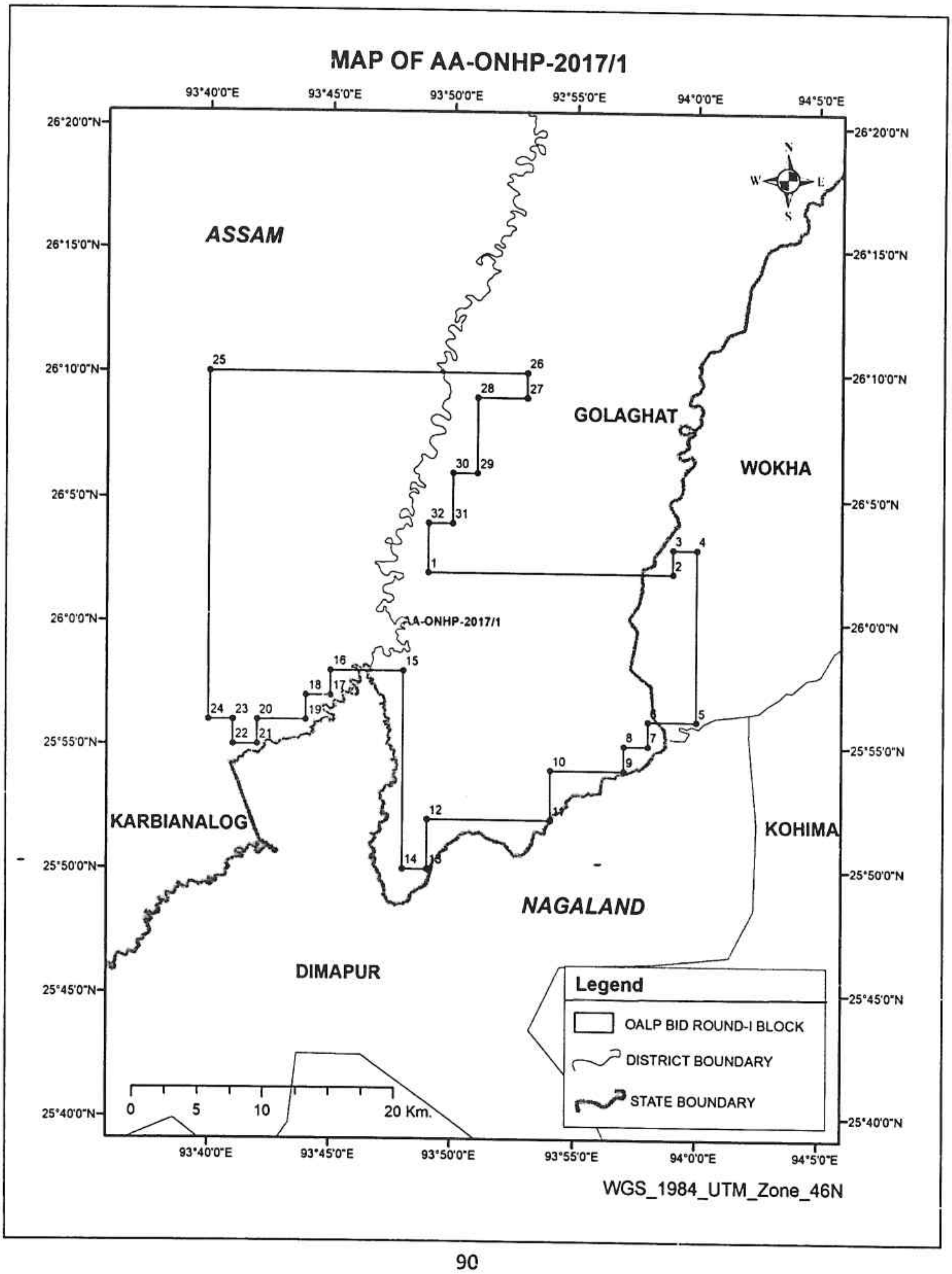
DESCRIPTION OF THE CONTRACT AREA

The area comprising approximately 715 Sq. km. onshore/offshore India identified as block AA-ONHP-2017/1 described herein and shown on the map attached as Appendix B ("Map of the Contract Area"). Longitude and latitude measurements commence at points 1, 2, 3...,32 are given below:

Points	Longitude	Latitude
1	93° 49'	26° 2'
2	93° 59'	26° 2'
3	93° 59'	26° 3'
4	94° 0'	26° 3'
5	94° 0'	25° 56'
6	93° 58'	25° 56'
7	93° 58'	25° 55'
8	93° 57'	25° 55'
9	93° 57'	25° 54'
10	93° 54'	25° 54'
11	93° 54'	25° 52'
12	93° 49'	25° 52'
13	93° 49'	25° 50'
14	93° 48'	25° 50'
15	93° 48'	25° 58'
16	93° 45'	25° 58'
17	93° 45'	25° 57'
18	93° 44'	25° 57'
19	93° 44'	25° 56'
20	93° 42'	25° 56'
21	93° 42'	25° 55'
22	93° 41'	25° 55'
23	93° 41'	25° 56'
24	93° 40'	25° 56'
25	93° 40'	26° 10'
26	93° 53'	26° 10'
27	93° 53'	26° 9'
28	93° 51'	26° 9'
29	93° 51'	26° 6'
30	93° 50'	26° 6'
31	93° 50'	26° 4'
32	93° 49'	26° 4'

APPENDIX B

MAP OF THE CONTRACT AREA

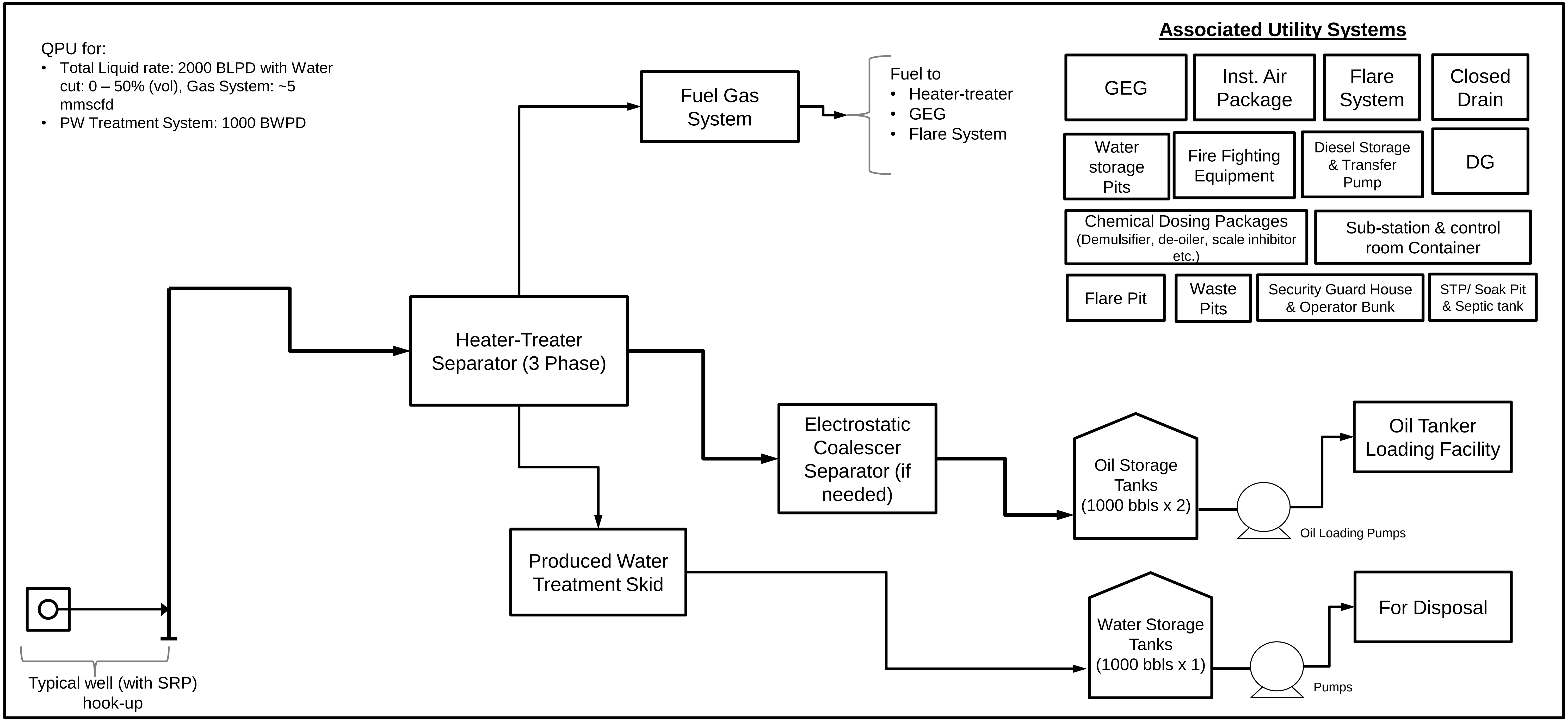


Appendix 2.2: Process Flow Diagram

vedanta transforming elements

Quick Production Unit/ Early Production Unit (2000 BLPD)

CAIRN



Appendix 2.3: Well Wise Environmental Settings

Sl. No	Well Name	Geographical Coordinates	HC Block	Admiration Setting			Existing Land cover of wells	Accessibility (in approx.)	Environmental Setting of Wells		Ecological Sensitivity		Settlement/ School within 1km	Existing INDUSTRY	Existing facility	Map Reference (Annex 2.1)
				Village	Tehsil	District			Terrain Type	Stream/ River	Forest	WL S/E SZ				
1	1	25°56'35.11"N 93°43'45.83"E		Joyram Engleng	Silonjan	Golaghat	Fallow land	An earthen road is 0.02 km away from the well location, which is connected to the AH 1.	Flat land	NA	A proposed reserve forest is present within the 2.5 km radius of the well location.	NA	Several clusters of settlement are present within the 2.5 km radius of the well location. The nearest one is 0.08 km away from the well location. Joyram Engleng, Takajan Kuki Gaon, Ram nath Kathar are the villages present within the 2.5 km radious of the well location.	NA	NA	
2	2	25°57'17.040"N, 93°49'43.980"E		Ambari	Sarupathar	Golaghat	Agricultural Land	An unnamed road is almost 0.85 km away towards	Flat land	NA	Diphu reserve forest is present, within 2.5 km radious	NA	Nearest settlement is present at a distance of 0.08 km away from the well location.	There are some numbers of	NA	

Sl. No	Well Name	Geographical Coordinates	HC Block	Admiration Setting			Existing Land cover of wells	Accessibility (in approx.)	Environmental Setting of Wells		Ecological Sensitivity		Settlement/ School within 1km	Existing INDUSTRY	Existing facility	Map Reference (Annex 2.1)
				Village	Tehsil	District			Terrain Type	Stream/ River	Forest	WL S/E SZ				
								south west from the well location, which is connected to the Nuiland Dimapur road.			of the well location.		Ambari, Nayanjan Gaon are the villages present within the 2.5 km radious of the well location.	brick fields are present to the south from the well location.		
3	3	25°59'3.454"N 93°51'41.232"E		Da Gaon No. 3	Sarupathar	Golaghat	Homested plantation	An unnamed road is 1.20 km east from the well location, which is	Flat land	NA	NA	NA	Some scattered settlement is present within .5 km radius of the well location, towards north east direction.	NA	No healthcare facility is present withi	

Sl. No	Well Name	Geographical Coordinates	HC Block	Admiration Setting			Existing Land cover of wells	Accessibility (in approx.)	Environmental Setting of Wells		Ecological Sensitivity		Settlement/ School within 1km	Existing INDUSTRY	Existing facility	Map Reference (Annex 2.1)
				Village	Tehsil	District			Terrain Type	Stream/ River	Forest	WL S/E SZ				
								connected with NH2.					No school is present within 2.5 km radius of the well location. Tengatol Basti, Rongpur, Nepali Basti, Lyphian Naga Basti are the villages found within 2.5 km radius of the well location.		n 2.5 km rdaius of the well location.	
4	4	25°58'38.82"N 93°41'3.45"E		Sarthe Killing	Diphu	Karbi Anglong	Agricultural land	An unnamed road is 2.19 km west from the well location, which is connected with NH 29.	Flat land	NA	NA	NA	A small patch of settlement is present 0.68 km south from the well location. Sirvomu Lower Primary school is present 0.63 km north west from the well location.	NA	No health Care facility is present within 2.5	

Sl. No	Well Name	Geographical Coordinates	HC Block	Admiration Setting			Existing Land cover of wells	Accessibility (in approx.)	Environmental Setting of Wells		Ecological Sensitivity		Settlement/ School within 1km	Existing INDUSTRY	Existing facility	Map Reference (Annex 2.1)
				Village	Tehsil	District			Terrain Type	Stream/ River	Forest	WL S/E SZ				
													Balipathar, Banimon, Bong sai Moi are the villages present within the 2.5 km radius of the well location.		km radius of the well location.	
5	5	25°58'43.96"N 93°46'14.57"E		Christian Basti	Diphu	Karbi Anglong	Agricultural land	An unnamed road is 0.18 km west from the well location, which is connected with Golaghat road.	Flat land	Dhansiri river is 0.78 km east from the well location.	NA	NA	A patch of settlement is present 0.38 km south west from the well location. Begnabill LP school is 0.42 km west and Khatkhati High school is 1.18 km north west from the well location, both schools are very near to the primary approach road.	NA	No health care facility is present within the 2.5 km	

Sl. No	Well Name	Geographical Coordinates	HC Block	Admiration Setting			Existing Land cover of wells	Accessibility (in approx.)	Environmental Setting of Wells		Ecological Sensitivity		Settlement/ School within 1km	Existing INDUSTRY	Existing facility	Map Reference (Annex 2.1)
				Village	Tehsil	District			Terrain Type	Stream/ River	Forest	WL S/E SZ				
													Habe Taimung, Kai Tereng are the villages present within the 2.5 km radius of the well location.		rdaius of the ell location.	
6	6	25°58'21.200"N, 93°48'15.770"E		Kai Tereng	Diphu	Karbi Anglong	Agricultural land	An unnamed road is 0.26 km east from the well location, which is connected to NH 129.	Flat land	Dhansiri river is within the .5 km radius of the well location.	NA	NA	A patch of settlement is present 0.39 km south from the well location. No school is resent within the 2.5 km radius of the well location. Dighir Basti, Kai tereng, Habe taimung are the villages within the 2.5 km radisu of the well location.	NA	No health care facility is present within 2.5 km radius of	

Sl. No	Well Name	Geographical Coordinates	HC Block	Admiration Setting			Existing Land cover of wells	Accessibility (in approx.)	Environmental Setting of Wells		Ecological Sensitivity		Settlement/ School within 1km	Existing INDUSTRY	Existing facility	Map Reference (Annex 2.1)
				Village	Tehsil	District			Terrain Type	Stream/ River	Forest	WLS/ESZ				
															the well location.	
7	7	26° 0'46.710"N, 93°49'26.130"E		Chungazan Hazari Gaon	Sarupathar	Golaghat	Agricultural land	An unnamed road is 0.08 km east from the well location, which is connected to NH 129.	Flat land	NA	A portion of Nambar Reserve forest is present within 2.5 km radius of the well location.	NA	No such settlement is present within 2.5 km radius of the well location. Changujan ME school is 1.74 km east from the well location. Da gaon No.4, Chungajan, Raiali Matikhola are the village spresent within 2.5 km radius of the well location.	NA	No health care facility is present within the 2.5 km rdaius of the	

Sl. No	Well Name	Geographical Coordinates	HC Block	Admiration Setting			Existing Land cover of wells	Accessibility (in approx.)	Environmental Setting of Wells		Ecological Sensitivity		Settlement/ School within 1km	Existing INDUSTRY	Existing facility	Map Reference (Annex 2.1)
				Village	Tehsil	District			Terrain Type	Stream/ River	Forest	WL S/E SZ				
															well location.	
8	8	26° 0'3.330"N 93°51'51.513"E		Madhapur	Sarupathar	Golaghat	Agricultural land	An unnamed road is 0.11 km north from the well location, which is connected to NH 129. A patch of settlement is present on the both side of the primary	Flat land	NA	The well is present in Nambar reserve forest.	NA	A small patch of settlement is present 0.21 km east from the well location. Chungajan ME school is present 2.19 km west from the well location. Da gaon no 2, Santipur No. 3 are the village spresent within 2.5 km radius of the well location.	NA	No health care facility is present within 2.5 km rdaius of the well	

Sl. No	Well Name	Geographical Coordinates	HC Block	Admiration Setting			Existing Land cover of wells	Accessibility (in approx.)	Environmental Setting of Wells		Ecological Sensitivity		Settlement/ School within 1km	Existing INDUSTRY	Existing facility	Map Refereence (Annex 2.1)
				Village	Tehsil	District			Terrain Type	Stream/ River	Forest	WLS/ESZ				
								approach road.							location.	
9	9	26° 1'59.81"N 93°46'29.71"E		Sukhajan	Diphu	Karbi Anglong	Agricultural land	An unnamed road is 0.05 km awat from the well locatin, which is connected to NH 39. Bokajan railway station is 1.68 km south from the wel location.	Flat land	Dhansiri river is 0.92 km east from the oil location.	A part of Namber forest reserve is present towards north from the well location.	NA	A dense patch of settlement is present towards east from the well location. CCI ME school, Kendriya Vidyalaya is present 2.21 km east from the well location. Koch Gaon, Dilwajan are the villages present within 2.5 km radius of the well location.	CCI is present 2.21 km east from the well location.	CCI health centre is present 2.29 km east from the well location.	

Sl. No	Well Name	Geographical Coordinates	HC Block	Admiration Setting			Existing Land cover of wells	Accessibility (in approx.)	Environmental Setting of Wells		Ecological Sensitivity		Settlement/ School within 1km	Existing INDUSTRY	Existing facility	Map Reference (Annex 2.1)
				Village	Tehsil	District			Terrain Type	Stream/ River	Forest	WL S/E SZ				
10	10	26° 0'42.820"N, 93°48'33.250"E		Bokajan	Diphu	Karbi Anglong	Agricultural land	An unnamed road is present just beaside the well location, and connected to Chungajan road.	Flat land	Dhansiri river is 0.57 km north west from the well location.	A part of both Namber and Diphu reseve foreset is resent within the 2.5 km raius of the well location.		A moderate patch of settlement is present on the both sides of the well location. CCI ME school, Kendriya Vidyalaya is present 2.21 km east from the well location. Koch Gaon, Dilwajan are the villages present within 2.5 km radius of the well location.	CCI is present 2.21 km east from the well location.	CCI health centre is present 2.29 km east from the well location.	

Sl. No	Well Name	Geographical Coordinates	HC Block	Admiration Setting			Existing Land cover of wells	Accessibility (in approx.)	Environmental Setting of Wells		Ecological Sensitivity		Settlement/ School within 1km	Existing INDUSTRY	Existing facility	Map Reference (Annex 2.1)
				Village	Tehsil	District			Terrain Type	Stream/ River	Forest	WLS/ESZ				
11	11	26° 1'12.252"N 93°51'16.208"E		Netezu	Sarupathar	Golaghat	Agricultural land	Naukhuti main market road is 1.57 km south from the well location. A patch of settlement is present on the both side of that road.	Flat land	NA	NA	NA	A patch of settlement is present towards east from the well location, within .5 km radius. No.1 amguri nepali school is 1.43 km west from the well location. Misamari, Matikhola, Holowguri are the villages present within 2.5 km radius of the well location.	NA	Mohima Health Sub center is 2.76 km north from the well location.	
12	12	26° 2'24.39"N 93°43'52.73"E		Sukhanjan	Diphu	Karbi Anglong	Agricultural land	An unnamed road is 0.88 km south from the well	Flat land	NA	A part of west Namber forest reserve is	NA	No settlements present within 2.5 km radius of the well location.	NA	NA	

Sl. No	Well Name	Geographical Coordinates	HC Block	Admiration Setting			Existing Land cover of wells	Accessibility (in approx.)	Environmental Setting of Wells		Ecological Sensitivity		Settlement/ School within 1km	Existing INDUSTRY	Existing facility	Map Reference (Annex 2.1)
				Village	Tehsil	District			Terrain Type	Stream/ River	Forest	WL S/E SZ				
								location, which is connected with NH 129.			present within 2.5 km radius of the well location, towards north.					
13	13	26° 3'43.52"N 93°46'6.20"E		Sariajan	Diphu	Karbi Anglong	Agricultural land	Golaghat road is 0.88 km south east from the wel location	Flat land	NA	A part of west Nambar forest reserve is present within 2.5 km radius of the well location.	NA	Moderate patch of settlements is present within the .5 km radius of the well location. Sartha Rongpo, Sartha Phangcho are the villages present within the 2.5 km radius of the well location.	NA	NA	

Sl. No	Well Name	Geographical Coordinates	HC Block	Admiration Setting			Existing Land cover of wells	Accessibility (in approx.)	Environmental Setting of Wells		Ecological Sensitivity		Settlement/ School within 1km	Existing INDUSTRY	Existing facility	Map Reference (Annex 2.1)
				Village	Tehsil	District			Terrain Type	Stream/ River	Forest	WL S/E SZ				
14	14	26° 5'7.39"N 93°46'28.18"E		Sariajan	Diphu	Karbi Anglong	Agriculture land	Golaghat road is 0.41 km east from the well location.	Flat land	NA	A part of west namber reserve forest is present within 2.5 km radius of the well location.	NA	No such settlement is present withinthe .5 km radius of the well location. Longkicho Engti, Sarthe rongpi are the villages found within 2.5 km radius of the well location.	NA	NA	
15	15	26° 9'38.27"N 93°52'43.48"E		Dighalganja NC	Sarupathar	Golaghat	Agricultural land	An unnamed road is just beside the well location, which is connected to NH 39.	Flat land	NA	NA	NA	Some scattered settlement is present within the .5 km radius of the well location. Khonikor, Naga Juri, Pan Jan are the villages present within 2.5 km radius of the well location.	NA	NA	

Sl. No	Well Name	Geographical Coordinates	HC Block	Admiration Setting			Existing Land cover of wells	Accessibility (in approx.)	Environmental Setting of Wells		Ecological Sensitivity		Settlement/ School within 1km	Existing INDUSTRY	Existing facility	Map Reference (Annex 2.1)
				Village	Tehsil	District			Terrain Type	Stream/ River	Forest	WL S/E SZ				
16	16	26° 6'28.63"N 93°47'40.31"E		Dilaojan	Diphu	Karbi Anglong		Golaghat road is 0.41 km east from the well location.	Flat land	NA	A part of west namber reserve forest is present within 2.5 km radius of the well location.	NA	No such settlement is present withinthe .5 km radius of the well location. Longkicho Engti, Sarthe rongpi are the villages found within 2.5 km radius of the well location.	NA	NA	
17	17	26° 8'4.62"N 93°50'0.89"E		No.1 Kori Gaon	Sarupathar	Golaghat	Agriculture land	An unnamed village road is just beside the well location, which is connected to NH 39.	Flat land	Dhansiri river is 0.45 km from the well location.	NA	NA	A patch of settlement is present within the .5 km radius of the well location, towards south. Nao Jan jatiya Vidyalaya is present 1.65 km south from the well location.	NA	NA	

Sl. No	Well Name	Geographical Coordinates	HC Block	Admiration Setting			Existing Land cover of wells	Accessibility (in approx.)	Environmental Setting of Wells		Ecological Sensitivity		Settlement/ School within 1km	Existing INDUSTRY	Existing facility	Map Reference (Annex 2.1)
				Village	Tehsil	District			Terrain Type	Stream/ River	Forest	WL S/E SZ				
								Na gaon Railway station is 1.71 km south from the well location.					Bardeka taimung, Moh Khuti are the villages present within the 2.5 km radius of the well location.			
18	18	26° 7'26.87"N 93°46'41.36"E		Dihingia		Karbi Anglong	Agricultural land	Golaghat road is 0.41 km east from the well location.	Flat land	NA	A part of west namber reserve forest is present within 2.5 km radius of the well location.	NA	No such settlement is present withinthe .5 km radius of the well location. Longkicho Engti, Sarthe rongpi are the villages found within 2.5 km radius of the well location.	NA	NA	

Sl. No	Well Name	Geographical Coordinates	H C Block	Admiration Setting			Existing Land cover of wells	Accessibility (in approx.)	Environmental Setting of Wells		Ecological Sensitivity		Settlement/ School within 1km	Existing INDUSTRY	Existing facility	Map Reference (Annex 2.1)
				Village	Tehsil	District			Terrain Type	Stream/ River	Forest	WL S/E SZ				
19	19	26°8'38.65"N 93°47'41.20"E		Rongagara	Silonijan	Karbi Anglong	Agricultural land	Golaghat road is 0.41 km east from the well location.	Flat land	NA	A part of west namber reserve forest is present within 2.5 km radius of the well location.	NA	No such settlement is present withinthe .5 km radius of the well location. Longkicho Engti, Sarthe rongpi are the villages found within 2.5 km radius of the well location.	NA	NA	
20	20	26° 9'26.45"N 93°49'21.87"E		Jabarajan	Silonijan	Karbi Anglong	Agriculture land	An unnamed village road is just beside the well location, which is connected to NH 39.	Flat land	Dhansssiri river is 0.45 km from the well location.	NA	NA	A patch of settlement is present within the .5 km radius of the well location, towards south. Nao Jan jatiya Vidyalaya is present 1.65 km south from the well location.	NA	NA	

Sl. No	Well Name	Geographical Coordinates	HC Block	Admiration Setting			Existing Land cover of wells	Accessibility (in approx.)	Environmental Setting of Wells		Ecological Sensitivity		Settlement/ School within 1km	Existing INDUSTRY	Existing facility	Map Reference (Annex 2.1)
				Village	Tehsil	District			Terrain Type	Stream/ River	Forest	WL S/E SZ				
								Na gaon Railway station is 1.71 km south from the well location.					Bardeka taimung, Moh Khuti are the villages present within the 2.5 km radius of the well location.			

Appendix 2.4: Environment Settings of Well (1km buffer map for each well)

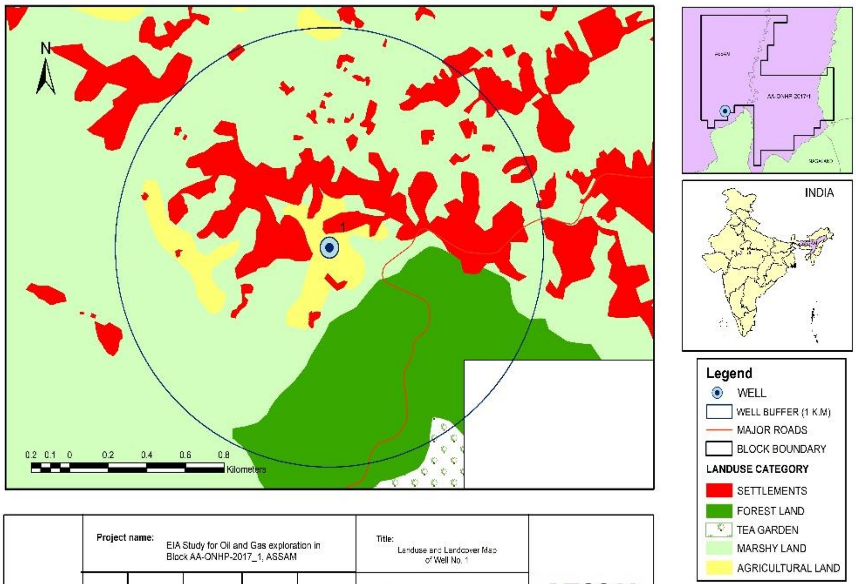


FIGURE NO	Project name: EIA Study for Oil and Gas exploration in Block AA-ONHP-2017_1, ASSAM					Title: Landuse and Landcover Map of Well No. 1	AECOM
	Date: 28/08/2019	Drawn By: Moumita Dey	Checked By: Souvik Basu	Approved By: Avijit Sarkar	Client Name: Vedanta Limited (Cairn Oil and Gas)	Source: Google Earth (22/01/2019), Toposheet No.: G46P/9, G46P/13, G46J/12 & G46J/16(Survey of India), Landsat 5 ETM+ & Resourcesat Liss III(Guided 2005 03 & 2011_12) Esri Digital Globe and the GIS User Community	

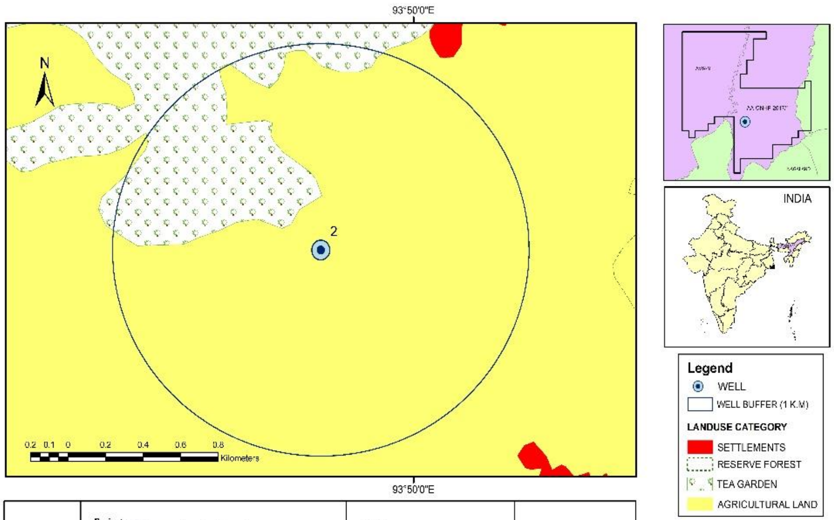


FIGURE NO	Project name: EIA Study for Oil and Gas exploration in Block AA-ONHP-2017_1, ASSAM					Title: Landuse and Landcover Map of Well No. 2	AECOM
	Date: 28/08/2019	Drawn By: Moumita Dey	Checked By: Souvik Basu	Approved By: Avijit Sarkar	Client Name: Vedanta Limited (Cairn Oil and Gas)	Source: Google Earth (22/01/2019), Toposheet No.: G46P/9, G46P/13, G46J/12 & G46J/16(Survey of India) Landsat 5 ETM+ & Resourcesat Liss III(Guided 2005 03 & 2011_12) Esri Digital Globe and the GIS User Community	

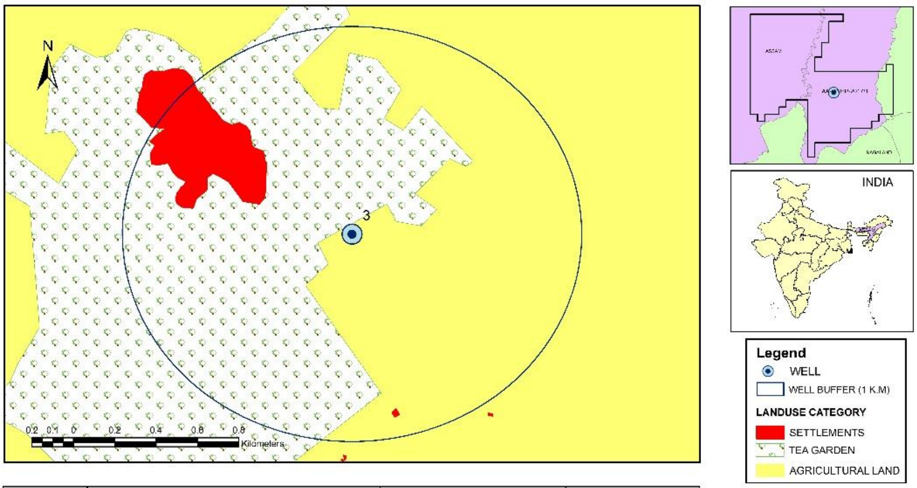


FIGURE NO	Project name: EIA Study for Oil and Gas exploration in Block AA-ONHP-2017_1, ASSAM					Title: Landuse and Landcover Map of Well No. 3	AECOM
	Date: 28/08/2019	Drawn By: Moumita Dey	Checked By: Souvik Basu	Approved By: Avijit Sarkar	Client Name: Vedanta Limited (Cairn Oil and Gas)	Source: Google Earth (22/01/2019), Toposheet No.: G46P/9, G46P/13, G46J/12 & G46J/16(Survey of India), Landsat 5 ETM+ & Resourcesat Liss III(Guided 2005-06 & 2011_12) Esri Digital Globe and the GIS User Community	

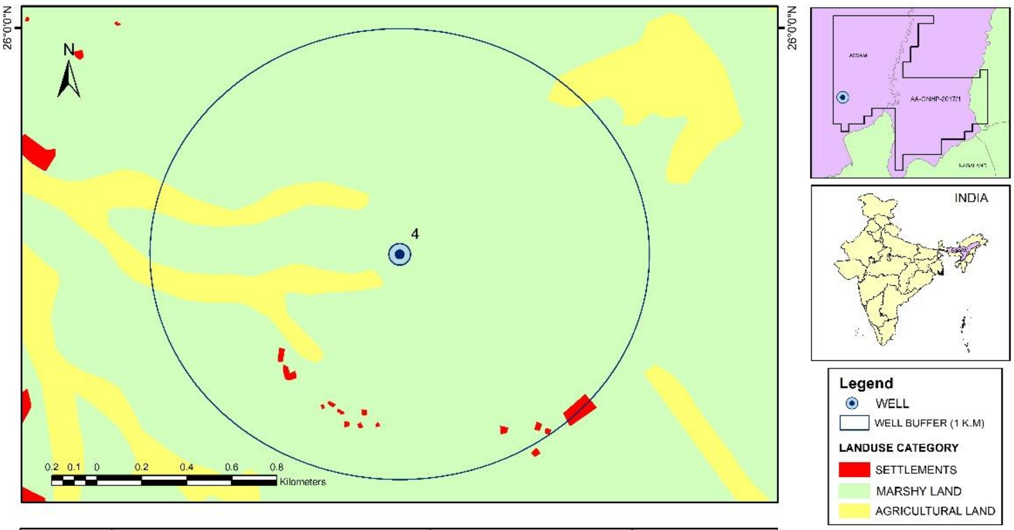
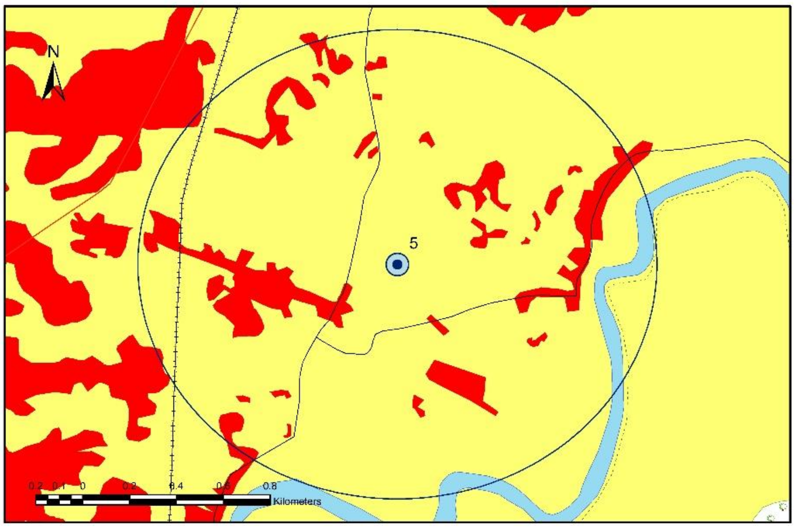


FIGURE NO	Project name: EIA Study for Oil and Gas exploration in Block AA-ONHP-2017_1, ASSAM					Title: Landuse and Landcover Map of Well No. 4	AECOM
	Date: 28/08/2019	Drawn By: Moumita Dey	Checked By: Souvik Basu	Approved By: Avijit Sarkar	Client Name: Vedanta Limited (Cairn Oil and Gas)	Source: Google Earth (22/01/2019), Toposheet No.: G46P/9, G46P/13, G46J/12 & G46J/16(Survey of India), Landsat 5 ETM+ & Resourcesat Liss III(Guided 2005-06 & 2011_12) Esri Digital Globe and the GIS User Community	



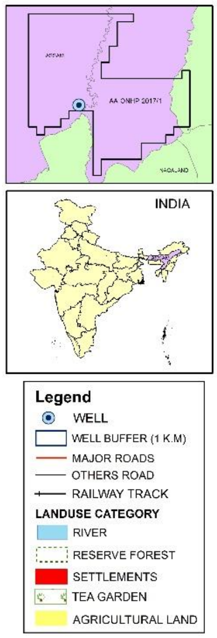


FIGURE NO	Project name: EIA Study for Oil and Gas exploration in Block AA-ONHP-2017_1, ASSAM					Title: Landuse and Landcover Map of Well No. 5	AECOM
	Date: 28/08/2019	Drawn By: Moumita Dey	Checked By: Souvik Basu	Approved By: Avijit Sarkar	Client Name: Vedanta Limited (Cairn Oil and Gas)	Source: Google Earth (22/01/2019), Toposheet No.: G46P/9, G46P/13, G46J/12 & G46J/16(Survey of India), Landsat 8 ETM+ & Resourcesat Liss III(Guided 2005-06 & 2011_12) Esri Digital Globe and the GIS User Community	

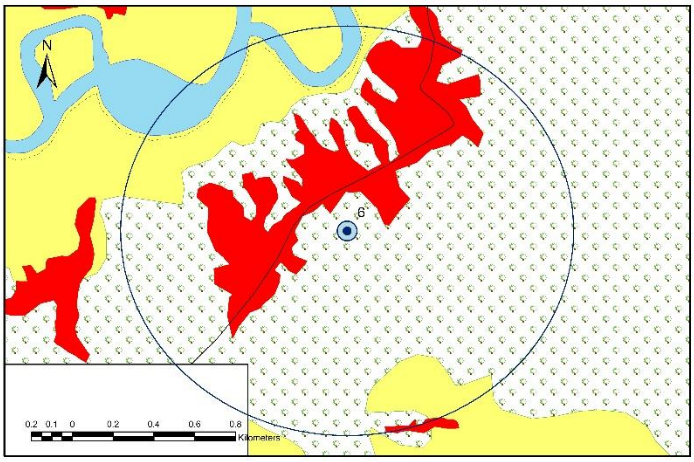


FIGURE NO	Project name: EIA Study for Oil and Gas exploration in Block AA-ONHP-2017_1, ASSAM					Title: Landuse and Landcover Map of Well No. 6	AECOM
	Date: 28/08/2019	Drawn By: Moumita Dey	Checked By: Souvik Basu	Approved By: Avijit Sarkar	Client Name: Vedanta Limited (Cairn Oil and Gas)	Source: Google Earth (22/01/2019), Toposheet No.: G46P/9, G46P/13, G46J/12 & G46J/16(Survey of India), Landsat 8 ETM+ & Resourcesat Liss III(Guided 2005-06 & 2011_12) Esri Digital Globe and the GIS User Community	

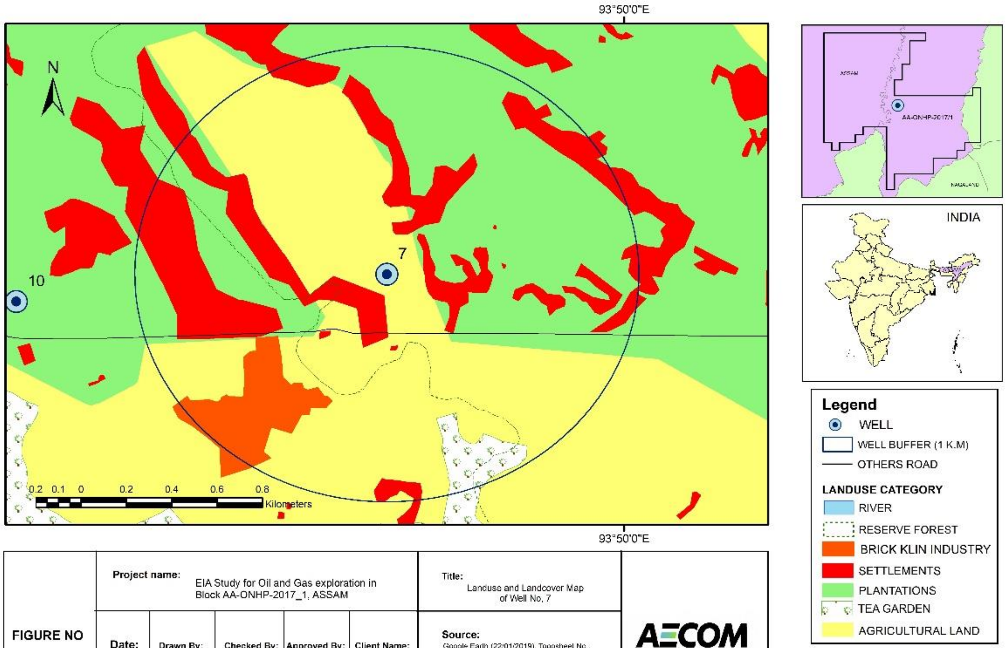


FIGURE NO	Project name: EIA Study for Oil and Gas exploration in Block AA-ONHP-2017_1, ASSAM					Title: Landuse and Landcover Map of Well No. 7	AECOM
	Date: 28/08/2019	Drawn By: Moumita Dey	Checked By: Souvik Basu	Approved By: Avijit Sarkar	Client Name: Vedanta Limited (Cairn Oil and Gas)	Source: Google Earth (22/01/2019), Toposheet No.: G46P/9, G46P/13, G46J/12 & G46J/16(Survey of India), Landsat 5 ETM+ & Resourcesat Liss III(Guided 2005-06 & 2011_12) Esri Digital Globe and the GIS User Community	

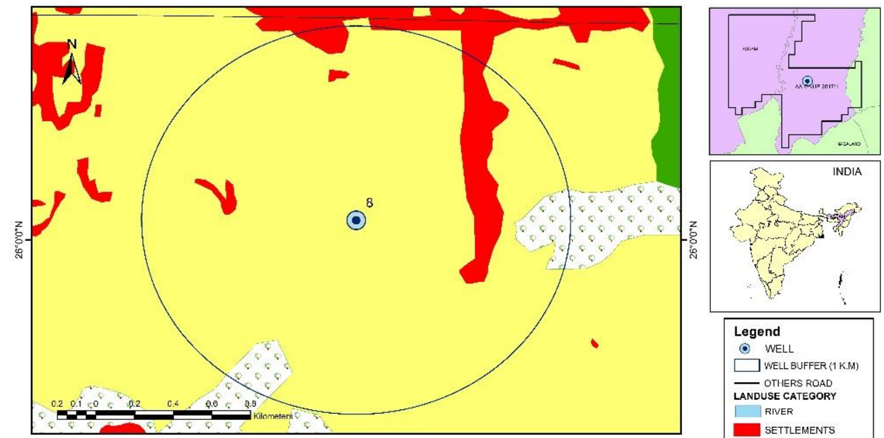
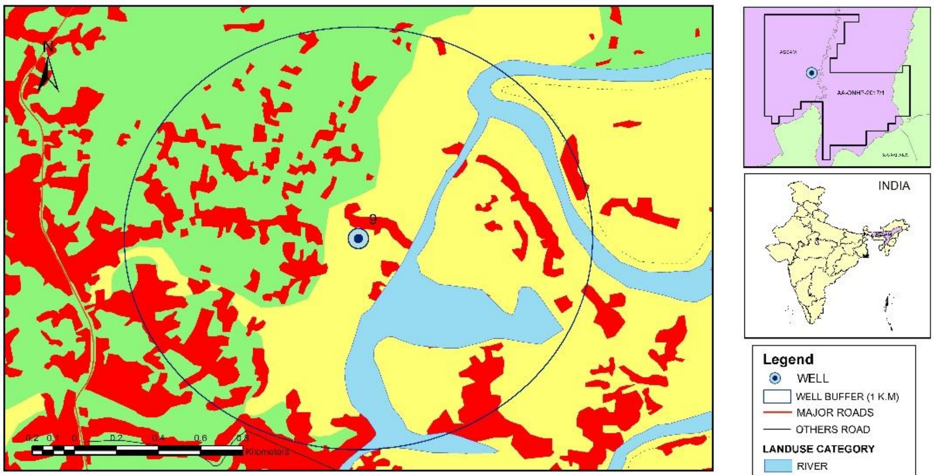


FIGURE NO	Project name: EIA Study for Oil and Gas exploration in Block AA-ONHP-2017_1, ASSAM					Title: Landuse and Landcover Map of Well No. 5	AECOM
	Date: 28/08/2019	Drawn By: Moumita Dey	Checked By: Souvik Basu	Approved By: Avijit Sarkar	Client Name: Vedanta Limited (Cairn Oil and Gas)	Source: Google Earth (22/01/2019), Toposheet No.: G46P/9, G46P/13, G46J/12 & G46J/16(Survey of India), Landsat 5 ETM+ & Resourcesat Liss III(Guided 2005-06 & 2011_12) Esri Digital Globe and the GIS User Community	



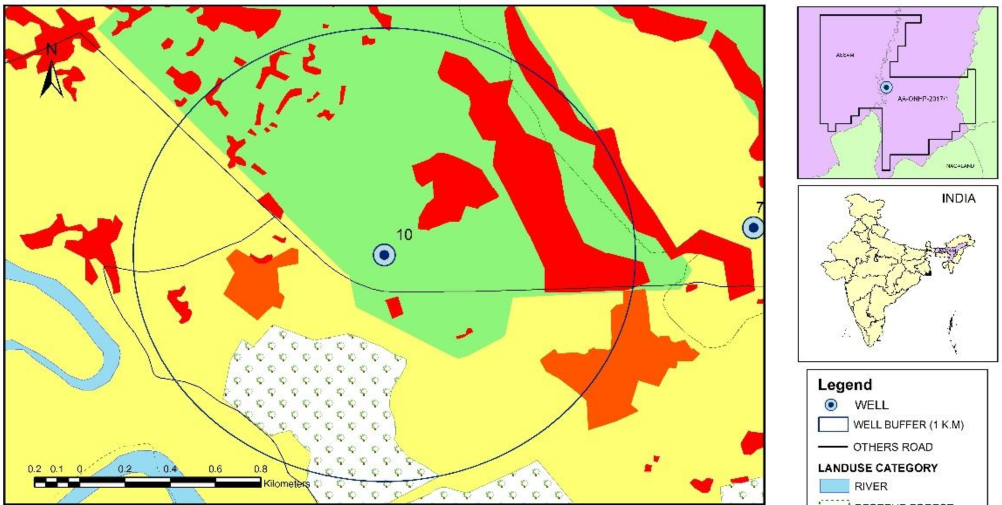
Legend

- WELL
- WELL BUFFER (1 K.M)
- MAJOR ROADS
- OTHERS ROAD

LANDUSE CATEGORY

- RIVER
- RESERVE FOREST
- SETTLEMENTS
- PLANTATIONS
- AGRICULTURAL LAND

FIGURE NO	Project name: EIA Study for Oil and Gas exploration in Block AA-ONHP-2017_1, ASSAM					Title: Landuse and Landcover Map of Well No. 9	AECOM
	Date: 28/08/2019	Drawn By: Moumita Dey	Checked By: Souvik Basu	Approved By: Avijit Sarkar	Client Name: Vedanta Limited (Cairn Oil and Gas)	Source: Google Earth (22/01/2019), Toposheet No.: G46P/9, G46P/13, G46J/12 & G46J/16(Survey of India), Landsat 5 ETM+ & Resourcesat Liss III(Guided 2005-06 & 2011_12) Esri Digital Globe and the GIS User Community	



Legend

- WELL
- WELL BUFFER (1 K.M)
- OTHERS ROAD

LANDUSE CATEGORY

- RIVER
- RESERVE FOREST
- BRICK KLIN INDUSTRY
- SETTLEMENTS
- TEA GARDEN
- PLANTATIONS
- AGRICULTURAL LAND

FIGURE NO	Project name: EIA Study for Oil and Gas exploration in Block AA-ONHP-2017_1, ASSAM					Title: Landuse and Landcover Map of Well No. 10	AECOM
	Date: 28/08/2019	Drawn By: Moumita Dey	Checked By: Souvik Basu	Approved By: Avijit Sarkar	Client Name: Vedanta Limited (Cairn Oil and Gas)	Source: Google Earth (22/01/2019), Toposheet No.: G46P/9, G46P/13, G46J/12 & G46J/16(Survey of India), Landsat 5 ETM+ & Resourcesat Liss III(Guided 2005-06 & 2011_12) Esri Digital Globe and the GIS User Community	

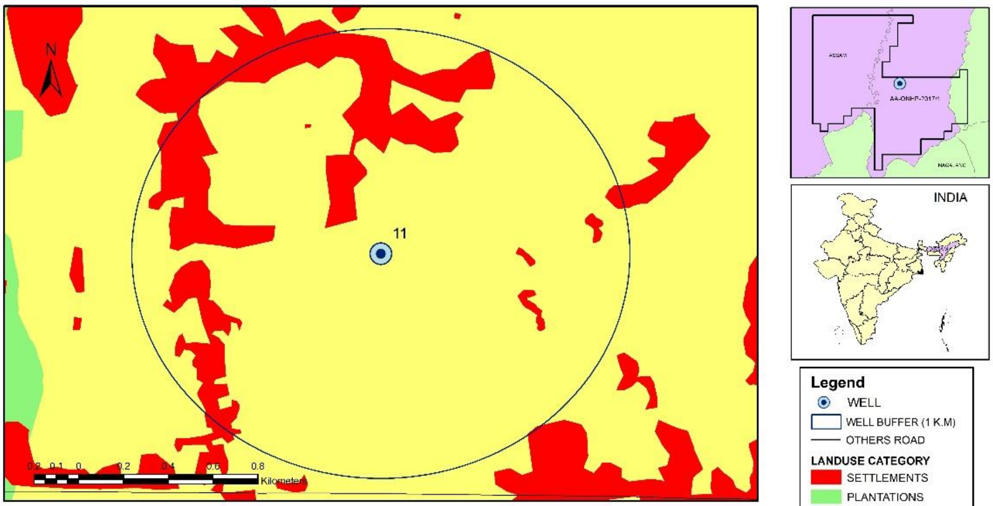


FIGURE NO	Project name: EIA Study for Oil and Gas exploration in Block AA-ONHP-2017_1, ASSAM					Title: Landuse and Landcover Map of Well No.11	AECOM
	Date: 28/08/2019	Drawn By: Moumita Dey	Checked By: Souvik Basu	Approved By: Avijit Sarkar	Client Name: Vedanta Limited (Cairn Oil and Gas)	Source: Google Earth (22/01/2019), Toposheet No.: G46P/9, G46P/13, G46J/12 & G46J/16(Survey of India), Landsat 5 ETM+ & Resourcesat Liss III(Guided 2005-06 & 2011_12) Esri Digital Globe and the GIS User Community	

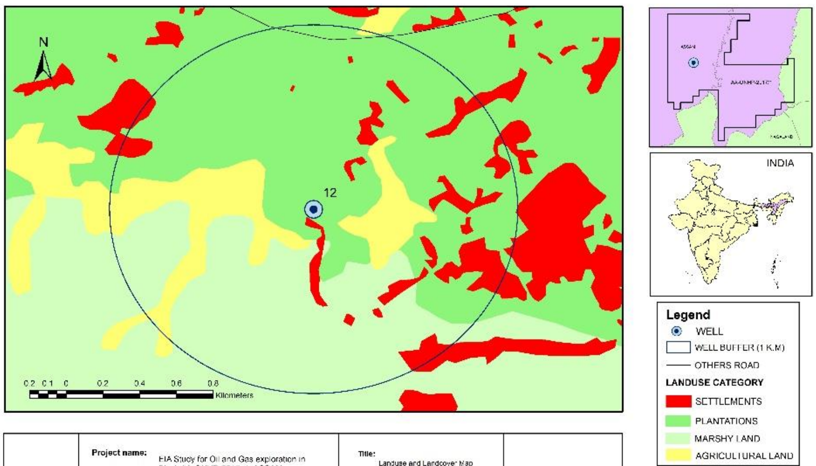
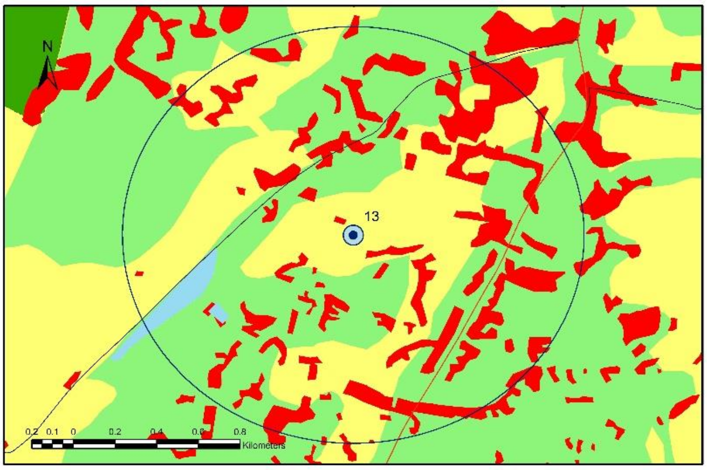


FIGURE NO	Project name: EIA Study for Oil and Gas exploration in Block AA-ONHP-2017_1, ASSAM					Title: Landuse and Landcover Map of Well No. 12	AECOM
	Date: 28/08/2019	Drawn By: Moumita Dey	Checked By: Souvik Basu	Approved By: Avijit Sarkar	Client Name: Vedanta Limited (Cairn Oil and Gas)	Source: Google Earth (22/01/2019), Toposheet No.: G46P/9, G46P/13, G46J/12 & G46J/16(Survey of India), Landsat 5 ETM+ & Resourcesat Liss III(Guided 2005-06 & 2011_12) Esri Digital Globe and the GIS User Community	



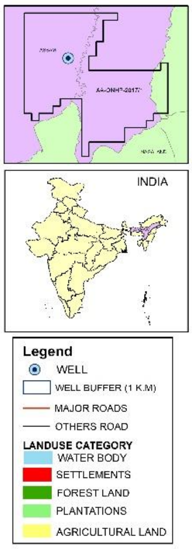


FIGURE NO	Project name: EIA Study for Oil and Gas exploration in Block AA-ONHP-2017_1, ASSAM					Title: Landuse and Landcover Map of Well No,13	AECOM
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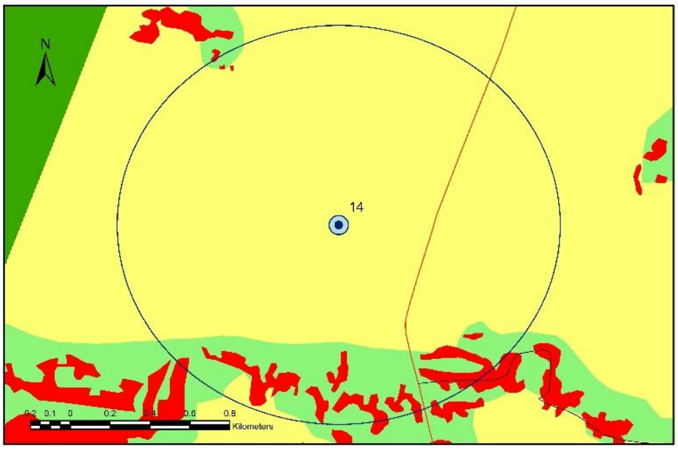


FIGURE NO	Project name: EIA Study for Oil and Gas exploration in Block AA-ONHP-2017_1, ASSAM					Title: Landuse and Landcover Map of Well No. 14	AECOM
	Date:	**Drawn By:**	**Checked By:**	**Approved By:**	**Client Name:**	**Source:**	
	28/08/2019	Moumita Dey	Souvik Basu	Avijit Sarkar	Vedanta Limited (Cairn Oil and Gas)	Google Earth (22/01/2019), Toposheet No.: G46P/9, G46P/13, G46J/12 & G46J/16(Survey of India), Landsat 5 ETM+ & Resourcesat Liss III(Guided 2005-06 & 2011_12) Esri Digital Globe and the GIS User Community	

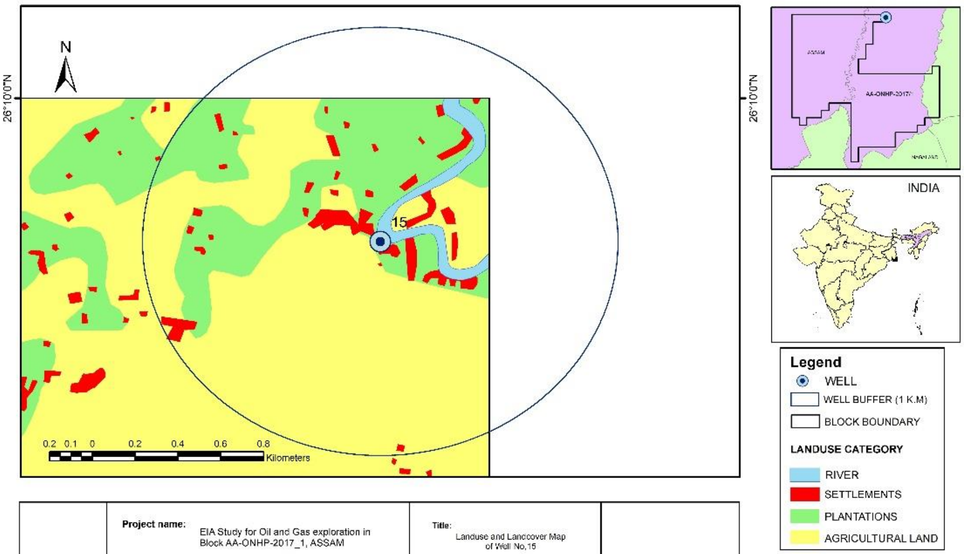


FIGURE NO	Project name: EIA Study for Oil and Gas exploration in Block AA-ONHP-2017_1, ASSAM					Title: Landuse and Landcover Map of Well No.15	AECOM
	Date: 28/08/2019	Drawn By: Moumita Dey	Checked By: Souvik Basu	Approved By: Avijit Sarkar	Client Name: Vedanta Limited (Cairn Oil and Gas)	Source: Google Earth (22/01/2019), Toposheet No. G46P/9, G46P/13, G46J/12 & G46J/16(Survey of India), Landsat 5 ETM+ & Resourcesat Liss III(Guided 2005-06 & 2011_12) Esri Digital Globe and the GIS User Community	

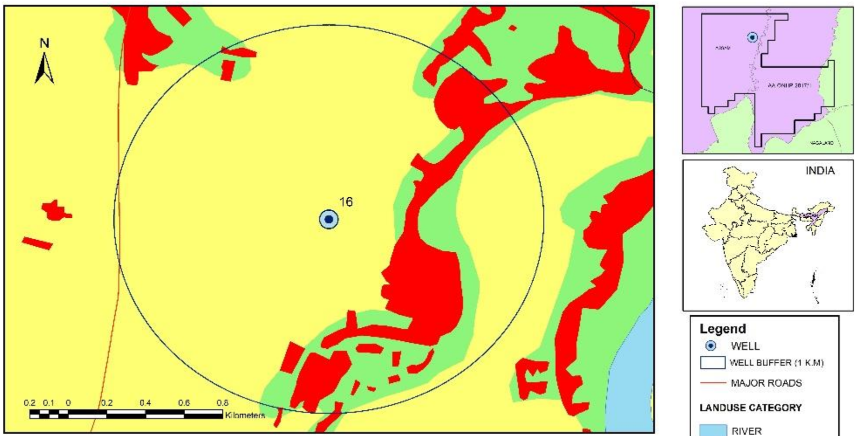
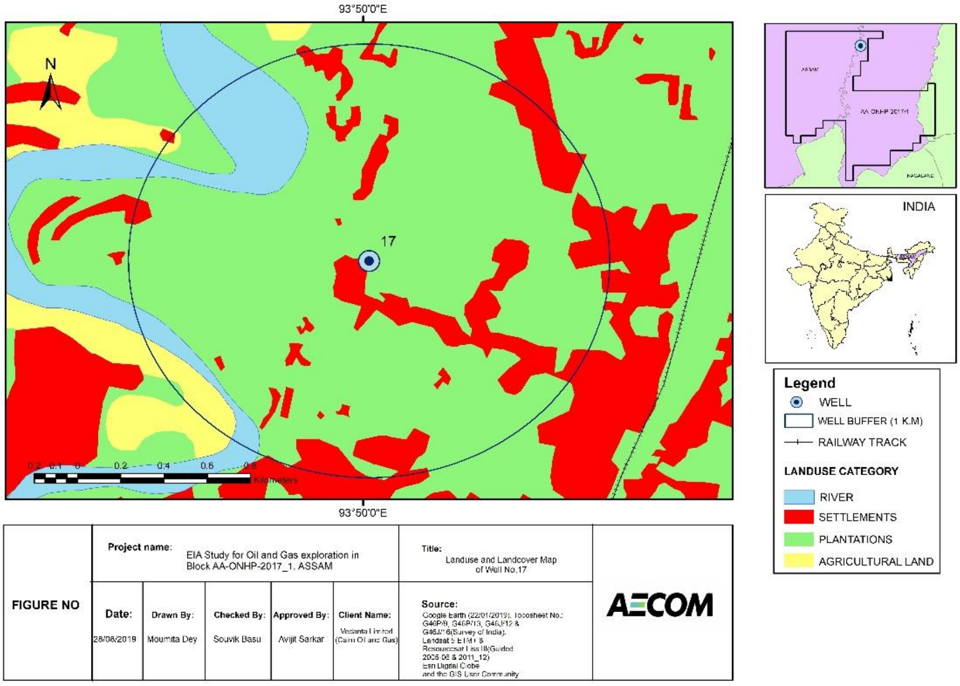
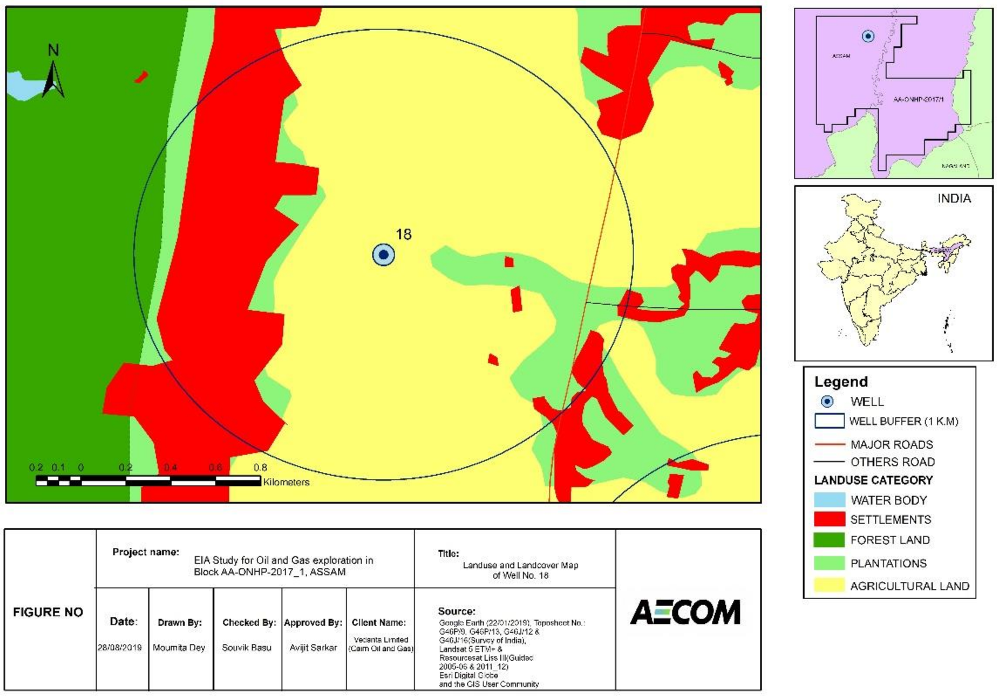


FIGURE NO	Project name: EIA Study for Oil and Gas exploration in Block AA-ONHP-2017_1. ASSAM					Title: Landuse and Landcover Map of Well No. 16	AECOM
	Date: 28/08/2019	Drawn By: Moumita Dey	Checked By: Souvik Basu	Approved By: Avijit Sarkar	Client Name: Vedanta Limited (Cairn Oil and Gas)	Source: Google Earth (22/01/2019), Toposheet No. G46P/9, G46P/13, G46J/12 & G46J/16(Survey of India), Landsat 5 ETM+ & Resourcesat Liss III(Guided 2005-06 & 2011_12) Esri Digital Globe and the GIS User Community	



93°50'0"E
N
17
Kilometers
93°50'0"E
INDIA
Legend
WELL
WELL BUFFER (1 K.M)
RAILWAY TRACK
LANDUSE CATEGORY
RIVER
SETTLEMENTS
PLANTATIONS
AGRICULTURAL LAND
FIGURE NO
Project name: EIA Study for Oil and Gas exploration in Block AA-ONHP-2017_1, ASSAM
Title: Landuse and Landcover Map of Well No.17
Date: 28/08/2019
Drawn By: Moumita Dey
Checked By: Souvik Basu
Approved By: Avijit Sarkar
Client Name: Vedanta Limited (Cairn Oil and Gas)
Source: Google Earth (22/01/2019), Toposheet No.: G46P/9, G46P/13, G46J/12 & G46J/16(Survey of India), Landsat 5 ETM+ & Resourcesat Liss III(Guided 2005-06 & 2011_12) Esri Digital Globe and the GIS User Community
AECOM



N
18
Kilometers
INDIA
Legend
WELL
WELL BUFFER (1 K.M)
MAJOR ROADS
OTHERS ROAD
LANDUSE CATEGORY
WATER BODY
SETTLEMENTS
FOREST LAND
PLANTATIONS
AGRICULTURAL LAND
FIGURE NO
Project name: EIA Study for Oil and Gas exploration in Block AA-ONHP-2017_1, ASSAM
Title: Landuse and Landcover Map of Well No. 18
Date: 28/08/2019
Drawn By: Moumita Dey
Checked By: Souvik Basu
Approved By: Avijit Sarkar
Client Name: Vedanta Limited (Cairn Oil and Gas)
Source: Google Earth (22/01/2019), Toposheet No.: G46P/9, G46P/13, G46J/12 & G46J/16(Survey of India), Landsat 5 ETM+ & Resourcesat Liss III(Guided 2005-06 & 2011_12) Esri Digital Globe and the GIS User Community
AECOM

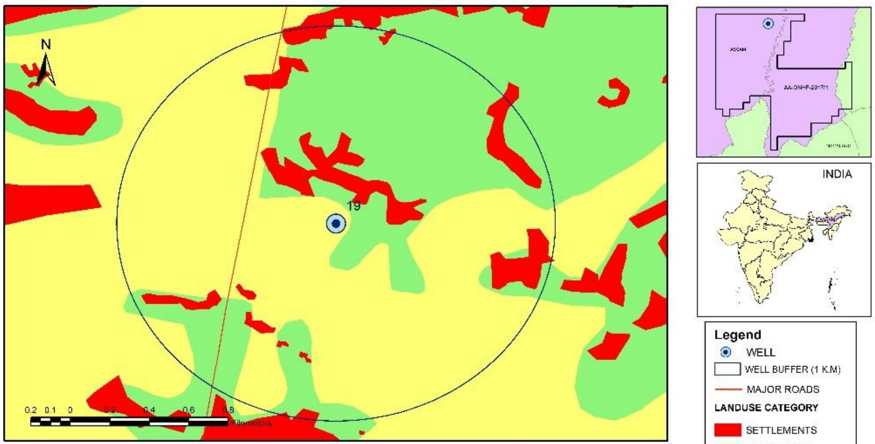


FIGURE NO	Project name: EIA Study for Oil and Gas exploration in Block AA-ONHP-2017_1, ASSAM					Title: Landuse and Landcover Map of Well No.19	
	Date: 28/08/2019	Drawn By: Moumita Dey	Checked By: Souvik Basu	Approved By: Avijit Sarkar	Client Name: Vedanta Limited (Cairn Oil and Gas)	Source: Google Earth (22/01/2018), Toposheet No.: G46P/9, G46P/13, G46J/12 & G46J/16(Survey of India), Landsat 5 ETM+ & Resourcesat Liss III(Guided 2005-06 & 2011_12) Esri Digital Globe and the GIS User Community	AECOM

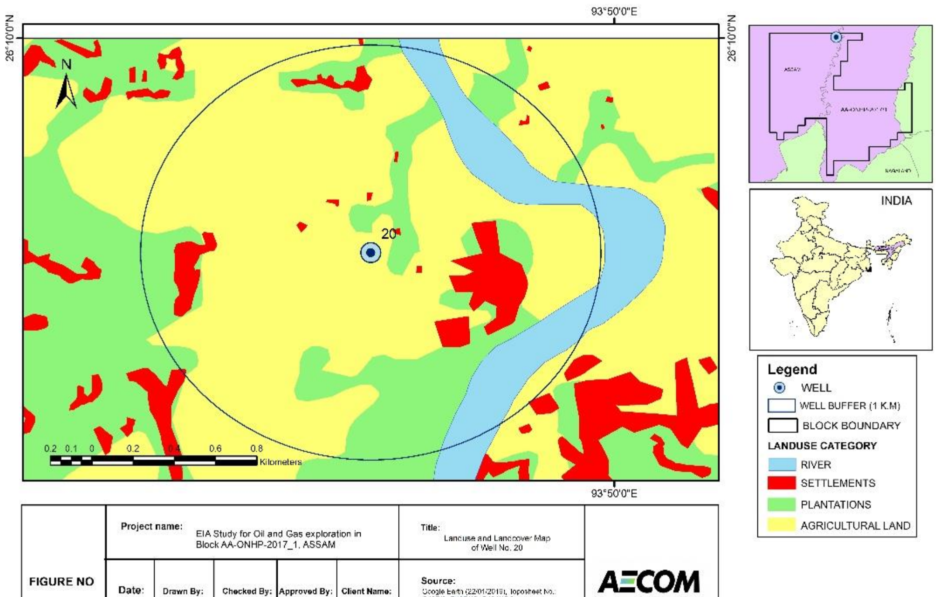


FIGURE NO	Project name: EIA Study for Oil and Gas exploration in Block AA-ONHP-2017_1, ASSAM					Title: Landuse and Landcover Map of Well No. 20	
	Date: 28/08/2019	Drawn By: Moumita Dey	Checked By: Souvik Basu	Approved By: Avijit Sarkar	Client Name: Vedanta Limited (Cairn Oil and Gas)	Source: Google Earth (22/01/2018), Toposheet No.: G46P/9, G46P/13, G46J/12 & G46J/16(Survey of India), Landsat 5 ETM+ & Resourcesat Liss III(Guided 2005-06 & 2011_12) Esri Digital Globe and the GIS User Community	AECOM

Appendix 2.5: The List of Chemicals to be Used During Drilling

CHEMICAL DETAIL

Function	chemicals
A. WBM Formulation	
Water /Base fluid	
Viscosifier	Biopolymer
Fluid Loss Agent	Drispac/CMC
Alkalinity Agent	Caustic Potash
Salinity	Potassium Sulphate
Lubricant	Torque Reducer/Blend of vegetable oil, Surfactant and Food Grade Paraffin Oil
Gelling agent	Bentonite
Biocide	Gluteraldehyde
Weighting Agent	Barite
B. SBM Formulation	
Base oil/Base Fluid	Synthetic Biodegradable Base Fluid
Water	-
Emulsifier	Polyamide, Petroleum Distillate, Dipropylene Glycol Methyl Ether
Viscosifier	Bentonite
Fluid Loss Agent	Gilsonite
Brine Phase	Sodium Formate
Alkalinity	Calcium Hydroxide
Bridging Agent	Calcium Carbonate Graded
Weighting Agent	Barite

Appendix 3.1: Micro-Meteorological Data

Appendix 3.1- Micro meteorology Data

Location - Bokajan

Coordinate-26°01'25.71"N, 93°46'21.79"E

ear	Month	Day	Hour	Temperature	Reltaive Humidity	Wind Dir	Wind Speed	Rainfall	Cloud Cover	Solar Rad
-	-	-	-	(°C)	(%)	(Deg)	(mph)	(In)	(%)	(wat/m2)
2019	3	10	1	23.1	89.2	231	2	0	0	0
2019	3	10	2	23.1	90.5	231	3	0	0	0
2019	3	10	3	23.1	88.1	231	6	0	0	0
2019	3	10	4	23	90.0	231	5	0	0	0
2019	3	10	5	23	88.9	231	3	0	10	0
2019	3	10	6	23	89.8	231	2	0	0	8
2019	3	10	7	24	90.4	231	0	0	10	103
2019	3	10	8	24	90.0	231	0	0	25	165
2019	3	10	9	24	87.3	231	0	0	0	343
2019	3	10	10	24	77.0	231	2	0	0	464
2019	3	10	11	24	66.1	231	0	0	0	554
2019	3	10	12	24.1	58.8	231	0	0	0	520
2019	3	10	13	24.2	53.1	231	0	0	0	619
2019	3	10	14	23.2	51.9	231	0	0	0	524
2019	3	10	15	25.2	51.8	231	0	0	0	381
2019	3	10	16	25.3	50.1	231	0	0	0	141
2019	3	10	17	25.6	55.7	231	0	0	0	41
2019	3	10	18	25	64.5	231	0	0	30	1
2019	3	10	19	24.6	71.9	231	3	0	30	0

2019	3	10	20	23.6	76.3	231	3	0	30	0
2019	3	10	21	23.3	79.7	231	3	0	30	0
2019	3	10	22	23.1	84.7	231	8	0	30	0
2019	3	10	23	23	88.0	231	6	0	30	0
2019	3	10	24	23	90.1	231	7	0	100	0
2019	3	11	1	23	91.4	231	7	0	100	0
2019	3	11	2	23.1	92.3	231	3	0	100	0
2019	3	11	3	23.4	92.5	231	3	0	100	0
2019	3	11	4	23.6	93.2	231	0	0	100	0
2019	3	11	5	23.8	93.6	231	3	0	100	0
2019	3	11	6	24	93.9	141	5	0	100	11
2019	3	11	7	24	93.6	141	5	0	100	104
2019	3	11	8	22.6	91.9	114	2	0	100	167
2019	3	11	9	24.9	86.1	55	3	0	100	345
2019	3	11	10	26	76.3	79	2	0	100	465
2019	3	11	11	26.9	66.8	49	0	0	74	522
2019	3	11	12	28.2	55.1	223	0	0	15	517
2019	3	11	13	29.6	50.1	265	0	0	25	587
2019	3	11	14	29.9	47.1	244	0	0	30	531
2019	3	11	15	30	46.5	237	0	0	20	377
2019	3	11	16	29.5	45.8	190	0	0	70	147
2019	3	11	17	28.3	47.6	100	0	0	100	44
2019	3	11	18	26.3	57.5	173	2	0	100	5
2019	3	11	19	24.8	70.4	159	2	0	100	0
2019	3	11	20	24	77.5	112	0	0	100	0
2019	3	11	21	22.8	81.1	146	2	0	100	0

2019	3	11	22	22.6	83.3	67	3	0	87	0
2019	3	11	23	21.9	84.2	66	5	0	64	0
2019	3	11	24	21.5	87.4	56	5	0	9	0
2019	3	12	1	20.4	88.8	125	6	0	96	0
2019	3	12	2	19.8	90.7	104	7	0	100	0
2019	3	12	3	20.2	91.0	254	5	0	100	0
2019	3	12	4	19.1	90.6	268	5	0	48	0
2019	3	12	5	18.5	91.3	211	3	0	20	0
2019	3	12	6	19.3	90.5	151	0	0	28	9
2019	3	12	7	20.2	89.9	160	0	0	28	108
2019	3	12	8	22.3	90.6	217	0	0	13	163
2019	3	12	9	24.7	88.8	104	0	0	14	383
2019	3	12	10	26.9	80.3	213	0	0	12	463
2019	3	12	11	29.2	75.8	148	0	0	5	528
2019	3	12	12	30.2	63.4	138	0	0	0	523
2019	3	12	13	32.2	55.3	169	0	0	2	588
2019	3	12	14	32.2	59.7	234	0	0	15	543
2019	3	12	15	33.1	62.5	145	0	0	26	396
2019	3	12	16	33.2	65.1	64	0	0	15	153
2019	3	12	17	31.5	68.8	81	0	0.1	20	38
2019	3	12	18	29.5	71.7	72	0	0	0	35
2019	3	12	19	28.2	74.4	72	2	0.02	0	0
2019	3	12	20	27.8	76.5	64	2	0	0	0
2019	3	12	21	26.7	78.8	69	3	0	0	0
2019	3	12	22	26.1	81.3	72	6	0	15	0
2019	3	12	23	25.3	88.0	66	8	0	10	0

2019	3	12	24	24.3	90.6	69	8	0	0	0
2019	3	13	1	23.2	92.5	79	8	0	0	0
2019	3	13	2	20.8	93.4	83	8	0	0	0
2019	3	13	3	20.3	93.9	83	6	0	0	0
2019	3	13	4	20	93.7	83	6	0	0	0
2019	3	13	5	19.1	92.7	83	3	0	0	0
2019	3	13	6	18.5	93.6	83	0	0	0	14
2019	3	13	7	19.2	94.7	83	0	0	0	94
2019	3	13	8	21.7	91.5	83	0	0	0	171
2019	3	13	9	23.7	84.4	83	0	0	0	351
2019	3	13	10	25.2	76.9	160	0	0	0	471
2019	3	13	11	26.6	66.5	213	0	0	0	431
2019	3	13	12	27.6	55.2	275	0	0	10	535
2019	3	13	13	28.2	46.9	280	0	0.05	9	591
2019	3	13	14	28.5	45.6	254	0	0.05	14	520
2019	3	13	15	28.6	49.8	248	0	0	48	385
2019	3	13	16	28.1	46.0	248	0	0	100	154
2019	3	13	17	26.7	43.7	173	0	0	100	39
2019	3	13	18	24.6	47.7	62	0	0	42	8
2019	3	13	19	23.2	56.7	74	3	0	21	0
2019	3	13	20	22.3	65.2	74	3	0	14	0
2019	3	13	21	21.8	63.0	79	3	0	10	0
2019	3	13	22	20.8	59.7	67	5	0	14	0
2019	3	13	23	20.6	59.5	94	7	0	17	0
2019	3	13	24	20.2	61.6	5	7	0	12	0
2019	3	14	1	20.2	64.0	5	0	0	19	0

2019	3	14	2	20	66.3	9	7	0	29	0
2019	3	14	3	19.1	68.4	114	5	0	47	0
2019	3	14	4	18.8	69.8	230	2	0	22	0
2019	3	14	5	19.5	70.7	333	0	0	32	0
2019	3	14	6	19.1	71.6	221	0	0	31	24
2019	3	14	7	20	72.3	117	0	0	33	111
2019	3	14	8	22	72.8	125	0	0	8	174
2019	3	14	9	23.8	73.7	199	0	0	4	351
2019	3	14	10	25.4	69.3	249	0	0	75	479
2019	3	14	11	27.2	64.6	251	0	0	13	511
2019	3	14	12	27.3	58.7	221	0	0	0	527
2019	3	14	13	28.7	49.4	70	0	0	0	574
2019	3	14	14	29.4	45.7	72	0	0	0	711
2019	3	14	15	29.1	39.1	134	0	0	10	345
2019	3	14	16	28.7	40.1	193	0	0.01	0	131
2019	3	14	17	27.6	46.2	170	0	0.01	2	48
2019	3	14	18	26.1	53.1	122	0	0	100	11
2019	3	14	19	20	61.4	112	0	0	100	0
2019	3	14	20	21.1	64.9	136	2	0	44	0
2019	3	14	21	20.8	69.7	77	3	0	20	0
2019	3	14	22	20.3	70.6	72	5	0	35	0
2019	3	14	23	19.8	69.9	190	5	0	10	0
2019	3	14	24	19.3	69.8	312	6	0	0	0
2019	3	15	1	18.7	70.1	269	7	0	0	0
2019	3	15	2	17.9	70.2	269	6	0	0	0
2019	3	15	3	18.2	70.6	269	7	0	0	0

2019	3	15	4	18.3	70.0	189	3	0	0	0
2019	3	15	5	17.5	70.8	276	3	0	0	0
2019	3	15	6	17.2	71.3	112	0	0	0	11
2019	3	15	7	17.4	71.6	57	0	0	10.2	104
2019	3	15	8	18.5	70.7	57	0	0	12	167
2019	3	15	9	19.5	70.9	57	2	0	10.2	345
2019	3	15	10	20.6	70.6	57	0	0	13.5	465
2019	3	15	11	21.6	70.6	57	0	0.02	12	522
2019	3	15	12	22.2	60.8	57	0	0.01	11.1	517
2019	3	15	13	21.6	59.4	163	0	0	12	587
2019	3	15	14	21.5	53.2	214	5	0.12	10.5	531
2019	3	15	15	21.7	50.8	103	8	0.05	8.1	377
2019	3	15	16	21.5	54.4	79	6	0.15	5.7	147
2019	3	15	17	21	59.3	155	5	0	1.2	44
2019	3	15	18	19.9	64.4	86	6	0.01	9.3	5
2019	3	15	19	19.1	69.9	98	2	0.12	12.6	0
2019	3	15	20	18.1	72.3	138	2	0.05	12.6	0
2019	3	15	21	17.7	73.5	129	5	0	12.6	0
2019	3	15	22	17.5	79.3	76	3	0.26	12.3	0
2019	3	15	23	17.6	81.8	70	3	3.81	30	0
2019	3	15	24	17.4	86.4	70	3	3.47	30	0
2019	3	16	1	17	81.7	70	7	0	30	0
2019	3	16	2	16.7	82.7	70	7	0	100	0
2019	3	16	3	16.4	85.2	70	5	0	100	0
2019	3	16	4	16.3	89.5	124	3	0	100	0
2019	3	16	5	16.6	90.3	152	0	0	100	0

2019	3	16	6	16.7	91.5	152	0	0	100	21
2019	3	16	7	17	91.8	151	0	0.03	95	88
2019	3	16	8	18.3	87.7	152	0	0.04	100	297
2019	3	16	9	20.2	76.0	152	0	0	80	352
2019	3	16	10	21.1	72.8	152	0	0	76	362
2019	3	16	11	22.8	60.5	152	0	0	10	445
2019	3	16	12	24.5	49.2	152	0	0	10	551
2019	3	16	13	25.6	44.6	152	2	0	13	549
2019	3	16	14	26.6	39.8	151	0	0	9	450
2019	3	16	15	25.9	38.8	110	0	0	0.9	308
2019	3	16	16	25.3	39.4	88	3	0	2.7	141
2019	3	16	17	23.7	42.4	110	2	0	100	60
2019	3	16	18	21.7	50.2	100	0	0	91	4
2019	3	16	19	20.8	55.4	81	2	0	92	0
2019	3	16	20	20.3	61.5	72	3	0	100	0
2019	3	16	21	19.9	69.4	74	5	0	100	0
2019	3	16	22	19	80.5	60	3	0	100	0
2019	3	16	23	18.4	84.4	70	3	0	100	0
2019	3	16	24	17.6	86.0	72	3	0	93	0
2019	3	17	1	17.2	87.5	72	6	0	100	0
2019	3	17	2	16.8	86.6	72	3	0	100	0
2019	3	17	3	16.8	84.8	72	6	0	100	0
2019	3	17	4	16.6	87.6	72	5	0	100	0
2019	3	17	5	16.5	87.0	73	3	0	100	0
2019	3	17	6	16.3	86.1	73	0	0	100	15
2019	3	17	7	17.2	88.1	73	0	0	100	80

2019	3	17	8	18.9	86.2	73	2	0	100	274
2019	3	17	9	20.5	82.9	73	0	0	100	401
2019	3	17	10	21.8	76.0	73	0	0	100	584
2019	3	17	11	23.4	69.6	73	2	0	100	716
2019	3	17	12	24.3	65.5	73	2	0	100	672
2019	3	17	13	24.4	59.2	86	0	0	100	671
2019	3	17	14	25.2	57.1	211	0	0	98	434
2019	3	17	15	24.9	55.9	63	3	0	100	430
2019	3	17	16	24.5	54.3	151	0	0	97	230
2019	3	17	17	22.8	55.3	129	0	0	0	85
2019	3	17	18	21.6	63.8	172	0	0	100	4
2019	3	17	19	20.3	78.0	165	3	0	98	0
2019	3	17	20	19.5	85.3	98	3	0	100	0
2019	3	17	21	19.3	88.6	234	3	0	94	0
2019	3	17	22	19	90.6	269	5	0	100	0
2019	3	17	23	18.7	92.1	269	3	0	100	0
2019	3	17	24	18.6	92.9	269	5	0	10	0
2019	3	18	1	18.5	91.8	269	3	0	1.8	0
2019	3	18	2	18.2	92.2	228	30	0	7.8	0
2019	3	18	3	17.2	91.5	238	3	0	30	0
2019	3	18	4	17.1	92.8	224	3	0	36	0
2019	3	18	5	17	91.3	199	3	0	3	0
2019	3	18	6	16.4	91.4	193	2	0	4	11
2019	3	18	7	16.7	92.2	200	2	0	1	117
2019	3	18	8	18.6	90.7	210	2	0	2	303
2019	3	18	9	20.5	86.4	218	0	0	3	486

2019	3	18	10	22.1	74.7	189	0	0	0	637
2019	3	18	11	22.8	71.7	22	2	0	7	727
2019	3	18	12	23.7	61.5	104	2	0	17	751
2019	3	18	13	24.3	55.1	67	2	0	19	720
2019	3	18	14	24.1	49.1	67	0	0	100	605
2019	3	18	15	23.9	46.0	76	0	0	100	428
2019	3	18	16	22.8	49.1	66	0	0	95	243
2019	3	18	17	21.5	55.6	74	0	0	100	83
2019	3	18	18	20.2	59.0	73	3	0	100	4
2019	3	18	19	19.4	65.7	135	3	0	100	0
2019	3	18	20	19	71.6	244	3	0	100	0
2019	3	18	21	18.4	75.4	138	7	0	100	0
2019	3	18	22	18.4	79.2	183	5	0	100	0
2019	3	18	23	18	81.9	183	5	0	100	0
2019	3	18	24	17.7	85.3	183	8	0	0	0
2019	3	19	1	17.5	88.4	183	0	0	3	0
2019	3	19	2	17.2	84.0	214	6	0	100	0
2019	3	19	3	17	85.6	262	6	0	100	0
2019	3	19	4	16.7	82.0	242	3	0	100	0
2019	3	19	5	16.6	83.2	234	0	0	100	0
2019	3	19	6	16.9	88.7	247	0	0	100	10
2019	3	19	7	17.2	87.5	242	0	0	100	101
2019	3	19	8	18	80.2	141	0	0	12	161
2019	3	19	9	19	80.5	59	0	0	100	340
2019	3	19	10	20	80.8	122	0	0	100	459
2019	3	19	11	20.8	81.0	227	0	0	100	541

2019	3	19	12	22	75.8	227	0	0	100	420
2019	3	19	13	22.1	70.7	227	0	0	9	631
2019	3	19	14	23.3	71.2	214	0	0	3	520
2019	3	19	15	23.2	75.7	186	0	0	0	385
2019	3	19	16	23.2	79.6	231	0	0	0	137
2019	3	19	17	22.7	77.8	125	0	0	36	43
2019	3	19	18	21.5	79.6	199	0	0.06	89	1
2019	3	19	19	20.7	84.6	182	3	0.5	100	0
2019	3	19	20	20.2	86.9	232	3	0	88	0
2019	3	19	21	20.1	85.4	218	5	0	18	0
2019	3	19	22	19.6	85.1	247	8	0	19	0
2019	3	19	23	19.6	87.3	288	6	0	5.4	0
2019	3	19	24	18.6	91.4	275	7	0	0	0
2019	3	20	1	18	92.2	275	7	0	0	0
2019	3	20	2	17.7	92.1	275	8	0	0	0
2019	3	20	3	17.6	92.3	275	7	0	0	0
2019	3	20	4	17.2	92.3	275	7	0.03	0	0
2019	3	20	5	16.9	92.0	275	8	0	0	0
2019	3	20	6	16.7	91.3	275	3	0	0	6
2019	3	20	7	17.4	94.5	275	3	0	0	48
2019	3	20	8	19.1	90.3	275	0	0	0	140
2019	3	20	9	21.2	83.2	275	3	0	0	373
2019	3	20	10	23.7	75.8	275	3	0	0	408
2019	3	20	11	25.4	64.9	275	0	0	0	573
2019	3	20	12	26.7	64.8	275	0	0	0	476
2019	3	20	13	27.1	61.8	273	2	0	0	163

2019	3	20	14	27.3	57.1	217	2	0	0	186
2019	3	20	15	27	60.3	148	0	0	0	296
2019	3	20	16	26.6	58.1	201	0	0	0	194
2019	3	20	17	25.8	56.7	148	0	0	0	55
2019	3	20	18	24.4	64.6	162	0	0	0	0
2019	3	20	19	23.7	69.7	112	6	0.07	0	0
2019	3	20	20	22.8	73.9	131	5	0.04	0	0
2019	3	20	21	21.6	71.7	97	6	0	0	0
2019	3	20	22	20.7	73.7	182	5	0.01	0	0
2019	3	20	23	20.5	80.4	341	5	0.01	0	0
2019	3	20	24	20.2	80.1	341	8	0	0	0
2019	3	21	1	19.6	83.5	341	8	0	0	0
2019	3	21	2	18.7	87.0	341	6	0	0	0
2019	3	21	3	18.2	87.9	341	7	0	0	0
2019	3	21	4	17.8	89.1	341	7	0	0	0
2019	3	21	5	17.6	89.1	341	3	0	0.3	0
2019	3	21	6	17.8	88.0	341	6	0	0	7
2019	3	21	7	18.8	91.1	341	3	0	2	69
2019	3	21	8	22.2	89.7	341	3	0	0	242
2019	3	21	9	24.6	82.5	343	0	0	0	403
2019	3	21	10	26.8	77.0	343	2	0	0	415
2019	3	21	11	27.8	73.7	343	0	0	10	560
2019	3	21	12	28.7	63.4	343	0	0	10	701
2019	3	21	13	29.7	56.7	323	2	0	10	699
2019	3	21	14	29.8	54.2	249	2	0	0	509
2019	3	21	15	30.2	52.7	151	2	0	0	335

2019	3	21	16	29.6	50.6	124	3	0	0	241
2019	3	21	17	28.4	52.6	216	0	0	0	85
2019	3	21	18	26.3	60.8	172	0	0	10	3
2019	3	21	19	25.1	62.4	321	2	0	10	0
2019	3	21	20	23.8	66.7	177	3	0	10	0
2019	3	21	21	22.3	75.9	104	5	0.01	10	0
2019	3	21	22	22.1	81.3	94	6	0.03	10	0
2019	3	21	23	20.5	84.8	94	6	0.03	10	0
2019	3	21	24	20	85.2	94	7	0.04	10	0
2019	3	22	1	20.3	88.1	94	7	0	0	0
2019	3	22	2	19.7	80.0	94	7	0	0	0
2019	3	22	3	18.8	79.8	94	6	0	0	0
2019	3	22	4	19.1	84.5	94	5	0	0	0
2019	3	22	5	18.3	87.1	94	7	0	0	0
2019	3	22	6	18	87.7	94	0	0	0	14
2019	3	22	7	19.2	86.6	94	7	0	10	121
2019	3	22	8	22.8	86.6	83	6	0	0	307
2019	3	22	9	24.8	87.4	50	5	0	10	488
2019	3	22	10	26.5	88.6	49	3	0	0	650
2019	3	22	11	28.2	87.8	49	0	0	0	743
2019	3	22	12	29.4	87.1	128	0	0	0	764
2019	3	22	13	30.4	81.7	186	2	0	0	446
2019	3	22	14	30.8	82.4	290	2	0	0	488
2019	3	22	15	31.7	78.0	235	0	0	10	311
2019	3	22	16	30.2	69.8	146	0	0	10	226
2019	3	22	17	28.1	76.2	69	0	0	10	70

2019	3	22	18	23.6	80.4	66	2	0	10	5
2019	3	22	19	22.3	86.2	96	3	0	10	0
2019	3	22	20	21.6	88.4	81	3	0	10	0
2019	3	22	21	20.5	91.3	81	5	0	14.4	0
2019	3	22	22	20.2	92.0	63	5	0	63	0
2019	3	22	23	20	92.0	179	0	0	84	0
2019	3	22	24	20.6	93.4	293	7	0	10	0
2019	3	23	1	20.2	93.8	248	5	0	0	0
2019	3	23	2	19.7	94.3	220	6	0.07	10	0
2019	3	23	3	19.6	94.5	220	7	0.08	10	0
2019	3	23	4	18.5	93.9	220	6	0.01	10	0
2019	3	23	5	18.4	93.9	220	2	0.11	6	0
2019	3	23	6	18.5	91.6	220	2	0.01	100	0
2019	3	23	7	19.2	91.5	232	2	0	100	31
2019	3	23	8	20.6	88.2	241	3	0	100	253
2019	3	23	9	23.3	85.5	241	7	0	100	422
2019	3	23	10	25.5	75.4	241	7	0	100	533
2019	3	23	11	26.8	72.2	241	0	0	100	676
2019	3	23	12	28	68.7	241	0	0	100	598
2019	3	23	13	29.1	66.1	241	8	0	100	612
2019	3	23	14	29.8	68.0	249	0	0	100	492
2019	3	23	15	29.8	64.1	139	0	0	100	397
2019	3	23	16	28.2	64.3	79	0	0	100	240
2019	3	23	17	27.2	66.6	62	8	0	84	85
2019	3	23	18	25.3	74.8	69	8	0	60	4
2019	3	23	19	24.1	86.1	72	6	0	10	0

2019	3	23	20	20.5	86.3	64	3	0	10	0
2019	3	23	21	20.1	89.4	64	3	0	11	0
2019	3	23	22	19.5	90.8	69	5	0.01	95	0
2019	3	23	23	19.5	87.7	90	3	0	96	0
2019	3	23	24	19	90.1	69	3	0	19.2	0
2019	3	24	1	18.8	90.7	70	3	0.02	45	0
2019	3	24	2	18.4	91.4	70	5	0.02	0	0
2019	3	24	3	18.1	93.5	129	0	0	0	0
2019	3	24	4	17.6	93.1	165	2	0	0	0
2019	3	24	5	16.9	94.1	165	3	0	0	0
2019	3	24	6	16.8	94.6	172	3	0	0	13
2019	3	24	7	18.7	95.0	187	3	0	0	81
2019	3	24	8	21.6	91.3	225	7	0	0	178
2019	3	24	9	23.6	80.1	225	6	0	0	263
2019	3	24	10	25.3	71.3	238	8	0	0	244
2019	3	24	11	26.6	64.9	256	7	0	100	305
2019	3	24	12	27.7	58.2	256	5	0	100	355
2019	3	24	13	28.2	54.5	256	8	0	55	407
2019	3	24	14	29	54.1	120	8	0	67	510
2019	3	24	15	29.8	50.0	88	6	0	64	173
2019	3	24	16	30	49.8	69	8	0	85	178
2019	3	24	17	29.2	51.6	80	6	0	98	76
2019	3	24	18	26.4	65.2	91	7	0	100	3
2019	3	24	19	24.2	76.6	69	2	0	100	0
2019	3	24	20	23.6	82.2	76	3	0	0	0
2019	3	24	21	23.1	82.7	74	3	0.02	10	0

2019	3	24	22	22.2	84.4	69	3	0.01	64	0
2019	3	24	23	21.8	83.4	77	3	0	71	0
2019	3	24	24	20.3	88.0	39	3	0	73	0
2019	3	25	1	19.6	90.4	134	3	0	25	0
2019	3	25	2	19.2	91.9	70	2	0	50	0
2019	3	25	3	18.8	91.5	69	3	0	75	0
2019	3	25	4	18.2	92.1	155	2	0	85	0
2019	3	25	5	18	88.2	194	2	0	71	0
2019	3	25	6	18.4	88.3	66	2	0	86	11
2019	3	25	7	19.4	89.2	64	3	0	10	84
2019	3	25	8	22.5	84.8	64	3	0	91	218
2019	3	25	9	25.4	75.1	64	6	0	10	479
2019	3	25	10	27	66.9	66	6	0	10	479
2019	3	25	11	28.7	61.6	80	8	0	10	716
2019	3	25	12	30.3	53.9	52	8	0	10	737
2019	3	25	13	31	50.5	53	8	0	42	637
2019	3	25	14	31.7	46.9	56	6	0	29	434
2019	3	25	15	32.9	42.6	59	5	0	58	245
2019	3	25	16	32.2	41.8	76	5	0	92	118
2019	3	25	17	31	48.4	124	3	0	100	58
2019	3	25	18	29.1	56.3	77	2	0	100	3
2019	3	25	19	26.5	64.9	96	0	0	100	0
2019	3	25	20	25.6	76.5	129	2	0	2	0
2019	3	25	21	24.3	80.4	135	0	0	7.8	0
2019	3	25	22	23.3	84.6	90	0	0	10.2	0
2019	3	25	23	21.7	87.4	46	0	0	0	0

2019	3	25	24	21.4	89.3	70	0	0	0	0
2019	3	26	1	21.4	90.5	70	0	0	0	0
2019	3	26	2	21.3	91.9	70	0	0	0	0
2019	3	26	3	21.6	91.8	70	0	0	25	0
2019	3	26	4	21.4	92.9	70	0	0	0	0
2019	3	26	5	21.5	93.9	70	2	0	0	0
2019	3	26	6	21	93.0	70	2	0	0	16
2019	3	26	7	21.4	92.7	234	3	0	10	127
2019	3	26	8	22.6	88.1	247	3	0	10	306
2019	3	26	9	24	77.9	247	5	0	10	490
2019	3	26	10	26.3	67.8	247	5	0	10	631
2019	3	26	11	28.4	59.0	247	7	0	17	715
2019	3	26	12	29.4	49.4	247	7	0	19	747
2019	3	26	13	29.9	48.6	247	8	0	25	698
2019	3	26	14	30.8	44.7	241	8	0	50	588
2019	3	26	15	30.3	43.4	121	7	0	75	399
2019	3	26	16	29.3	40.3	93	7	0	100	234
2019	3	26	17	28.5	45.7	74	3	0	100	82
2019	3	26	18	26.8	53.6	69	3	0	100	5
2019	3	26	19	25.9	72.8	114	3	0	21.9	0
2019	3	26	20	25	75.2	238	2	0	10	0
2019	3	26	21	23.6	73.4	302	2	0	72	0
2019	3	26	22	23.7	72.7	297	0	0	100	0
2019	3	26	23	23.5	64.8	213	2	0	100	0
2019	3	26	24	22.8	64.0	57	0	0	0	0
2019	3	27	1	22.2	73.2	83	0	0	0	0

2019	3	27	2	22	75.7	84	2	0	5	0
2019	3	27	3	21.8	74.2	84	0	0	48	0
2019	3	27	4	20.8	74.4	84	0	0	79	0
2019	3	27	5	20.3	79.5	149	0	0	10	0
2019	3	27	6	19.9	85.3	145	2	0	10	19
2019	3	27	7	19.6	84.6	194	3	0	10	140
2019	3	27	8	19.7	80.2	190	3	0	10	324
2019	3	27	9	19.8	76.5	166	3	0	12	503
2019	3	27	10	20.6	64.4	168	8	0	10	645
2019	3	27	11	21	54.4	168	0	0	71	729
2019	3	27	12	22.1	44.9	168	7	0	58	739
2019	3	27	13	22.8	39.2	168	7	0	8	683
2019	3	27	14	23	37.3	138	6	0	5	577
2019	3	27	15	22.2	35.3	67	5	0	2	397
2019	3	27	16	21.7	36.4	100	3	0	10	109
2019	3	27	17	19.7	36.3	168	0	0.01	10	7
2019	3	27	18	18.6	46.8	141	3	0.1	10	0
2019	3	27	19	18.6	67.6	165	5	0.01	10	0
2019	3	27	20	18.9	71.6	186	6	0	10	0
2019	3	27	21	18.6	77.5	186	3	0	10	0
2019	3	27	22	18.4	73.7	286	3	0	10	0
2019	3	27	23	18.3	63.0	293	3	0	22	0
2019	3	27	24	18.3	71.0	360	5	0	60	0
2019	3	28	1	18.3	70.1	360	6	0.02	7	0
2019	3	28	2	18.3	73.5	360	8	0.06	5	0
2019	3	28	3	18	74.7	360	5	0	4	0

2019	3	28	4	18	80.7	360	3	0	0	0
2019	3	28	5	18.1	84.9	360	5	0	0	0
2019	3	28	6	18.3	87.0	360	5	0	0	16
2019	3	28	7	18.7	88.1	360	5	0	0	79
2019	3	28	8	20.2	79.7	360	0	0	0	228
2019	3	28	9	21.2	64.6	360	8	0	0	557
2019	3	28	10	22.9	55.7	360	7	0	0	700
2019	3	28	11	23.6	51.6	360	8	0	0	764
2019	3	28	12	24.2	48.1	360	7	0	0	742
2019	3	28	13	24.9	43.8	360	7	0	0	701
2019	3	28	14	25.7	42.2	122	6	0	0	662
2019	3	28	15	25.4	38.4	190	5	0	10	331
2019	3	28	16	24.3	37.8	107	3	0	10	123
2019	3	28	17	23.7	39.9	72	2	0	10	49
2019	3	28	18	23.1	43.8	168	3	0	10	2
2019	3	28	19	22.5	59.9	114	0	0.11	10	0
2019	3	28	20	22	73.3	139	0	0.02	10	0
2019	3	28	21	21.5	77.2	103	8	0.02	10	0
2019	3	28	22	20.8	79.4	87	6	0	38	0
2019	3	28	23	20.5	85.3	280	7	0	10	0
2019	3	28	24	20.1	88.1	307	5	0	10	0
2019	3	29	1	19.8	88.9	307	3	0	7	0
2019	3	29	2	19.7	89.6	307	2	0	0	0
2019	3	29	3	19.9	90.7	307	3	0	11	0
2019	3	29	4	19.3	91.0	307	2	0	10	0
2019	3	29	5	19	91.7	307	3	0	10	0

2019	3	29	6	19	93.5	307	2	0	10	18
2019	3	29	7	20.1	91.0	307	2	0	100	185
2019	3	29	8	22.3	80.9	307	3	0	100	393
2019	3	29	9	23.9	72.6	307	3	0	100	599
2019	3	29	10	25.5	64.0	307	3	0	81	749
2019	3	29	11	26.5	56.2	307	6	0	3	832
2019	3	29	12	27.1	48.3	307	6	0	2	853
2019	3	29	13	27.8	43.0	283	8	0	2	800
2019	3	29	14	28	37.8	269	7	0	0	685
2019	3	29	15	27.6	38.3	168	8	0	5	500
2019	3	29	16	26.3	37.7	151	6	0	54	304
2019	3	29	17	25.3	36.9	266	3	0.01	73	117
2019	3	29	18	23.6	43.1	252	0	0	89	8
2019	3	29	19	22.7	61.3	234	0	0	92	0
2019	3	29	20	22.1	75.8	288	2	0	71	0
2019	3	29	21	19.1	82.6	293	3	0	6	0
2019	3	29	22	18.7	83.1	273	2	0	2	0
2019	3	29	23	18.1	81.7	231	2	0	2	0
2019	3	29	24	18	79.9	234	3	0	100	0
2019	3	30	1	18.1	81.2	217	3	0	100	0
2019	3	30	2	18	86.8	184	3	0	100	0
2019	3	30	3	17.7	88.0	184	2	0	79	0
2019	3	30	4	17.6	90.6	184	2	0	1	0
2019	3	30	5	17.7	90.8	184	0	0	0	0
2019	3	30	6	17.7	89.9	184	2	0	0	21
2019	3	30	7	18.1	89.3	184	3	0	0	134

2019	3	30	8	19.5	83.3	184	3	0	0	361
2019	3	30	9	21.2	76.0	184	6	0	0	567
2019	3	30	10	22.1	65.3	184	7	0	0	707
2019	3	30	11	23.3	53.4	184	6	0	0	766
2019	3	30	12	24.5	45.4	184	6	0	0	812
2019	3	30	13	25.7	45.0	184	6	0	0	763
2019	3	30	14	26.6	41.9	184	6	0	3	646
2019	3	30	15	26.6	42.4	184	5	0	0	479
2019	3	30	16	25.1	41.9	186	5	0	0	277
2019	3	30	17	24.2	43.7	104	3	0	0	104
2019	3	30	18	23.3	62.0	90	0	0	0	7
2019	3	30	19	22.7	73.4	84	2	0	10	0
2019	3	30	20	22.3	75.6	172	0	0	10	0
2019	3	30	21	21.6	76.4	174	3	0	0	0
2019	3	30	22	20.7	79.4	238	3	0	0	0
2019	3	30	23	19.9	81.3	189	3	0	0	0
2019	3	30	24	20.2	86.2	156	3	0	10	0
2019	3	31	1	19.7	87.3	167	2	0	0	0
2019	3	31	2	19.4	88.8	167	2	0	0	0
2019	3	31	3	19.1	90.2	167	0	0	0	0
2019	3	31	4	19.5	85.0	167	0	0	0	0
2019	3	31	5	19.3	88.4	167	2	0	0	0
2019	3	31	6	19.4	89.5	167	0	0	0	14
2019	3	31	7	20.3	86.8	158	2	0	0	63
2019	3	31	8	20.7	85.9	129	2	0	0	86
2019	3	31	9	21.8	92.3	143	3	0	1.5	288

2019	3	31	10	22.8	92.2	163	3	0	30	374
2019	3	31	11	22.3	89.4	148	3	0	30	552
2019	3	31	12	22.1	89.7	145	5	0	30	413
2019	3	31	13	21.7	88.2	143	3	0	45	362
2019	3	31	14	22.1	89.1	163	3	0	50	382
2019	3	31	15	22.2	88.8	101	3	0	87	228
2019	3	31	16	21.8	89.4	142	2	0	100	67
2019	3	31	17	21.2	86.3	235	0	0	100	35
2019	3	31	18	20.2	85.4	299	0	0	100	0
2019	3	31	19	19.7	90.1	86	3	0	100	0
2019	3	31	20	19.4	92.1	131	3	0	100	0
2019	3	31	21	19.5	92.5	163	3	0	84	0
2019	3	31	22	19.2	94.1	182	2	0	100	0
2019	3	31	23	18.7	95.1	196	0	0	100	0
2019	3	31	24	18.5	95.4	118	5	0	100	0
2019	4	1	1	18.5	95.4	149	7	0	75	0
2019	4	1	2	18.5	95.3	194	3	0	5	0
2019	4	1	3	18.4	95.6	217	6	0	0	0
2019	4	1	4	18.5	95.3	141	3	0.01	0	0
2019	4	1	5	18.4	95.0	196	6	0.19	0	0
2019	4	1	6	18.4	95.3	142	8	0.07	0	0
2019	4	1	7	18.5	95.1	194	7	0.09	0	4
2019	4	1	8	19	93.4	220	6	0.05	0	19
2019	4	1	9	20.1	92.4	193	6	0	0	75
2019	4	1	10	21.7	89.3	186	8	0	0	167
2019	4	1	11	23.2	81.1	187	8	0	0	148

2019	4	1	12	25.4	77.7	189	2	0.01	0	480
2019	4	1	13	26.9	76.6	198	3	0	0	412
2019	4	1	14	28.2	77.4	198	2	0	0	318
2019	4	1	15	28.3	75.0	189	0	0.05	0	62
2019	4	1	16	28.2	74.2	184	6	0	0	77
2019	4	1	17	27.3	72.2	131	8	0.04	0	15
2019	4	1	18	24.9	73.2	186	5	0	10	4
2019	4	1	19	23.5	79.2	254	5	0	10	0
2019	4	1	20	22.6	84.0	263	5	0	10	0
2019	4	1	21	22	89.1	172	3	0	10	0
2019	4	1	22	21.3	89.2	155	5	0	0	0
2019	4	1	23	21.5	91.0	180	3	0	0	0
2019	4	1	24	20.7	91.6	107	6	0.01	0	0
2019	4	2	1	20.3	93.3	90	3	0.01	0	0
2019	4	2	2	19.7	94.6	156	3	0	0	0
2019	4	2	3	19.4	95.0	196	3	0	0	0
2019	4	2	4	18.9	95.6	190	2	0	0	0
2019	4	2	5	18.5	93.9	215	3	0.01	0	0
2019	4	2	6	19	93.7	252	3	0	0	11
2019	4	2	7	20.1	95.1	280	5	0	0	93
2019	4	2	8	23.1	91.7	321	3	0	0	209
2019	4	2	9	25.3	88.9	318	3	0	0	282
2019	4	2	10	27.6	81.5	234	5	0	0	424
2019	4	2	11	28.6	73.9	177	8	0	0	544
2019	4	2	12	29.6	65.4	190	0	0	0	630
2019	4	2	13	29.9	66.7	197	8	0	0	550

2019	4	2	14	30.3	65.6	196	0	0	0	514
2019	4	2	15	30.9	67.0	189	0	0	0	330
2019	4	2	16	31.4	66.6	186	8	0	0	111
2019	4	2	17	30	65.5	184	8	0	0	45
2019	4	2	18	27.6	70.7	189	5	0	0	2
2019	4	2	19	26	76.3	180	3	0	0	0
2019	4	2	20	24.6	74.1	194	5	0	0	0
2019	4	2	21	23.7	76.0	194	3	0	0	0
2019	4	2	22	23.8	76.6	203	2	0	0	0
2019	4	2	23	22.7	76.0	196	6	0	0	0
2019	4	2	24	21.5	83.7	162	3	0	0	0
2019	4	3	1	21.5	90.2	162	0	0	0	0
2019	4	3	2	21.5	92.4	210	3	0	0	0
2019	4	3	3	21.2	93.3	324	3	0	0	0
2019	4	3	4	20.8	92.5	143	3	0	0	0
2019	4	3	5	20.3	91.8	143	2	0.01	0	0
2019	4	3	6	20.5	91.7	156	2	0	0	28
2019	4	3	7	21.7	92.3	228	3	0	0	140
2019	4	3	8	22	90.9	234	5	0	0	318
2019	4	3	9	22.1	88.7	232	3	0	0	494
2019	4	3	10	21.2	83.8	153	6	0	0	660
2019	4	3	11	20.5	81.0	165	6	0	0	762
2019	4	3	12	20.5	74.2	160	8	0	0	709
2019	4	3	13	20.8	64.9	167	7	0	0	753
2019	4	3	14	21.1	60.8	182	8	0	0	507
2019	4	3	15	20.5	55.7	193	0	0	0	323

2019	4	3	16	20.1	52.4	191	8	0	0	118
2019	4	3	17	20	52.1	200	8	0	10	66
2019	4	3	18	19.9	58.6	203	0	0	10	1
2019	4	3	19	19.7	71.4	204	7	0	10	0
2019	4	3	20	19.4	79.0	224	8	0.01	10	0
2019	4	3	21	19.3	74.5	111	0	0.07	0	0
2019	4	3	22	19.3	77.7	241	6	0.02	10	0
2019	4	3	23	19.2	86.1	166	5	0	18	0
2019	4	3	24	19	82.7	200	8	0	7	0
2019	4	4	1	19	83.5	213	5	0.01	0	0
2019	4	4	2	19	88.8	213	7	0	0	0
2019	4	4	3	18.9	87.5	214	3	0.02	0	0
2019	4	4	4	18.6	88.6	204	3	0.04	0	0
2019	4	4	5	18.7	92.3	214	6	0	0	0
2019	4	4	6	18.8	92.2	201	8	0	0	18
2019	4	4	7	19.7	91.5	194	7	0.01	0	72
2019	4	4	8	20.6	90.8	200	8	0	0	371
2019	4	4	9	21.1	90.2	198	0	0	0	467
2019	4	4	10	20.6	86.3	187	0	0	0	685
2019	4	4	11	21.1	77.7	197	0	0	0	834
2019	4	4	12	22.7	74.5	200	8	0	0	870
2019	4	4	13	22.6	68.5	200	7	0	0	835
2019	4	4	14	24	63.6	191	7	0	0	710
2019	4	4	15	25.3	72.6	182	8	0	2	478
2019	4	4	16	25.7	76.6	177	8	0	10	195
2019	4	4	17	24.7	77.6	189	6	0	10	68

2019	4	4	18	23.5	78.1	189	3	0	10	5
2019	4	4	19	22.3	78.7	203	3	0	10	0
2019	4	4	20	21.9	83.3	110	6	0.02	10	0
2019	4	4	21	21.7	85.8	35	6	0	10	0
2019	4	4	22	21.9	87.8	38	5	0	69	0
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2019	4	4	24	20.7	88.7	52	0	0	75	0
2019	4	5	1	20.3	91.2	52	0	0	75	0
2019	4	5	2	20.1	93.0	52	0	0	4	0
2019	4	5	3	20.1	91.7	52	0	0	25	0
2019	4	5	4	19.9	92.4	52	0	0	0	0
2019	4	5	5	19.8	93.6	52	0	0	0	0
2019	4	5	6	20.1	93.7	52	0	0	0	21
2019	4	5	7	21.1	93.5	52	0	0	100	95
2019	4	5	8	22.5	92.1	52	0	0	100	153
2019	4	5	9	24.5	87.9	52	0	0	100	289
2019	4	5	10	25.6	87.1	52	0	0	100	254
2019	4	5	11	27.2	82.3	52	2	0	100	145
2019	4	5	12	28.1	69.5	52	3	0	100	130
2019	4	5	13	28.8	60.3	52	3	0	100	100
2019	4	5	14	28.4	57.4	52	7	0	100	166
2019	4	5	15	26.8	57.5	52	3	0	100	113
2019	4	5	16	23.3	54.3	52	2	0	100	86
2019	4	5	17	22.2	52.2	52	3	0	100	44
2019	4	5	18	22	55.3	52	3	0	100	1
2019	4	5	19	21.9	73.2	52	5	0	100	0

2019	4	5	20	21.8	78.5	52	3	0	100	0
2019	4	5	21	21.5	82.8	52	3	0	100	0
2019	4	5	22	20.8	86.5	52	5	0	89	0
2019	4	5	23	20.6	89.6	52	6	0.02	91	0
2019	4	5	24	20.3	91.2	52	5	0.05	5	0
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2019	4	6	2	20.5	93.6	52	3	0.12	100	0
2019	4	6	3	20.1	94.5	52	3	0	100	0
2019	4	6	4	19.9	95.0	52	0	0.01	100	0
2019	4	6	5	19.8	95.3	52	0	0.04	100	0
2019	4	6	6	19.8	95.5	52	0	0.02	100	5
2019	4	6	7	20.2	94.6	52	0	0	100	27
2019	4	6	8	20.6	83.1	52	2	0	100	111
2019	4	6	9	21.5	74.6	52	0	0	100	217
2019	4	6	10	23	67.5	52	0	0	100	406
2019	4	6	11	25.3	59.1	52	0	0	100	533
2019	4	6	12	26.8	50.3	52	2	0	98	677
2019	4	6	13	28.2	45.2	52	2	0	74	775
2019	4	6	14	28.6	44.0	52	0	0	91	696
2019	4	6	15	29.1	40.3	52	0	0	83	438
2019	4	6	16	28.8	39.7	52	0	0	100	297
2019	4	6	17	28.4	42.5	52	0	0	100	100
2019	4	6	18	26.3	48.2	52	2	0	89	4
2019	4	6	19	24.6	64.4	52	3	0	61	0
2019	4	6	20	23.5	73.8	52	3	0	16	0
2019	4	6	21	22.5	80.4	52	3	0	15	0

2019	4	6	22	22.2	83.0	52	6	0	67	0
2019	4	6	23	21.7	84.3	52	3	0	86	0
2019	4	6	24	20.6	86.6	52	5	0	0	0
2019	4	7	1	20.2	89.6	52	5	0	0	0
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2019	4	7	4	19.4	93.2	52	2	0	100	0
2019	4	7	5	18.9	92.2	52	2	0	100	0
2019	4	7	6	19.6	91.9	52	0	0	100	34
2019	4	7	7	22.5	91.9	52	2	0	100	177
2019	4	7	8	23.7	82.4	52	0	0	17	375
2019	4	7	9	26.5	76.7	52	0	0	12	595
2019	4	7	10	28.6	64.0	52	0	0	13	713
2019	4	7	11	29.7	55.4	52	0	0	99	761
2019	4	7	12	31.3	56.6	52	0	0	100	803
2019	4	7	13	31.9	63.6	52	0	0	100	680
2019	4	7	14	32	74.1	52	2	0	100	635
2019	4	7	15	32.1	82.3	52	2	0	22	481
2019	4	7	16	31.8	83.1	52	5	0	100	318
2019	4	7	17	31.2	82.2	52	6	0	100	95
2019	4	7	18	29.2	84.8	52	3	0	100	9
2019	4	7	19	27.1	89.5	52	3	0	68	0
2019	4	7	20	26.3	90.2	52	3	0	14	0
2019	4	7	21	25	91.9	52	5	0	90	0
2019	4	7	22	23.6	92.6	52	5	0	100	0
2019	4	7	23	22.8	92.1	52	3	0	93	0

2019	4	7	24	22.1	91.3	52	3	0	0	0
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2019	4	8	2	21.5	94.1	52	3	0	6	0
2019	4	8	3	21.1	93.6	52	5	0	17	0
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2019	4	8	5	20.5	92.8	52	3	0	23	0
2019	4	8	6	21.2	93.5	52	3	0	42	39
2019	4	8	7	23.3	93.9	52	3	0	21	101
2019	4	8	8	26.2	91.2	52	2	0	32	60
2019	4	8	9	27.6	90.1	52	0	0	73	68
2019	4	8	10	29.5	89.4	52	0	0.04	70	248
2019	4	8	11	31	86.4	52	2	0.16	88	61
2019	4	8	12	32.4	75.0	52	3	0.08	100	99
2019	4	8	13	33.3	66.1	52	2	0.01	79	170
2019	4	8	14	33.5	69.2	52	3	0.01	84	115
2019	4	8	15	34.3	66.8	52	0	0.01	87	44
2019	4	8	16	34.2	62.7	52	2	0.02	100	29
2019	4	8	17	32.4	61.9	52	0	0.02	84	12
2019	4	8	18	30.6	63.7	52	3	0	100	1
2019	4	8	19	28.7	73.5	52	3	0	100	0
2019	4	8	20	27.5	80.9	52	3	0	21	0
2019	4	8	21	27.2	83.1	52	3	0	3	0
2019	4	8	22	26.6	88.9	52	0	0	0	0
2019	4	8	23	25.4	91.4	52	0	0	74	0
2019	4	8	24	24.1	92.0	52	2	0	10	0
2019	4	9	1	23.6	92.5	52	0	0	82	0

2019	4	9	2	23.2	93.1	52	0	0	0	0
2019	4	9	3	23	93.9	52	0	0	14	0
2019	4	9	4	23	93.4	52	0	0.01	12	0
2019	4	9	5	22.3	94.0	52	0	0.01	2	0
2019	4	9	6	23.2	93.6	52	0	0	3	24
2019	4	9	7	24.6	92.8	52	0	0	50	109
2019	4	9	8	27.2	88.5	52	0	0	56	159
2019	4	9	9	29	80.8	52	0	0	100	151
2019	4	9	10	30.6	69.4	52	0	0.04	19	138
2019	4	9	11	32.2	60.3	52	0	0	19	240
2019	4	9	12	33	58.4	52	0	0	17	410
2019	4	9	13	33.9	55.0	52	0	0	0	226
2019	4	9	14	34.6	56.1	52	0	0	8	692
2019	4	9	15	35	54.6	52	0	0	100	539
2019	4	9	16	34.1	68.2	52	0	0	100	306
2019	4	9	17	32.7	82.8	52	0	0	100	119
2019	4	9	18	31.3	86.0	52	0	0	100	21
2019	4	9	19	29.3	88.6	52	0	0	100	0
2019	4	9	20	28.8	83.9	52	0	0	62	0
2019	4	9	21	28.1	88.4	52	0	0	81	0
2019	4	9	22	28.3	90.1	52	0	0	100	0
2019	4	9	23	27.5	90.6	52	0	0	100	0
2019	4	9	24	27.4	89.9	52	0	0	95	0
2019	4	10	1	26	91.1	52	0	0	87	0
2019	4	10	2	24.1	94.0	52	0	0	91	0
2019	4	10	3	22.6	94.2	52	0	0	95	0

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2019	4	10	7	22.2	91.2	52	0	0	100	119
2019	4	10	8	23.1	80.2	52	0	0	100	305
2019	4	10	9	23.7	73.1	52	0	0	100	455
2019	4	10	10	23.9	67.6	52	0	0	100	485
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2019	4	10	12	24.7	62.1	52	0	0	100	664
2019	4	10	13	24.9	60.5	52	0	0	100	628
2019	4	10	14	26.2	57.5	52	0	0	100	389
2019	4	10	15	27.2	56.4	52	0	0.04	100	155
2019	4	10	16	28.6	56.0	52	0	0	100	55
2019	4	10	17	27.4	53.7	52	0	0	100	45
2019	4	10	18	26	55.4	52	0	0	100	0
2019	4	10	19	24.3	68.3	52	0	0	100	0
2019	4	10	20	24	77.7	52	0	0	100	0
2019	4	10	21	23.7	81.9	52	3	0	13	0
2019	4	10	22	23.8	87.0	52	5	0	10	0
2019	4	10	23	23.6	88.9	52	3	0	10	0
2019	4	10	24	23.7	90.5	52	5	0	100	0
2019	4	11	1	23.5	92.7	52	7	0	100	0
2019	4	11	2	23.1	93.1	52	7	0	100	0
2019	4	11	3	22.8	93.0	52	6	0	100	0
2019	4	11	4	22.6	94.5	52	6	0	100	0
2019	4	11	5	22.5	94.0	52	3	0.02	100	0

2019	4	11	6	22.6	93.4	52	3	0.01	100	4
2019	4	11	7	23.4	92.5	52	3	0.02	100	35
2019	4	11	8	23.9	84.9	52	3	0.04	100	102
2019	4	11	9	25.9	75.5	52	5	0.01	100	192
2019	4	11	10	27.1	67.4	52	3	0	100	404
2019	4	11	11	26.8	59.0	52	3	0	100	832
2019	4	11	12	27.8	57.0	52	2	0	100	856
2019	4	11	13	28.3	54.2	52	2	0	100	802
2019	4	11	14	27	50.3	52	0	0	100	732
2019	4	11	15	27.2	46.7	52	2	0	100	552
2019	4	11	16	26.9	44.8	52	3	0	100	332
2019	4	11	17	26.2	45.5	52	3	0	100	138
2019	4	11	18	25.5	46.8	52	3	0	100	9
2019	4	11	19	25	63.0	52	3	0	100	0
2019	4	11	20	24.5	71.7	52	7	0	100	0
2019	4	11	21	24.3	81.3	52	5	0	100	0
2019	4	11	22	23.7	82.9	52	3	0	100	0
2019	4	11	23	23	85.0	52	7	0	100	0
2019	4	11	24	22.3	88.3	52	3	0	100	0
2019	4	12	1	22.1	89.1	52	6	0	100	0
2019	4	12	2	22.3	89.9	52	3	0	4	0
2019	4	12	3	22.3	90.0	52	3	0	9	0
2019	4	12	4	22.3	91.7	52	8	0	12	0
2019	4	12	5	22.3	91.0	52	8	0	17	0
2019	4	12	6	22.4	92.2	52	5	0	17	61
2019	4	12	7	23.1	89.7	52	8	0	21	263

2019	4	12	8	24.2	81.8	52	26	0	29	482
2019	4	12	9	25.3	69.2	52	8	0	28	674
2019	4	12	10	26.5	62.8	52	3	0	18	824
2019	4	12	11	25.1	55.4	52	8	0	100	908
2019	4	12	12	20.3	50.0	52	8	0	100	925
2019	4	12	13	20.7	48.6	52	5	0	40	866
2019	4	12	14	23.2	46.3	52	3	0	1.5	724
2019	4	12	15	25.3	44.3	52	3	0	0.9	545
2019	4	12	16	27.2	42.2	52	3	0	0	335
2019	4	12	17	26.3	41.8	52	3	0	0.6	138
2019	4	12	18	24.1	43.6	52	7	0	1.8	10
2019	4	12	19	23.1	61.1	52	6	0	30	0
2019	4	12	20	22.8	69.1	52	5	0	100	0
2019	4	12	21	22.6	79.5	52	3	0	100	0
2019	4	12	22	22	81.6	52	2	0	100	0
2019	4	12	23	21.7	87.1	52	5	0	100	0
2019	4	12	24	21.6	88.3	52	6	0	100	0
2019	4	13	1	21.5	87.6	52	3	0	100	0
2019	4	13	2	21.3	90.0	52	3	0	100	0
2019	4	13	3	20.9	90.7	52	3	0	100	0
2019	4	13	4	20.8	92.1	52	2	0	100	0
2019	4	13	5	20.9	90.4	52	2	0	100	0
2019	4	13	6	21.2	92.4	52	0	0	100	58
2019	4	13	7	21.3	90.8	52	2	0	100	239
2019	4	13	8	21	82.5	52	2	0	100	452
2019	4	13	9	22	67.9	52	3	0	100	637

2019	4	13	10	22.7	63.5	52	2	0	100	785
2019	4	13	11	24.5	55.0	52	2	0	100	868
2019	4	13	12	26.1	51.9	52	0	0	100	882
2019	4	13	13	27.3	47.1	52	3	0	100	824
2019	4	13	14	28.5	45.6	52	5	0	100	700
2019	4	13	15	29	43.3	52	3	0	100	527
2019	4	13	16	28.6	41.5	52	3	0	100	323
2019	4	13	17	28	42.7	52	2	0	100	132
2019	4	13	18	26.5	46.7	52	6	0	100	11
2019	4	13	19	24.7	63.6	52	3	0	100	0
2019	4	13	20	23.7	73.5	52	3	0	73	0
2019	4	13	21	23.2	79.4	52	3	0	58	0
2019	4	13	22	23	83.1	52	6	0	73	0
2019	4	13	23	22.4	85.0	52	7	0	2	0
2019	4	13	24	21.9	85.7	52	6	0	83	0
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2019	4	14	3	21.7	86.5	52	7	0	25	0
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2019	4	14	5	21.4	81.9	52	3	0	11	0
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2019	4	14	7	23	82.9	52	2	0	94	208
2019	4	14	8	25	82.0	52	2	0	100	424
2019	4	14	9	27.6	79.5	52	2	0	79	605
2019	4	14	10	28.3	78.0	52	3	0	84	758
2019	4	14	11	30	74.8	52	3	0	84	846

2019	4	14	12	30.5	65.8	52	3	0	92	868
2019	4	14	13	31.8	60.7	52	3	0	59	812
2019	4	14	14	32.1	56.2	52	0	0	44	682
2019	4	14	15	31.7	54.2	52	2	0	21	425
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2019	4	14	17	30.5	60.8	52	3	0	10	79
2019	4	14	18	29.1	67.1	52	0	0	10	20
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2019	4	15	3	22.6	91.2	52	8	0	25	0
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2019	4	15	5	22.1	90.1	52	3	0.32	0	0
2019	4	15	6	22.3	90.0	52	3	0	0	9
2019	4	15	7	24.4	90.6	52	5	0	10	124
2019	4	15	8	25.8	88.2	52	6	0	65	131
2019	4	15	9	27.5	83.0	52	6	0	72	164
2019	4	15	10	28.6	74.6	52	2	0.01	81	117
2019	4	15	11	29.6	71.2	52	3	0	89	246
2019	4	15	12	30.9	63.8	52	3	0	100	258
2019	4	15	13	31.3	68.2	52	3	0	75	252

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2019	4	15	17	28.6	69.6	52	3	0	10	67
2019	4	15	18	27.1	73.3	52	3	0	64	11
2019	4	15	19	26.3	74.5	52	5	0	91	0
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2019	4	16	6	21.3	91.7	52	3	0	10	28
2019	4	16	7	22.7	91.6	52	5	0	10	75
2019	4	16	8	25	87.2	52	3	0	63	115
2019	4	16	9	26.7	81.4	52	5	0	72	459
2019	4	16	10	28.6	72.9	52	0	0	92	497
2019	4	16	11	29.8	67.0	52	5	0	100	227
2019	4	16	12	31.1	61.5	52	6	0	100	410
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2019	4	16	14	29.2	59.9	52	8	0	95	159
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2019	4	16	16	29.9	90.1	52	3	0	72	99
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2019	4	16	18	26.2	88.7	52	3	0	10	7
2019	4	16	19	24.6	85.8	52	7	0	100	0
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2019	4	16	23	22	92.9	52	3	0	82	0
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2019	4	17	1	20.8	93.3	52	5	0	0	0
2019	4	17	2	19.8	94.9	52	0	0	5	0
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2019	4	17	7	21.8	91.1	52	2	0	26	81
2019	4	17	8	24.3	87.3	52	2	0	90	194
2019	4	17	9	26	86.6	52	2	0	20	260
2019	4	17	10	28.1	90.7	52	2	0	15	275
2019	4	17	11	29.1	86.8	52	3	0.06	88	85
2019	4	17	12	29.2	77.5	52	3	0.1	97	22
2019	4	17	13	30.6	80.1	52	2	0	10	105
2019	4	17	14	31.4	72.6	52	2	0	0	379
2019	4	17	15	29.8	64.1	52	3	0	56	390
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2019	4	17	17	28.8	60.0	52	3	0	2	110

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2019	4	17	20	25.1	80.4	52	2	0	0	0
2019	4	17	21	24.7	82.8	52	7	0.12	0	0
2019	4	17	22	23.8	85.6	52	8	0.12	10	0
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2019	4	17	24	23.1	92.2	52	5	0.01	100	0
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2019	4	18	3	21.7	93.6	52	6	0.16	100	0
2019	4	18	4	22.1	94.0	52	3	0.68	100	0
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2019	4	18	7	22.6	92.5	52	6	0.01	100	27
2019	4	18	8	23.3	90.3	52	0	0	20	27
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2019	4	18	10	27.1	83.0	52	6	0	6	288
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2019	4	18	14	30.5	65.8	52	7	0	92	696
2019	4	18	15	29.9	63.5	52	7	0	100	480
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2019	4	18	23	23.7	84.1	52	8	0	10	0
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2019	4	19	7	22	91.1	52	6	0	100	157
2019	4	19	8	24.3	85.6	52	6	0	100	305
2019	4	19	9	27.1	75.1	52	5	0	100	529
2019	4	19	10	28.7	67.8	52	5	0	100	571
2019	4	19	11	30	63.0	52	5	0	100	800
2019	4	19	12	30.8	57.0	52	3	0	100	696
2019	4	19	13	31.8	58.0	52	5	0	100	824
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2019	4	19	19	27.3	67.2	52	3	0	10	0
2019	4	19	20	26.2	71.0	52	8	0	10	0
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2019	4	20	7	23.7	84.9	52	3	0	10	223
2019	4	20	8	25.8	75.9	52	6	0	23	401
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2019	4	20	12	32.7	58.2	52	0	0	69	828
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2019	4	20	16	34.7	51.5	52	2	0	97	121
2019	4	20	17	34.1	54.5	52	2	0	0.3	101
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2019	4	20	19	29	67.5	52	3	0	10	0
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2019	4	21	3	22.7	84.9	52	7	0	1.2	0
2019	4	21	4	22	89.7	52	5	0	5	0
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2019	4	21	7	24.9	84.4	52	2	0	100	200
2019	4	21	8	26.6	77.5	52	2	0	100	396
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2019	4	21	13	35.2	52.4	52	2	0	88	664
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2019	4	21	15	36.2	46.4	52	2	0	100	103
2019	4	21	16	36	43.5	52	0	0	100	186
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2019	4	21	18	32.8	46.0	52	3	0	100	7
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2019	4	22	11	33.4	57.1	52	3	0	100	806
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2019	4	22	17	34.7	54.7	52	0	0	100	71
2019	4	22	18	33	60.0	52	6	0	10	9
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2019	4	24	15	24.8	40.1	52	0	0	99	479
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2019	4	25	12	22.8	49.9	52	3	0	2	864
2019	4	25	13	23.2	43.6	52	0	0	14	799
2019	4	25	14	22.7	43.2	52	2	0	0	683
2019	4	25	15	23.7	41.3	52	3	0	80	515
2019	4	25	16	24	39.6	52	0	0	97	319
2019	4	25	17	23.6	38.9	52	0	0	100	134
2019	4	25	18	22.7	42.4	52	3	0	100	8
2019	4	25	19	21.9	57.6	52	3	0	100	0
2019	4	25	20	21.5	71.7	52	3	0	100	0
2019	4	25	21	20.9	77.8	52	3	0	100	0
2019	4	25	22	20.9	83.2	52	5	0	71	0
2019	4	25	23	21	85.7	52	5	0	66	0
2019	4	25	24	20.9	88.6	52	3	0	62	0
2019	4	26	1	20.7	88.8	52	3	0	0	0
2019	4	26	2	20.8	88.0	52	3	0	0	0
2019	4	26	3	20.8	90.5	52	2	0	19	0
2019	4	26	4	20.8	89.5	52	2	0	10	0
2019	4	26	5	21	91.2	52	0	0	78	1
2019	4	26	6	21	92.0	52	0	0	91	68
2019	4	26	7	21.1	88.1	52	2	0	96	240
2019	4	26	8	21.2	81.8	52	3	0	100	436
2019	4	26	9	21.3	70.8	52	2	0	100	589

2019	4	26	10	21.8	64.4	52	2	0	100	756
2019	4	26	11	21.9	58.3	52	2	0	11	831
2019	4	26	12	22.7	58.4	52	5	0	100	844
2019	4	26	13	23.1	51.5	52	6	0	100	790
2019	4	26	14	23	47.9	52	3	0	100	670
2019	4	26	15	22.4	48.0	52	8	0	100	511
2019	4	26	16	22	47.6	52	0	0	21	298
2019	4	26	17	21.5	48.2	52	5	0	81	118
2019	4	26	18	21	50.1	52	5	0	86	11
2019	4	26	19	20.7	61.4	52	5	0	86	0
2019	4	26	20	20.8	72.6	52	3	0	87	0
2019	4	26	21	20.6	80.8	52	3	0	62	0
2019	4	26	22	20.5	85.0	52	3	0	57	0
2019	4	26	23	20.5	86.5	52	6	0	10	0
2019	4	26	24	20.3	86.8	52	5	0	51	0
2019	4	27	1	20.1	87.5	52	3	0	0	0
2019	4	27	2	20.2	89.3	52	8	0	2	0
2019	4	27	3	20.2	89.4	52	0	0	8	0
2019	4	27	4	20.2	92.1	52	5	0	0	0
2019	4	27	5	20.2	90.5	52	7	0	10	0
2019	4	27	6	20.2	90.9	52	3	0	10	50
2019	4	27	7	20.5	88.2	52	5	0	11	181
2019	4	27	8	20.7	81.8	52	2	0	75	357
2019	4	27	9	21.4	75.9	52	3	0	72	481
2019	4	27	10	21.5	63.1	52	8	0	66	618
2019	4	27	11	21.9	57.6	52	6	0	60	695

2019	4	27	12	21.7	58.2	52	3	0	82	772
2019	4	27	13	22.8	55.9	52	3	0	57	729
2019	4	27	14	22.5	55.6	52	3	0	38	626
2019	4	27	15	22.5	59.8	52	3	0	10	455
2019	4	27	16	21.7	65.1	52	6	0	10	269
2019	4	27	17	21.8	91.1	52	3	0	16	115
2019	4	27	18	21.6	92.3	52	2	0	10	14
2019	4	27	19	21.3	90.6	52	2	0	10	0
2019	4	27	20	21.2	89.6	52	3	0	10	0
2019	4	27	21	21.2	88.5	52	6	0	10	0
2019	4	27	22	21.1	91.4	52	8	0	10	0
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2019	4	27	24	21.1	91.3	52	8	0	10	0
2019	4	28	1	21.1	93.3	52	8	0	0	0
2019	4	28	2	21	94.2	52	8	0	0	0
2019	4	28	3	21	94.1	52	2	0	24	0
2019	4	28	4	21.1	94.2	52	3	0	0	0
2019	4	28	5	21.1	92.1	52	3	0	0	0
2019	4	28	6	21.2	94.4	52	3	0	0	47
2019	4	28	7	21.7	92.0	52	3	0	0	163
2019	4	28	8	22.7	91.9	52	2	0	10	294
2019	4	28	9	23.6	86.5	52	2	0	0	433
2019	4	28	10	24	81.6	52	0	0	10	149
2019	4	28	11	25.1	72.5	52	8	0	0	122
2019	4	28	12	26.2	68.6	52	3	0	10	152
2019	4	28	13	27.7	73.9	52	6	0	7	133

2019	4	28	14	28.5	76.6	52	3	0	5	177
2019	4	28	15	28	77.8	52	3	0	10	184
2019	4	28	16	27.3	77.7	52	3	0	10	119
2019	4	28	17	25.5	77.7	52	3	0	10	97
2019	4	28	18	24.7	77.6	52	6	0	10	12
2019	4	28	19	24.5	77.5	52	3	0	10	0
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2019	4	28	21	23.6	78.6	52	7	0	10	0
2019	4	28	22	23.6	79.2	52	5	0	10	0
2019	4	28	23	23.5	80.0	52	8	0	10	0
2019	4	28	24	22.6	80.2	52	3	0	10	0
2019	4	29	1	22.6	80.0	52	3	0	0	0
2019	4	29	2	22.5	80.0	52	5	0	0	0
2019	4	29	3	22.4	79.7	52	3	0	4	0
2019	4	29	4	22.2	79.6	52	6	0	0	0
2019	4	29	5	22	79.3	52	7	0	0	0
2019	4	29	6	22.3	78.9	52	7	0	0	19
2019	4	29	7	22.3	79.3	52	8	0	0	39
2019	4	29	8	22.6	79.9	52	0	0	0	54
2019	4	29	9	23.3	80.2	52	0	0.02	0	33
2019	4	29	10	23.7	80.7	52	5	0.24	0	41
2019	4	29	11	25.6	81.9	52	3	0.4	3	79
2019	4	29	12	26.2	82.8	52	6	0.04	16	238
2019	4	29	13	26.5	83.3	52	6	0.02	3	134
2019	4	29	14	27.1	82.4	52	2	0	2	215
2019	4	29	15	26.5	82.1	52	2	0	3	201

2019	4	29	16	26.1	82.1	52	2	0	80	71
2019	4	29	17	25.4	83.3	52	3	0	96	11
2019	4	29	18	25	83.2	52	3	0.5	93	0
2019	4	29	19	24.6	83.0	52	2	0.02	18	0
2019	4	29	20	24.1	82.4	52	5	0.01	0	0
2019	4	29	21	24.1	81.8	52	8	0.01	0	0
2019	4	29	22	24	81.7	52	3	0	0	0
2019	4	29	23	24	81.6	52	7	0	0	0
2019	4	29	24	23.8	81.4	52	7	0	0	0
2019	4	30	1	23.6	81.9	52	5	0	0	0
2019	4	30	2	23.6	82.0	52	5	0	0	0
2019	4	30	3	23.5	82.1	52	8	0	25	0
2019	4	30	4	23.4	82.5	52	3	0	0	0
2019	4	30	5	23.1	83.1	52	3	0	0	0
2019	4	30	6	23.1	83.3	52	3	0	0	25
2019	4	30	7	23.6	83.7	52	3	0	68	23
2019	4	30	8	24.2	83.9	52	2	0	70	52
2019	4	30	9	25.4	84.4	52	7	0.35	10	24
2019	4	30	10	27	85.6	52	7	0.29	67	43
2019	4	30	11	28.3	86.6	52	3	0.12	10	96
2019	4	30	12	28.8	87.7	52	5	0.02	59	108
2019	4	30	13	28.2	84.1	52	3	0	47	125
2019	4	30	14	27.1	84.1	52	3	0	5	133
2019	4	30	15	25.2	84.9	52	0	0	21	264
2019	4	30	16	24.7	86.0	52	2	0	13	199
2019	4	30	17	24.1	85.5	52	0	0	100	91

2019	4	30	18	24.2	84.3	52	3	0	100	4
2019	4	30	19	23.6	83.6	52	3	0.01	100	0
2019	4	30	20	23.2	83.0	52	7	0.3	10	0
2019	4	30	21	23.2	81.4	52	6	0.11	0	0
2019	4	30	22	22.7	82.1	52	7	0	0	0
2019	4	30	23	22.4	83.1	52	8	0	0	0
2019	4	30	24	22.1	80.8	52	7	0.26	0	0
2019	5	1	1	21.8	80.2	52	7	0.14	0	0
2019	5	1	2	21.5	79.9	52	7	0.13	0	0
2019	5	1	3	21.4	79.7	52	5	0.07	7	0
2019	5	1	4	21.5	79.6	52	7	0.05	0	0
2019	5	1	5	21.6	79.8	52	7	0	0	0
2019	5	1	6	21.7	80.0	52	5	0.07	0	9
2019	5	1	7	21.6	80.2	52	8	0.17	100	13
2019	5	1	8	21.7	80.5	52	3	0.12	100	27
2019	5	1	9	22.5	80.6	52	5	0.16	100	28
2019	5	1	10	23.5	81.0	52	5	0.07	100	115
2019	5	1	11	24.7	83.4	52	3	0.01	100	82
2019	5	1	12	25.6	86.8	52	2	0	16	250
2019	5	1	13	26.7	88.3	52	5	0	85	186
2019	5	1	14	25.3	82.2	52	8	0	100	120
2019	5	1	15	25.1	82.3	52	3	0	100	56
2019	5	1	16	26.5	85.2	52	7	0	100	29
2019	5	1	17	26.3	85.8	52	6	0	100	34
2019	5	1	18	25.6	86.9	52	0	0.43	100	0
2019	5	1	19	25	88.6	52	2	0.13	100	0

2019	5	1	20	24.6	90.7	52	6	0.13	100	0
2019	5	1	21	24.2	90.6	52	5	0.3	100	0
2019	5	1	22	23.6	87.5	52	3	0	100	0
2019	5	1	23	23.4	85.1	52	3	0.01	100	0
2019	5	1	24	23.1	83.5	52	5	0.05	100	0
2019	5	2	1	23	83.4	52	3	0.08	100	0
2019	5	2	2	22.7	82.6	52	3	0.06	100	0
2019	5	2	3	22.7	82.7	52	3	0	100	0
2019	5	2	4	22.6	82.4	52	3	0.21	100	0
2019	5	2	5	22.6	82.6	52	2	0.02	100	0
2019	5	2	6	22.8	82.8	52	3	0.02	100	19
2019	5	2	7	23.8	82.6	52	2	0.02	100	34
2019	5	2	8	25.1	82.7	52	0	0.02	100	61
2019	5	2	9	26.2	83.3	52	2	0	100	154
2019	5	2	10	27.9	84.4	52	0	0.01	100	120
2019	5	2	11	30	84.5	52	0	0.05	100	238
2019	5	2	12	30	85.0	52	2	0.24	100	176
2019	5	2	13	30.6	85.8	52	2	0	100	257
2019	5	2	14	31.1	86.2	52	2	0.01	100	95
2019	5	2	15	30.5	87.1	52	2	0.03	100	74
2019	5	2	16	29.5	87.8	52	2	0.23	100	26
2019	5	2	17	28.2	86.7	52	0	0.05	100	29
2019	5	2	18	26.6	86.5	52	3	0.01	100	1
2019	5	2	19	25.3	86.4	52	3	0.09	100	0
2019	5	2	20	24.8	85.7	52	5	0.49	100	0
2019	5	2	21	23.9	84.3	52	5	0.02	89	0

2019	5	2	22	23.8	83.6	52	5	0.28	100	0
2019	5	2	23	23.4	84.4	52	5	0.17	100	0
2019	5	2	24	23.1	86.1	52	3	0.19	100	0
2019	5	3	1	22.4	84.1	52	6	0.21	100	0
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2019	5	3	3	22.7	81.9	52	7	0.05	100	0
2019	5	3	4	21.8	82.0	52	3	0.09	100	0
2019	5	3	5	21.7	81.8	52	2	0.01	100	0
2019	5	3	6	21.6	81.3	52	2	0	100	28
2019	5	3	7	21.7	81.3	52	2	0	100	78
2019	5	3	8	21.5	81.4	52	2	0	100	183
2019	5	3	9	21.6	81.4	52	2	0	100	302
2019	5	3	10	22.5	79.7	52	2	0	100	423
2019	5	3	11	22.5	71.8	52	2	0	100	573
2019	5	3	12	21.8	70.3	52	0	0	100	822
2019	5	3	13	23.3	65.2	52	0	0	100	844
2019	5	3	14	23.6	63.4	52	2	0	100	702
2019	5	3	15	23.8	64.0	52	2	0	100	445
2019	5	3	16	24	63.6	52	2	0.01	100	239
2019	5	3	17	23.7	65.2	52	3	0	100	50
2019	5	3	18	23.2	67.3	52	3	0.01	100	12
2019	5	3	19	22.8	76.9	52	8	0	100	0
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2019	5	3	21	21.7	75.0	52	8	0	100	0
2019	5	3	22	21.8	84.2	52	8	0	100	0
2019	5	3	23	21.7	86.8	52	8	0	100	0

2019	5	3	24	21.6	86.3	52	8	0	100	0
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2019	5	4	3	21.1	84.2	52	2	0	100	0
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2019	5	4	7	20.9	84.1	52	3	0	100	33
2019	5	4	8	20.6	84.9	52	3	0	100	96
2019	5	4	9	20.8	84.8	52	2	0	44	137
2019	5	4	10	21.1	83.3	52	2	0.01	100	233
2019	5	4	11	21.6	82.3	52	2	0	100	569
2019	5	4	12	22.5	82.5	52	3	0	64	356
2019	5	4	13	22.6	81.3	52	2	0	17	366
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2019	5	4	15	23.5	80.4	52	6	0	89	110
2019	5	4	16	23	81.4	52	3	0.01	93	72
2019	5	4	17	22.2	81.7	52	3	0	81	45
2019	5	4	18	21.6	80.9	52	3	0	97	10
2019	5	4	19	21.6	77.6	52	3	0	97	0
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2019	5	4	22	21.2	82.1	52	5	0	10	0
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2019	5	5	2	20.7	81.3	52	3	0	100	0
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2019	5	5	4	20.5	81.0	52	3	0.03	100	0
2019	5	5	5	20.5	81.4	52	2	0.01	100	0
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2019	5	5	7	20.6	82.6	52	2	0	85	116
2019	5	5	8	20.7	83.6	52	2	0	100	178
2019	5	5	9	20.8	84.2	52	2	0	27	509
2019	5	5	10	21.1	85.1	52	3	0	17	818
2019	5	5	11	21.3	84.8	52	2	0	13	827
2019	5	5	12	22	83.6	52	2	0	8	650
2019	5	5	13	22.8	82.7	52	3	0	5	291
2019	5	5	14	22.8	82.3	52	2	0.05	93	65
2019	5	5	15	23.7	82.7	52	2	0.08	100	42
2019	5	5	16	24	83.2	52	2	0.09	100	29
2019	5	5	17	23.7	83.2	52	3	0.04	100	14
2019	5	5	18	22.7	83.3	52	3	0	80	1
2019	5	5	19	22.1	83.8	52	5	0.01	82	0
2019	5	5	20	22.1	84.5	52	5	0.01	83	0
2019	5	5	21	21.7	85.6	52	7	0.01	69	0
2019	5	5	22	21.5	84.7	52	3	0	68	0
2019	5	5	23	21.2	84.5	52	3	0.17	42	0
2019	5	5	24	21	84.2	52	3	0.22	0	0
2019	5	6	1	20.9	84.2	52	8	0.19	0	0
2019	5	6	2	20.9	84.1	52	8	0.15	0	0
2019	5	6	3	21	84.1	52	3	0.1	0	0

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2019	5	6	5	21.1	84.0	52	2	0.1	5	0
2019	5	6	6	20.9	83.8	52	3	0.06	0	14
2019	5	6	7	20.7	83.7	52	3	0.06	10	31
2019	5	6	8	20.7	83.3	52	6	0.02	100	78
2019	5	6	9	20.7	84.0	52	7	0	100	145
2019	5	6	10	20.7	85.0	52	3	0	100	277
2019	5	6	11	20.8	85.6	52	3	0	18	463
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2019	5	6	13	22	86.6	52	2	0	0	526
2019	5	6	14	23	86.9	52	2	0.04	0	137
2019	5	6	15	23.7	86.4	52	3	0.03	1	227
2019	5	6	16	23.7	83.4	52	3	0	76	166
2019	5	6	17	22.8	83.9	52	3	0	83	63
2019	5	6	18	22.1	81.8	52	3	0	91	19
2019	5	6	19	21.9	78.0	52	5	0	85	0
2019	5	6	20	21.6	74.7	52	0	0	70	0
2019	5	6	21	21.5	73.2	52	5	0	2	0
2019	5	6	22	21.5	71.5	52	5	0	0	0
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2019	5	7	3	20.8	76.8	52	3	0	0	0
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2019	5	7	5	20.8	75.6	52	2	0	0	1

2019	5	7	6	20.8	75.5	52	2	0	0	47
2019	5	7	7	21.3	76.0	52	2	0	0	120
2019	5	7	8	21.8	75.8	52	0	0	35	218
2019	5	7	9	21.6	75.7	52	0	0	100	508
2019	5	7	10	22.2	76.6	52	0	0	100	768
2019	5	7	11	23.4	78.5	52	0	0.01	100	750
2019	5	7	12	24.2	81.4	52	2	0	100	671
2019	5	7	13	24.3	78.2	52	0	0	100	826
2019	5	7	14	23.9	76.4	52	0	0	100	709
2019	5	7	15	23.7	75.8	52	2	0	72	520
2019	5	7	16	23.8	76.0	52	3	0	1	333
2019	5	7	17	23.3	75.8	52	2	0	12	135
2019	5	7	18	22.7	76.2	52	3	0	83	21
2019	5	7	19	22.7	76.5	52	3	0	90	0
2019	5	7	20	22.4	77.0	52	7	0	92	0
2019	5	7	21	21.9	77.3	52	7	0	71	0
2019	5	7	22	22.1	78.5	52	8	0	75	0
2019	5	7	23	22	82.5	52	8	0	65	0
2019	5	7	24	21.8	82.7	52	7	0	49	0
2019	5	8	1	21.5	83.1	52	6	0	0	0
2019	5	8	2	21.3	83.5	52	6	0	0	0
2019	5	8	3	21.1	83.6	52	3	0	0	0
2019	5	8	4	21.2	83.7	52	0	0	0	0
2019	5	8	5	21.1	83.8	52	3	0	0	1
2019	5	8	6	21.5	83.8	52	2	0	0	14
2019	5	8	7	21.7	83.8	52	0	0	100	36

2019	5	8	8	22.6	83.8	52	0	0.03	100	58
2019	5	8	9	23.8	83.7	52	2	0.01	100	110
2019	5	8	10	25	83.7	52	0	0	100	167
2019	5	8	11	25.8	83.4	52	0	0	100	111
2019	5	8	12	27.6	83.4	52	2	0	100	139
2019	5	8	13	28.1	83.3	52	2	0	18	214
2019	5	8	14	28.8	83.3	52	0	0	0	183
2019	5	8	15	29.3	82.6	52	0	0	10	179
2019	5	8	16	29.5	81.7	52	0	0	10	136
2019	5	8	17	28.2	80.5	52	3	0	29	59
2019	5	8	18	27.3	80.5	52	3	0	100	12
2019	5	8	19	26.7	81.3	52	3	0	100	0
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2019	5	8	21	25.5	83.3	52	8	0	56	0
2019	5	8	22	24.8	84.1	52	8	0	10	0
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2019	5	9	3	21.9	82.8	52	2	0	0	0
2019	5	9	4	22	82.9	52	0	0	0	0
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2019	5	9	7	23.6	83.6	52	0	0.39	0	19
2019	5	9	8	24.5	84.1	52	0	0.13	0	31
2019	5	9	9	24.8	84.7	52	0	0.03	2	68

2019	5	9	10	25.6	86.9	52	0	0.31	0	62
2019	5	9	11	27.1	89.5	52	0	0	1	125
2019	5	9	12	28	96.3	52	0	0	13	249
2019	5	9	13	29	90.5	52	0	0.01	75	317
2019	5	9	14	29.5	83.5	52	0	0	79	301
2019	5	9	15	29.8	80.2	52	0	0	100	274
2019	5	9	16	30	77.9	52	2	0	100	180
2019	5	9	17	28.7	76.4	52	0	0	100	65
2019	5	9	18	27.1	76.9	52	3	0	87	11
2019	5	9	19	25.1	76.5	52	3	0	100	0
2019	5	9	20	24.9	93.4	52	3	0	100	0
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2019	5	9	22	22.7	96.0	52	8	0	100	0
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2019	5	10	2	22	96.7	52	7	0	100	0
2019	5	10	3	21.9	96.8	52	3	0	100	0
2019	5	10	4	22.2	97.7	52	2	0.05	14	0
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2019	5	10	6	22.1	93.6	52	2	0.08	0	11
2019	5	10	7	21.8	94.5	52	3	0.07	4	23
2019	5	10	8	22.3	96.6	52	2	0.21	9	16
2019	5	10	9	23.6	95.5	52	3	0.08	12	28
2019	5	10	10	24.3	95.2	121	0	0.02	8	51
2019	5	10	11	24.2	96.1	220	2	0	11	122

2019	5	10	12	25.2	96.4	220	2	0	10	212
2019	5	10	13	25.1	92.8	220	20	0	16	318
2019	5	10	14	25.3	92.6	220	7	0	92	250
2019	5	10	15	25.6	93.0	220	5	0	98	364
2019	5	10	16	25.6	93.9	220	5	0	100	262
2019	5	10	17	25.2	96.5	220	8	0	100	119
2019	5	10	18	24	93.8	220	3	0	100	16
2019	5	10	19	23.3	93.9	220	3	0	89	0
2019	5	10	20	23.1	93.9	220	3	0	74	0
2019	5	10	21	23	94.6	220	3	0	70	0
2019	5	10	22	22.7	96.5	220	6	0	62	0
2019	5	10	23	22	96.2	220	5	0	82	0
2019	5	10	24	21.5	97.4	220	5	0	100	0
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2019	5	11	2	21.7	97.4	220	3	0	50	0
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2019	5	11	6	21.6	97.0	220	0	0.04	0	3
2019	5	11	7	21.8	97.1	220	0	0.15	0	7
2019	5	11	8	22.7	97.0	220	2	0.22	0	9
2019	5	11	9	23.1	97.1	220	2	0.18	0.6	11
2019	5	11	10	24.2	97.4	220	0	0.03	0.3	79
2019	5	11	11	24.3	95.6	220	2	0	10	98
2019	5	11	12	24.3	92.4	220	0	0	10	204
2019	5	11	13	24.5	95.4	220	0	0	7	232

2019	5	11	14	24.5	95.8	220	3	0	8.1	342
2019	5	11	15	25.6	92.1	220	3	0	12.6	372
2019	5	11	16	26	87.0	220	3	0	10	276
2019	5	11	17	25.5	87.3	220	6	0	10	108
2019	5	11	18	24.6	89.3	220	7	0	18	18
2019	5	11	19	24	93.0	220	5	0	47	0
2019	5	11	20	23.8	92.6	220	6	0	65	0
2019	5	11	21	23.6	92.0	220	7	0	59	0
2019	5	11	22	23.1	93.0	220	7	0	59	0
2019	5	11	23	22.9	94.3	220	8	0	38	0
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2019	5	12	3	22.3	96.3	220	3	0	19	0
2019	5	12	4	22.1	96.8	220	3	0	60	0
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2019	5	12	9	25.3	80.1	220	2	0	32	96
2019	5	12	10	25.7	78.3	220	0	0	4	258
2019	5	12	11	26.7	80.5	220	0	0	65	612
2019	5	12	12	28.2	79.6	220	0	0	100	618
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2019	5	12	15	29.8	76.7	220	2	0	89	190

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2019	5	12	17	29.1	78.6	220	2	0	85	37
2019	5	12	18	27.9	80.9	220	3	0	94	3
2019	5	12	19	26.3	88.0	220	3	0	93	0
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2019	5	12	24	24	89.0	220	25	0	0	0
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2019	5	13	6	22.7	96.2	220	3	0.01	0	51
2019	5	13	7	23.3	93.8	220	2	0	0	96
2019	5	13	8	24	89.7	220	2	0	0	204
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2019	5	13	10	25	78.0	220	2	0	0	466
2019	5	13	11	25	74.8	220	3	0	15	607
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2019	5	13	16	27	54.7	220	2	0	92	320
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2019	5	13	21	23.7	80.8	220	6	0	64	0
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2019	5	14	9	23	94.1	220	2	0	0	566
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2019	5	14	12	24	82.1	220	2	0	10	916
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2019	5	14	16	26.6	84.6	220	3	0	0	327
2019	5	14	17	26.1	88.1	220	3	0	40	90
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2019	5	14	23	23.6	96.4	220	0	0	0	0
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2019	5	15	5	23.2	97.2	220	3	0.45	100	0
2019	5	15	6	23.2	97.1	220	2	0.08	100	9
2019	5	15	7	23.7	97.0	220	0	0.07	100	27
2019	5	15	8	24.5	94.4	220	0	0.01	80	139
2019	5	15	9	25.3	87.5	220	3	0	60	319
2019	5	15	10	26.6	88.9	220	7	0	50	400
2019	5	15	11	27.8	91.0	220	2	0	10	251
2019	5	15	12	29	86.9	220	3	0	0	507
2019	5	15	13	29.5	81.0	220	3	0	0	453
2019	5	15	14	29.6	80.5	220	5	0	0	476
2019	5	15	15	30.1	80.7	220	2	0	0	433
2019	5	15	16	29.8	80.1	220	2	0	0	357
2019	5	15	17	29.2	79.9	220	7	0	0	159
2019	5	15	18	28.2	81.5	220	3	0	0	23
2019	5	15	19	27.4	87.5	220	8	0	0	0
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201 9	5	16	5	21.6	96.1	220	5	0.05	70	0
201 9	5	16	6	22.8	96.5	220	3	0.1	55	11
201 9	5	16	7	23.8	95.8	220	3	0.01	40	59
201 9	5	16	8	25	89.4	220	6	0	20	156
201 9	5	16	9	24.6	84.6	220	0	0	10	208
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201 9	5	16	11	27.8	70.4	220	2	0	0	174
201 9	5	16	12	28.9	66.3	220	3	0	0	109
201 9	5	16	13	29.3	66.4	220	3	0	0	176
201 9	5	16	14	29.3	63.7	220	5	0	0	230
201 9	5	16	15	30.1	60.4	220	3	0	0	392
201 9	5	16	16	29.8	60.3	220	2	0	0	259
201 9	5	16	17	28.9	59.9	220	3	0	0	130
201 9	5	16	18	27.6	65.7	220	3	0	0	21
201 9	5	16	19	26.8	71.9	220	6	0	10	0
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201 9	5	16	21	26	85.9	220	8	0	40	0
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2019	5	16	24	24.3	93.4	220	6	0	0	0
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2019	5	17	2	23.6	94.3	220	6	0.03	70	0
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2019	5	17	9	25.7	87.8	220	6	0	0	468
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2019	5	17	19	27.9	89.5	220	5	0	0	0
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2019	5	19	2	23.1	95.7	220	5	0	0	0
2019	5	19	3	22.9	95.0	220	3	0	0	0

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2019	5	19	13	25.2	65.9	220	5	0	10	158
2019	5	19	14	25.7	60.5	220	3	0	10	364
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2019	5	19	16	25.4	58.5	220	3	0	0	203
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2019	5	19	19	24.1	73.8	220	5	0.02	45	0
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2019	5	20	5	22.9	91.5	220	2	0	0	5

2019	5	20	6	22.9	91.7	220	2	0	0	36
2019	5	20	7	23	90.5	220	2	0	0	124
2019	5	20	8	23.3	88.9	220	0	0	0	230
2019	5	20	9	23.8	86.1	220	0	0	0	171
2019	5	20	10	23.8	82.9	220	2	0	0	586
2019	5	20	11	24.8	77.3	220	2	0	0	554
2019	5	20	12	25.6	73.2	220	3	0	0	754
2019	5	20	13	26.5	74.9	220	0	0	0	681
2019	5	20	14	26.7	73.2	220	0	0	0	403
2019	5	20	15	27.8	67.6	220	2	0	0	457
2019	5	20	16	27	71.3	220	3	0	0	321
2019	5	20	17	26.2	69.6	220	2	0	0	148
2019	5	20	18	25.7	73.7	220	2	0	0	29
2019	5	20	19	25.2	79.9	220	3	0	0	0
2019	5	20	20	25	85.8	220	3	0	0	0
2019	5	20	21	24.8	89.8	220	3	0	0	0
2019	5	20	22	24.6	91.7	220	8	0	0	0
2019	5	20	23	24.3	92.3	220	5	0	0	0
2019	5	20	24	24.3	92.8	220	8	0	0	0
2019	5	21	1	24.2	94.2	220	8	0	0	0
2019	5	21	2	24.1	94.5	220	3	0	0	0
2019	5	21	3	23.8	95.1	220	2	0.17	0	0
2019	5	21	4	23.7	95.6	220	0	0	0	0
2019	5	21	5	23.7	95.9	220	0	0	0	6
2019	5	21	6	23.9	96.4	220	2	0	0	122
2019	5	21	7	24.5	95.3	220	0	0.01	0	227

2019	5	21	8	25.1	91.5	220	0	0	0	309
2019	5	21	9	25.7	84.1	220	0	0	0	369
2019	5	21	10	25.7	81.4	220	2	0	0	415
2019	5	21	11	26	79.4	220	0	0	0	566
2019	5	21	12	28.5	74.1	220	2	0	0	839
2019	5	21	13	29.4	65.1	220	0	0	0	821
2019	5	21	14	30.1	55.8	220	0	0	0	579
2019	5	21	15	30	59.3	220	3	0	0	547
2019	5	21	16	29.8	61.7	220	2	0	0	328
2019	5	21	17	28.5	64.9	220	2	0	0	147
2019	5	21	18	27.6	64.3	220	3	0	0	30
2019	5	21	19	27.2	73.3	220	3	0	0	0
2019	5	21	20	27	84.0	220	5	0	0	0
2019	5	21	21	26.8	87.8	220	3	0	0	0
2019	5	21	22	26.2	89.0	220	6	0	0	0
2019	5	21	23	24.6	88.9	220	8	0	0	0
2019	5	21	24	24.4	92.3	220	6	0	0	0
2019	5	22	1	24.5	91.7	220	6	0	0	0
2019	5	22	2	24.2	89.4	220	5	0	0	0
2019	5	22	3	24.2	91.9	220	5	0	0	0
2019	5	22	4	23.9	93.3	220	2	0	0	0
2019	5	22	5	23.4	89.2	220	2	0	0	9
2019	5	22	6	24.4	89.0	220	0	0	0	65
2019	5	22	7	25	91.1	220	0	0	0	271
2019	5	22	8	25.7	89.0	220	0	0	0	439
2019	5	22	9	27	88.6	220	0	0	0	230

2019	5	22	10	29.3	90.8	220	0	0	0	185
2019	5	22	11	25.6	89.5	220	2	0	0	683
2019	5	22	12	27.8	88.5	220	0	0	0	916
2019	5	22	13	29.5	88.2	220	5	0	0	837
2019	5	22	14	31.1	86.3	220	3	0	0	709
2019	5	22	15	32.2	84.2	220	5	0	0	457
2019	5	22	16	32.1	83.4	220	0	0	0	307
2019	5	22	17	31.2	81.8	220	3	0	0	141
2019	5	22	18	29.8	82.1	220	3	0	0	17
2019	5	22	19	28.7	85.7	220	3	0	0	0
2019	5	22	20	28	88.4	220	6	0	0	0
2019	5	22	21	27.3	89.4	220	6	0	70	0
2019	5	22	22	24.1	90.5	220	5	0	45	0
2019	5	22	23	24	92.9	220	5	0	60	0
2019	5	22	24	23.4	94.2	220	7	0	90	0
2019	5	23	1	23	94.5	220	7	0.64	100	0
2019	5	23	2	22.8	94.3	220	6	0.03	100	0
2019	5	23	3	23.1	94.7	220	6	0.27	100	0
2019	5	23	4	23.2	95.3	220	3	0.24	60	0
2019	5	23	5	23.8	95.4	220	3	0.03	40	0
2019	5	23	6	24	94.9	220	3	0	30	30
2019	5	23	7	24.3	95.0	220	8	0.01	45	34
2019	5	23	8	25.2	94.7	220	3	0.01	55	59
2019	5	23	9	26.3	94.6	220	2	0	50	233
2019	5	23	10	26.1	92.4	220	8	0.04	40	110
2019	5	23	11	27	87.4	220	0	0	30	132

2019	5	23	12	27.1	82.1	220	3	0	20	170
2019	5	23	13	28	79.3	220	5	0	20	233
2019	5	23	14	27.1	84.7	220	3	0	0	369
2019	5	23	15	25.9	84.7	220	3	0	0	407
2019	5	23	16	26.1	88.4	220	0	0	0	271
2019	5	23	17	26.5	86.4	220	0	0	0	132
2019	5	23	18	26.5	87.1	220	3	0	0	31
2019	5	23	19	25.6	91.4	220	3	0	0	0
2019	5	23	20	25.2	93.4	220	5	0	0	0
2019	5	23	21	25	91.6	220	6	0	0	0
2019	5	23	22	24.5	91.1	220	5	0	0	0
2019	5	23	23	24.3	91.9	220	0	0	60	0
2019	5	23	24	24	93.9	220	0	0	70	0
2019	5	24	1	24	94.8	220	2	0	100	0
2019	5	24	2	23.8	94.9	220	0	0.18	100	0
2019	5	24	3	23.9	92.3	220	8	0.07	100	0
2019	5	24	4	24	94.0	220	3	0.05	80	0
2019	5	24	5	24	94.1	220	3	0.04	90	0
2019	5	24	6	24.2	94.2	220	3	0.01	80	31
2019	5	24	7	24.6	94.1	220	0	0	70	91
2019	5	24	8	25.2	90.8	220	0	0	60	82
2019	5	24	9	26	85.4	220	0	0.71	40	11
2019	5	24	10	27.3	82.6	220	0	0.05	40	174
2019	5	24	11	29	76.8	220	0	0	20	392
2019	5	24	12	30.2	73.2	220	0	0	10	423
2019	5	24	13	31.2	77.1	220	0	0	10	277

2019	5	24	14	32	82.9	220	0	0	0	286
2019	5	24	15	32.3	78.2	220	3	0	0	198
2019	5	24	16	32	73.6	220	3	0	0	104
2019	5	24	17	31.5	74.7	220	3	0	0	50
2019	5	24	18	30.3	79.3	220	2	0	0	4
2019	5	24	19	28.7	83.3	220	3	0	0	0
2019	5	24	20	27.8	88.1	220	2	0.01	0	0
2019	5	24	21	27.2	86.5	220	0	0	0	0
2019	5	24	22	26.7	85.4	220	3	0	0	0
2019	5	24	23	26.4	88.3	220	3	0	0	0
2019	5	24	24	26.1	86.8	220	3	0	0	0
2019	5	25	1	25.7	87.3	220	5	0	0	0
2019	5	25	2	25.3	89.0	220	3	0	40	0
2019	5	25	3	25	90.5	220	3	0	50	0
2019	5	25	4	24.5	90.5	220	3	0	30	0
2019	5	25	5	24.1	89.3	220	2	0	20	2
2019	5	25	6	25.2	90.4	220	3	0.01	10	17
2019	5	25	7	26.8	87.0	220	0	0	10	59
2019	5	25	8	28.8	81.9	220	6	0	30	105
2019	5	25	9	30.1	73.0	220	2	0.06	40	119
2019	5	25	10	31.3	68.9	220	0	0	20	145
2019	5	25	11	32.6	70.1	220	3	0	10	252
2019	5	25	12	33.3	63.4	220	0	0	0	320
2019	5	25	13	33.1	62.5	220	7	0	0	294
2019	5	25	14	33.4	62.9	220	2	0	0	391
2019	5	25	15	33.8	61.9	220	3	0	0	420

2019	5	25	16	34.2	62.8	220	3	0	0	225
2019	5	25	17	33.3	70.4	220	5	0	0	85
2019	5	25	18	32.6	73.3	220	3	0	0	16
2019	5	25	19	30.9	74.3	220	0	0	0	0
2019	5	25	20	29.3	84.1	220	3	0	0	0
2019	5	25	21	28.7	86.1	220	3	0	0	0
2019	5	25	22	28.8	88.3	220	3	0	0	0
2019	5	25	23	29	88.4	220	7	0	0	0
2019	5	25	24	27.8	91.3	220	5	0	0	0
2019	5	26	1	27.1	91.7	220	8	0	0	0
2019	5	26	2	26.8	91.3	220	7	0	0	0
2019	5	26	3	26.6	93.5	220	8	0	0	0
2019	5	26	4	25.7	93.6	220	3	0	0	0
2019	5	26	5	23.1	93.9	220	2	0	0	3
2019	5	26	6	23.6	94.5	220	0	0	0	32
2019	5	26	7	25.4	92.5	220	0	0	0	113
2019	5	26	8	27.3	90.4	220	0	0	0	151
2019	5	26	9	28.5	86.3	220	3	0	0	216
2019	5	26	10	29.1	85.2	220	3	0	0	152
2019	5	26	11	29.7	81.1	220	3	0	0	214
2019	5	26	12	28.1	71.7	220	2	0	0	504
2019	5	26	13	27.2	71.6	220	2	0	0	557
2019	5	26	14	28.6	66.8	220	0	0	0	508
2019	5	26	15	28.6	71.0	220	0	0	0	450
2019	5	26	16	28.1	72.2	220	0	0	0	307
2019	5	26	17	28.3	69.3	220	2	0	0	86

2019	5	26	18	28.2	72.2	220	3	0	0	16
2019	5	26	19	26.8	78.6	220	2	0	0	0
2019	5	26	20	26.1	82.4	220	3	0	80	0
2019	5	26	21	25.8	84.5	220	5	0	100	0
2019	5	26	22	26.1	85.9	220	5	0.01	100	0
2019	5	26	23	25.7	87.5	220	5	0	100	0
2019	5	26	24	25.6	83.3	220	3	0	80	0
2019	5	27	1	25.5	83.5	220	6	0.01	100	0
2019	5	27	2	24.7	89.2	220	3	0.02	100	0
2019	5	27	3	24.6	92.4	220	3	0.01	100	0
2019	5	27	4	24.9	92.6	220	0	0	50	0
2019	5	27	5	24.7	93.9	220	0	0	30	7
2019	5	27	6	24.5	93.9	220	0	0	45	126
2019	5	27	7	25.2	93.0	220	0	0.01	50	145
2019	5	27	8	25.7	91.2	220	0	0	40	352
2019	5	27	9	26.8	85.8	220	2	0	30	467
2019	5	27	10	26.8	73.0	220	2	0	10	756
2019	5	27	11	23.1	65.0	220	0	0.33	40	234
2019	5	27	12	23.7	60.8	220	0	0	0	581
2019	5	27	13	25.7	56.3	220	0	0	0	744
2019	5	27	14	27	57.2	220	0	0	0	675
2019	5	27	15	27.2	54.6	220	0	0	0	568
2019	5	27	16	26.4	67.0	220	0	0	0	355
2019	5	27	17	25.7	83.6	220	0	0	0	133
2019	5	27	18	25.4	84.9	220	2	0	0	16
2019	5	27	19	25	85.4	220	3	0	0	0

2019	5	27	20	24.7	87.0	220	3	0	45	0
2019	5	27	21	24.4	86.9	220	3	0	50	0
2019	5	27	22	24	87.4	220	7	0.13	10	0
2019	5	27	23	23.6	89.4	220	6	0	10	0
2019	5	27	24	23.6	88.9	220	5	0	0	0
2019	5	28	1	23.3	89.9	220	5	0	0	0
2019	5	28	2	23.1	92.5	220	5	0	0	0
2019	5	28	3	22.8	93.2	220	3	0	0	0
2019	5	28	4	22.6	93.9	220	2	0	0	0
2019	5	28	5	22.6	93.1	220	0	0	0	7
2019	5	28	6	23.6	92.3	220	0	0	0	72
2019	5	28	7	25.5	91.1	220	0	0	0	198
2019	5	28	8	27.2	86.7	220	0	0	0	299
2019	5	28	9	28.4	83.4	220	2	0	0	492
2019	5	28	10	29.8	76.8	220	0	0	45	206
2019	5	28	11	30.5	68.6	220	0	0	30	224
2019	5	28	12	31.9	60.6	220	0	0	55	338
2019	5	28	13	32.7	60.9	220	0	0	60	359
2019	5	28	14	33.8	58.8	220	0	0.02	30	87
2019	5	28	15	33.9	57.4	220	0	0.02	30	53
2019	5	28	16	33	55.9	220	0	0	10	85
2019	5	28	17	32.6	55.0	220	0	0	10	82
2019	5	28	18	31.1	58.5	220	2	0	0	25
2019	5	28	19	29.6	67.1	220	5	0	0	0
2019	5	28	20	28.3	79.4	220	3	0	0	0
2019	5	28	21	28	84.3	220	7	0	0	0

2019	5	28	22	27.3	88.3	220	7	0	0	0
2019	5	28	23	27.2	89.3	220	7	0	0	0
2019	5	28	24	26.3	90.8	220	6	0	40	0
2019	5	29	1	26	92.2	220	7	0	45	0
2019	5	29	2	25.8	91.9	220	3	0	60	0
2019	5	29	3	26	92.9	220	2	0.07	70	0
2019	5	29	4	25.3	90.6	220	0	0.03	30	0
2019	5	29	5	25.1	90.3	220	0	0	20	7
2019	5	29	6	26.2	92.3	220	2	0	10	23
2019	5	29	7	28.2	89.1	220	3	0	10	74
2019	5	29	8	28.9	81.5	220	5	0	0	90
2019	5	29	9	30	72.9	220	2	0	0	228
2019	5	29	10	31.1	65.5	220	3	0	0	578
2019	5	29	11	32.5	58.6	220	3	0	0	865
2019	5	29	12	33.1	60.0	220	3	0	0	892
2019	5	29	13	33.6	58.5	220	2	0	0	836
2019	5	29	14	34.2	56.7	220	3	0	0	719
2019	5	29	15	34.4	55.7	220	6	0	0	523
2019	5	29	16	34.4	53.2	220	2	0	0	315
2019	5	29	17	33.5	55.9	220	3	0	0	128
2019	5	29	18	32.2	59.1	220	8	0	0	27
2019	5	29	19	31.1	65.4	220	8	0	0	0
2019	5	29	20	30.1	73.9	220	8	0	0	0
2019	5	29	21	29.1	82.2	220	8	0	0	0
2019	5	29	22	29.2	86.6	220	0	0	0	0
2019	5	29	23	28.8	87.6	220	5	0	0	0

2019	5	29	24	28.4	88.5	220	6	0	0	0
2019	5	30	1	28.2	85.6	220	6	0	0	0
2019	5	30	2	27.8	89.1	220	5	0	0	0
2019	5	30	3	27.6	90.9	220	0	0	0	0
2019	5	30	4	27.3	91.1	220	0	0	0	0
2019	5	30	5	27.1	90.7	220	0	0	0	9
2019	5	30	6	27	91.4	220	0	0	0	112
2019	5	30	7	26.9	85.2	220	5	0	0	253
2019	5	30	8	27.3	85.9	220	6	0	0	499
2019	5	30	9	25.8	89.7	220	3	0	0	680
2019	5	30	10	27.6	87.6	220	2	0	0	793
2019	5	30	11	30	75.0	220	8	0	0	814
2019	5	30	12	30.5	65.1	220	8	0	0	771
2019	5	30	13	32.6	64.4	220	0	0	0	620
2019	5	30	14	33.2	60.6	220	5	0	0	504
2019	5	30	15	29.6	62.5	220	3	0	0	484
2019	5	30	16	28.5	60.6	220	0	0	0	370
2019	5	30	17	26.5	60.9	220	2	0	0	154
2019	5	30	18	25.8	66.3	220	0	0	0	39
2019	5	30	19	25.7	72.5	220	3	0	0	0
2019	5	30	20	25.7	76.6	220	3	0	0	0
2019	5	30	21	25.5	82.7	220	5	0	0	0
2019	5	30	22	25.5	85.0	220	5	0	0	0
2019	5	30	23	25.4	88.3	220	8	0	0	0
2019	5	30	24	25.1	90.2	220	0	0	0	0
2019	5	31	1	24.8	89.2	220	8	0	30	0

2019	5	31	2	24.8	90.0	220	8	0	20	0
2019	5	31	3	24.6	92.3	220	8	0	40	0
2019	5	31	4	24.3	91.4	220	3	0.32	30	0
2019	5	31	5	24.5	92.7	220	0	0	10	1
2019	5	31	6	24.8	84.6	220	0	0	0	89
2019	5	31	7	24.6	76.5	220	0	0	0	306
2019	5	31	8	25	69.7	220	0	0	0	525
2019	5	31	9	25.8	64.9	220	0	0	0	734
2019	5	31	10	27.7	63.6	220	0	0	0	622
2019	5	31	11	27.2	65.0	220	0	0	0	768
2019	5	31	12	27.2	69.2	220	0	0	0	209
2019	5	31	13	27.1	67.1	220	0	0	0	264
2019	5	31	14	27.5	66.2	220	0	0	0	492
2019	5	31	15	28	70.5	220	0	0	0	214
2019	5	31	16	28.4	73.7	220	0	0	0	111
2019	5	31	17	29.4	70.7	220	0	0	0	88
2019	5	31	18	28.3	70.1	200	3	0	0	35
2019	5	31	19	26.9	75.5	197	2	0	0	0
2019	5	31	20	26.2	84.1	197	5	0	0	0
2019	5	31	21	25.7	88.1	197	5	0	0	0
2019	5	31	22	25.2	90.8	197	6	0	0	0
2019	5	31	23	25.2	90.5	197	5	0	0	0
2019	5	31	24	25	92.2	197	7	0	0	0
2019	6	1	1	24.9	90.2	197	6	0	0	0
2019	6	1	2	24.7	93.3	197	3	0	0	0
2019	6	1	3	24.5	93.4	197	5	0	0	0

2019	6	1	4	24.6	90.5	197	2	0	0	0
2019	6	1	5	24.6	92.2	197	0	0	40	1
2019	6	1	6	25	93.0	197	0	0.01	30	25
2019	6	1	7	25.6	88.0	197	0	0	45	129
2019	6	1	8	24.9	74.1	197	0	0	50	122
2019	6	1	9	24.2	71.0	197	0	0	30	280
2019	6	1	10	25.6	68.3	197	0	0.01	60	122
2019	6	1	11	27.5	61.2	197	0	0.72	70	51
2019	6	1	12	28.9	57.0	197	0	0.03	75	245
2019	6	1	13	29.5	60.0	197	0	0	55	410
2019	6	1	14	30.8	59.2	197	0	0	40	421
2019	6	1	15	32.5	59.0	197	0	0	0	392
2019	6	1	16	32.6	55.7	197	0	0	10	192
2019	6	1	17	32.8	55.4	197	0	0	0	72
2019	6	1	18	30.8	58.5	197	3	0	0	32
2019	6	1	19	29.7	65.8	197	3	0	0	0
2019	6	1	20	29	74.5	197	3	0	0	0
2019	6	1	21	28	79.1	197	3	0	0	0
2019	6	1	22	28.1	85.7	197	6	0	0	0
2019	6	1	23	27.1	88.1	197	5	0	0	0
2019	6	1	24	26.8	89.4	197	3	0	0	0
2019	6	2	1	26.7	89.5	197	3	0	0	0
2019	6	2	2	26.7	91.1	197	3	0	0	0
2019	6	2	3	26.3	92.1	197	0	0	0	0
2019	6	2	4	26.1	90.7	197	0	0	0	0
2019	6	2	5	26.2	91.7	197	0	0	0	15

2019	6	2	6	27.9	92.0	197	0	0	0	142
2019	6	2	7	28.2	84.4	197	0	0	0	336
2019	6	2	8	28.5	78.5	197	0	0	0	538
2019	6	2	9	30.5	69.7	197	0	0	0	682
2019	6	2	10	32.3	61.7	197	0	0	0	735
2019	6	2	11	32.8	56.8	197	0	0	0	756
2019	6	2	12	33.8	55.2	197	0	0	0	890
2019	6	2	13	34.4	55.2	197	6	0	0	778
2019	6	2	14	35	56.2	197	3	0	0	689
2019	6	2	15	35.5	55.1	197	0	0	0	558
2019	6	2	16	36.2	54.8	197	0	0	0	396
2019	6	2	17	36.1	56.6	197	3	0	0	201
2019	6	2	18	34.6	61.7	197	5	0	0	37
2019	6	2	19	32.2	67.6	197	3	0	0	0
2019	6	2	20	30.7	77.7	197	2	0	0	0
2019	6	2	21	30.3	83.2	197	6	0	0	0
2019	6	2	22	29.7	84.9	197	5	0	0	0
2019	6	2	23	29.5	87.5	197	8	0	0	0
2019	6	2	24	29.4	87.9	197	3	0	0	0
2019	6	3	1	28.9	90.5	197	3	0	0	0
2019	6	3	2	28.3	91.2	197	5	0	0	0
2019	6	3	3	27.1	92.1	197	6	0	0	0
2019	6	3	4	26.1	92.5	197	7	0	0	0
2019	6	3	5	26	91.4	197	2	0	0	10
2019	6	3	6	26.5	91.0	197	8	0	0	107
2019	6	3	7	27.4	85.3	197	0	0	0	315

2019	6	3	8	28	74.7	197	0	0	0	475
2019	6	3	9	29.3	64.8	197	0	0	0	510
2019	6	3	10	30.9	58.8	197	2	0	0	692
2019	6	3	11	32.1	67.0	197	2	0	0	796
2019	6	3	12	32.1	80.1	197	2	0	0	724
2019	6	3	13	32.2	80.2	197	0	0	0	707
2019	6	3	14	32.9	69.4	197	2	0	0	690
2019	6	3	15	29.1	65.6	197	0	0	0	551
2019	6	3	16	27.8	62.3	197	2	0	0	381
2019	6	3	17	27.5	62.8	197	2	0	0	170
2019	6	3	18	27.5	68.1	197	3	0	0	27
2019	6	3	19	27.3	70.5	197	2	0	0	0
2019	6	3	20	27	74.7	197	3	0	0	0
2019	6	3	21	26.7	75.4	197	5	0	0	0
2019	6	3	22	26.5	75.2	197	6	0	0	0
2019	6	3	23	26.3	75.2	197	3	0	0	0
2019	6	3	24	26.1	79.4	197	5	0	0	0
2019	6	4	1	25.1	82.0	197	6	0	0	0
2019	6	4	2	25.1	85.5	197	8	0	0	0
2019	6	4	3	25.2	83.9	197	6	0	0	0
2019	6	4	4	25.2	85.1	197	5	0	0	0
2019	6	4	5	25.1	87.9	197	5	0.01	15	19
2019	6	4	6	25.4	90.5	197	0	0	20	56
2019	6	4	7	26.6	88.4	197	2	0	10	89
2019	6	4	8	27.8	85.5	197	3	0	25	127
2019	6	4	9	28.8	82.4	197	0	0.09	30	100

2019	6	4	10	30.2	81.7	197	0	0	10	640
2019	6	4	11	31	78.5	197	2	0	0	945
2019	6	4	12	31.4	73.4	197	3	0	0	865
2019	6	4	13	32.1	69.4	197	0	0	0	875
2019	6	4	14	31.3	66.1	197	0	0	0	650
2019	6	4	15	29.5	65.2	197	0	0	30	168
2019	6	4	16	30.7	61.9	197	0	0	50	39
2019	6	4	17	31.6	61.4	197	3	0.03	40	29
2019	6	4	18	31.7	67.8	197	0	0	0	15
2019	6	4	19	31.5	70.8	197	3	0	0	0
2019	6	4	20	31.2	78.3	197	6	0	0	0
2019	6	4	21	31.1	84.5	197	5	0	0	0
2019	6	4	22	30.8	84.1	197	3	0	0	0
2019	6	4	23	29.2	87.7	197	8	0	30	0
2019	6	4	24	28.5	89.5	197	0	0.01	40	0
2019	6	5	1	27.8	91.0	197	3	0	10	0
2019	6	5	2	27.5	89.2	197	8	0	0	0
2019	6	5	3	27.2	91.3	197	8	0	0	0
2019	6	5	4	26.8	92.2	197	3	0	0	0
2019	6	5	5	26.3	93.0	197	5	0	0	7
2019	6	5	6	26.3	93.4	197	2	0	50	68
2019	6	5	7	26.4	89.3	197	0	0	30	132
2019	6	5	8	26.5	79.2	197	0	0	10	237
2019	6	5	9	26.6	74.4	197	8	0.01	10	409
2019	6	5	10	27.1	69.5	197	2	0	0	623
2019	6	5	11	28.2	65.3	197	2	0	0	283

2019	6	5	12	29.5	60.8	197	0	0	0	225
2019	6	5	13	30.5	58.4	197	0	0	0	214
2019	6	5	14	31.1	56.8	197	2	0	0	355
2019	6	5	15	31.2	68.9	197	3	0	0	297
2019	6	5	16	31.6	73.0	197	3	0	0	289
2019	6	5	17	31.5	69.6	197	0	0	0	232
2019	6	5	18	31.2	64.0	197	0	0	0	38
2019	6	5	19	30.8	71.2	197	3	0	0	0
2019	6	5	20	30.2	80.8	197	3	0	0	0
2019	6	5	21	29.8	84.1	197	8	0	0	0
2019	6	5	22	29.7	81.8	197	3	0	0	0
2019	6	5	23	29.5	82.0	197	7	0	0	0
2019	6	5	24	27.1	84.6	197	8	0	0	0
2019	6	6	1	26.4	88.9	197	6	0	0	0
2019	6	6	2	25.2	87.8	197	3	0	0	0
2019	6	6	3	25	90.2	197	3	0	0	0
2019	6	6	4	25	88.6	197	3	0	0	0
2019	6	6	5	24.9	89.4	197	0	0	5	3
2019	6	6	6	25.2	91.2	197	0	0	20	39
2019	6	6	7	26.4	85.5	197	0	0	30	126
2019	6	6	8	27.6	78.3	197	0	0.14	40	50
2019	6	6	9	28.6	71.4	197	0	0.05	30	172
2019	6	6	10	30	66.4	197	2	0	0	557
2019	6	6	11	30.8	64.7	197	2	0	0	439
2019	6	6	12	31.2	59.7	197	3	0	0	664
2019	6	6	13	31.9	61.8	197	0	0	0	534

2019	6	6	14	31.1	62.1	197	0	0	0	605
2019	6	6	15	29.3	56.9	197	2	0	0	612
2019	6	6	16	30.5	60.9	197	3	0	0	396
2019	6	6	17	31.4	61.5	197	0	0	0	202
2019	6	6	18	31.5	63.2	197	0	0	0	29
2019	6	6	19	31.3	67.0	197	2	0	0	0
2019	6	6	20	30.1	75.1	197	5	0	0	0
2019	6	6	21	28.6	83.5	197	5	0	0	0
2019	6	6	22	27.6	83.3	197	3	0	0	0
2019	6	6	23	26.3	86.9	197	5	0	30	0
2019	6	6	24	25.3	88.4	197	0	0	40	0
2019	6	7	1	24.8	89.5	197	7	0	20	0
2019	6	7	2	24.8	90.7	197	0	0	10	0
2019	6	7	3	24.9	85.5	197	0	0	0	0
2019	6	7	4	24.9	86.8	197	3	0	0	0
2019	6	7	5	24.8	89.4	197	3	0	0	14
2019	6	7	6	25.1	89.6	197	2	0	10	125
2019	6	7	7	26.3	86.5	197	0	0	10	146
2019	6	7	8	27.5	84.4	197	0	0	0	175
2019	6	7	9	28.5	78.3	197	2	0	0	588
2019	6	7	10	29.9	65.7	197	3	0	0	697
2019	6	7	11	30.7	58.8	197	2	0	0	712
2019	6	7	12	31.1	60.3	197	0	0	0	851
2019	6	7	13	31.8	61.1	197	3	0	0	840
2019	6	7	14	31	59.8	197	2	0	0	760
2019	6	7	15	29.2	58.2	197	0	0	0	508

2019	6	7	16	30.4	58.5	197	0	0	0	400
2019	6	7	17	31.3	84.2	197	0	0	0	206
2019	6	7	18	31.4	88.9	197	0	0	0	44
2019	6	7	19	31.2	89.9	197	2	0	0	0
2019	6	7	20	30.9	89.6	197	3	0	30	0
2019	6	7	21	30.8	88.9	197	3	0	20	0
2019	6	7	22	30.5	89.3	197	5	0	10	0
2019	6	7	23	28.9	90.5	197	7	0	30	0
2019	6	7	24	28.2	91.9	197	7	0	50	0
2019	6	8	1	24.8	92.2	197	7	0	40	0
2019	6	8	2	24.8	92.3	197	6	0.01	60	0
2019	6	8	3	24.9	92.4	197	6	0.02	75	0
2019	6	8	4	24.9	93.0	197	3	0.05	80	0
2019	6	8	5	24.8	93.6	197	0	0.01	40	5
2019	6	8	6	25.1	92.7	197	0	0	20	100
2019	6	8	7	26.3	92.4	197	0	0	10	108
2019	6	8	8	27.5	91.9	197	0	0	0	222
2019	6	8	9	28.5	87.4	197	0	0	0	552
2019	6	8	10	29.9	86.7	197	0	0	0	846
2019	6	8	11	30.7	82.8	197	0	0	0	896
2019	6	8	12	31.1	76.6	197	0	0	0	555
2019	6	8	13	31.8	71.1	197	0	0	0	374
2019	6	8	14	31	66.5	197	0	0	0	505
2019	6	8	15	29.2	63.9	197	0	0	0	181
2019	6	8	16	30.4	63.9	197	0	0	0	156
2019	6	8	17	31.3	62.3	197	0	0	0	95

2019	6	8	18	31.4	67.5	197	2	0	0	35
2019	6	8	19	31.2	72.0	197	3	0	0	0
2019	6	8	20	30.9	77.6	197	5	0	30	0
2019	6	8	21	30.8	80.5	197	6	0	35	0
2019	6	8	22	30.5	82.2	197	7	0	40	0
2019	6	8	23	28.9	85.1	197	7	0	45	0
2019	6	8	24	28.2	83.3	197	5	0.03	40	0
2019	6	9	1	24.7	79.6	197	7	0.33	55	0
2019	6	9	2	24.7	81.2	197	7	0	40	0
2019	6	9	3	24.8	84.0	197	3	0	30	0
2019	6	9	4	24.8	86.9	197	3	0.01	60	0
2019	6	9	5	24.7	90.5	197	0	0	40	3
2019	6	9	6	25	91.7	197	0	0	20	54
2019	6	9	7	26.2	91.5	197	0	0	0	204
2019	6	9	8	27.4	88.0	197	0	0	0	345
2019	6	9	9	28.4	79.0	197	0	0	0	407
2019	6	9	10	29.8	74.1	197	0	0	0	670
2019	6	9	11	30.6	72.7	197	0	0	0	641
2019	6	9	12	31	68.4	197	0	0	0	597
2019	6	9	13	31.7	63.5	197	0	0	20	710
2019	6	9	14	30.9	64.6	197	0	0	40	197
2019	6	9	15	29.1	76.1	197	0	0.08	60	172
2019	6	9	16	30.3	86.9	197	0	0	70	97
2019	6	9	17	31.2	82.3	251	0	0.17	55	37
2019	6	9	18	31.3	84.6	293	3	0	40	0
2019	6	9	19	31.1	82.7	293	3	0	60	0

2019	6	9	20	30.8	82.3	293	5	0	45	0
2019	6	9	21	30.7	85.6	293	6	0	60	0
2019	6	9	22	30.4	85.3	290	5	2.05	70	0
2019	6	9	23	28.8	83.7	270	8	19.5	80	0
2019	6	9	24	28.1	82.8	225	8	0.37	100	0
2019	6	10	1	24.6	82.6	225	3	0.11	100	0
2019	6	10	2	24.6	88.2	225	3	0.23	100	0
2019	6	10	3	24.7	92.6	227	5	0.07	100	0
2019	6	10	4	24.7	94.1	227	0	0.01	100	0
2019	6	10	5	24.6	93.1	227	0	0.01	100	1
2019	6	10	6	24.9	92.3	227	3	0.14	100	51
2019	6	10	7	26.1	92.1	227	0	0.6	100	194
2019	6	10	8	27.3	93.0	227	0	0	100	354
2019	6	10	9	28.3	91.9	227	0	0.44	100	411
2019	6	10	10	29.7	87.3	227	0	0.34	100	780
2019	6	10	11	30.5	83.3	227	0	0.47	100	647
2019	6	10	12	30.9	78.8	227	2	0	100	597
2019	6	10	13	31.6	73.5	227	0	0.34	100	714
2019	6	10	14	30.8	70.6	227	2	0.38	100	311
2019	6	10	15	29	68.7	227	0	0.88	100	382
2019	6	10	16	30.2	67.3	227	2	0.31	100	297
2019	6	10	17	31.1	66.7	227	2	0	100	37
2019	6	10	18	31.2	66.8	227	0	0.34	100	0
2019	6	10	19	31	75.9	227	2	0.02	100	0
2019	6	10	20	30.7	82.1	227	2	0.59	100	0
2019	6	10	21	30.6	84.1	227	3	1.02	100	0

201 9	6	10	22	30.3	86.0	227	3	0	100	0
201 9	6	10	23	28.7	87.7	227	3	0.12	100	0

Appendix 3.2: Ambient Air quality Monitoring Results

Appendix 3.2-Air Monitoring Data

AQ1/B1(26° 7'34.57"N, 93°49'31.19"E)																	
	S.N.	**Date**	**PM10 (µg/m3)**	**PM2.5 (µg/m3)**	**SO2 (µg/m3)**	**NO2 (µg/m3)**	**O3 (µg/m3)**	**NH3 (µg/m3)**	**CO (mg/m3)**	**As (ng/m3)**	**Ni (ng/m3)**	**Pb (µg/m3)**	**C6H6 (µg/m3)**	**BaP (ng/m3)**	**HC as methne (ppm)**	**HC as non-methane (ppm)**
Week 1	1	13/3/2019	65.2	37.2	<6.0	19.6	<20.0	<10.0	0.22	<1.0	<5.0	0.02	<4.2	<0.5	1.46	<0.1
	2	16/3/2019	58.4	26.4	<6.0	28.3	<20.0	<10.0	0.45	<1.0	<5.0	<0.01	<4.2	<0.5	0.81	<0.1
Week 2	3	20/3/2019	56.6	24.3	<6.0	22	<20.0	<10.0	0.32	<1.0	<5.0	<0.01	<4.2	<0.5	1.47	<0.1
	4	23/3/2019	77.2	40.2	6.4	26.4	<20.0	25.3	0.5	<1.0	<5.0	<0.01	<4.2	<0.5	2.29	<0.1
Week 3	5	27/3/2019	75.3	39.3	<6.0	24.5	24.2	<10.0	0.42	<1.0	<5.0	<0.01	<4.2	<0.5	1.98	<0.1
	6	30/3/2019	54.8	29.6	<6.0	16.8	<20.0	26.3	0.27	<1.0	<5.0	0.04	<4.2	<0.5	1.53	<0.1
Week 4	7	1/4/2019	56.8	34.2	<6.0	17.2	<20.0	16.9	0.36	<1.0	<5.0	0.03	<4.2	<0.5	0.94	<0.1
	8	03/04/2019	42.5	20.5	<6.0	22.7	21.4	11.2	0.55	<1.0	<5.0	0.02	<4.2	<0.5	2.79	<0.1
Week 5	9	06/04/2019	65.5	32.5	8.1	19.8	<20	<10	0.32	<1.0	<5.0	0.01	<4.2	<0.5	1.36	<0.1
	10	10/04/2019	70.9	39.8	7.2	25.2	21.8	10.9	0.15	<1.0	<5.0	<0.01	<4.2	<0.5	1.31	<0.1
Week 6	11	13/04/2019	60.7	33.9	6.6	23.4	<20.0	<10.0	0.49	<1.0	<5.0	<0.01	<4.2	<0.5	2.78	<0.1
	12	17/04/2019	58.7	25.8	6.2	17.2	<20.0	<10.0	0.36	<1.0	<5.0	<0.01	<4.2	<0.5	1.41	<0.1
Week 7	13	20/04/2019	78.1	40.7	<6.0	27.6	<20.0	10.2	0.25	<1.0	<5.0	<0.01	<4.2	<0.5	2.4	<0.1
	14	24/04/2019	58.4	27.7	6.9	19.8	<20.0	<10.0	0.62	<1.0	<5.0	<0.01	<4.2	<0.5	1.31	<0.1
Week 8	15	27/04/2019	62.8	29.1	<6.0	20.5	<20.0	<10.0	0.33	<1.0	<5.0	<0.01	<4.2	<0.5	1.31	<0.1
	16	01/05/2019	69.9	34.5	7.5	27.6	<20.0	10.4	0.47	<1.0	<5.0	0.05	<4.2	<0.5	1.19	<0.1
Week 9	17	04/05/2019	54.5	32.7	<6.0	17.9	<20.0	21.2	0.25	<1.0	<5.0	<0.01	<4.2	<0.5	1.31	<0.1
	18	08/05/2019	67.5	42.3	6.5	23.8	<20.0	<10.0	0.36	<1.0	<5.0	<0.01	<4.2	<0.5	1.16	<0.1
Week 10	19	11/05/2019	34.2	14.5	6.2	16.5	<20.0	<10.0	0.45	<1.0	<5.0	<0.01	<4.2	<0.5	1	<0.1

	20	15/05/2019	78.3	51.7	7.6	25.6	24.5	19.6	0.58	<1.0	<5.0	<0.01	<4.2	<0.5	1.18	<0.1
Week 11	21	18/05/2019	81.3	36.2	<6.0	33.9	21.4	<10.0	0.64	<1.0	<5.0	<0.01	<4.2	<0.5	1.98	<0.1
	22	22/05/2019	68.4	32.6	<6.0	23.5	<20.0	15.4	0.29	<1.0	<5.0	<0.01	<4.2	<0.5	1.6	<0.1
Week 12	23	25/05/2019	48.9	21.4	6.6	18.6	23.7	<10.0	0.18	<1.0	<5.0	<0.01	<4.2	<0.5	1.58	<0.1
	24	29/05/2019	57.3	18.5	<6.0	25.2	<20.0	16.6	0.37	<1.0	<5.0	<0.01	<4.2	<0.5	1.8	<0.1
Week 13	25	6/5/2019	42.6	18.7	<6.0	15.2	<20.0	<10.0	0.62	<1.0	<5.0	<0.01	<4.2	<0.5	1.56	<0.1
	26	6/8/2019	52.4	30.2	<6.0	26.8	<20.0	18.6	0.33	<1.0	<5.0	<0.01	<4.2	<0.5	1.75	<0.1

AQ2/B1(26°09'32.13"N 93°46'54.90"E)																
	S.N.	**Date**	**PM10 (µg/m3)**	**PM2.5 (µg/m3)**	**SO2 (µg/m3)**	**NO2 (µg/m3)**	**O3 (µg/m3)**	**NH3 (µg/m3)**	**CO (mg/m3)**	**As (ng/m3)**	**Ni (ng/m3)**	**Pb (µg/m3)**	**C6H6 (µg/m3)**	**BaP (ng/m3)**	**HC as methne (ppm)**	**HC as non-methane (ppm)**
Week 1	1	10/3/2019	64.2	29.8	<6.0	24.2	<20.0	<10.0	0.28	<1.0	<5.0	<0.01	<4.2	<0.5	1.44	<0.1
	2	17/3/2019	71.6	40.2	7.2	22.4	<20.0	<10.0	0.56	<1.0	<5.0	0.03	<4.2	>0.5	2.08	<0.1
Week 2	3	21/3/2019	62.5	36.6	<6.0	19.5	<20.0	<10.0	0.35	<1.0	<5.0	<0.01	<4.2	<0.5	2.38	<0.1
	4	24/3/2019	76.8	39.2	7.2	28.2	<20.0	<10.0	0.25	<1.0	5.4	0.05	<4.2	<0.5	0.93	<0.1
Week 3	5	14/3/2019	46.6	22.6	<6.0	20.6	<20.0	<10.0	0.41	<1.0	<5.0	0.01	<4.2	<0.5	1.17	<0.1
	6	28/3/2019	56.8	25.4	<6.0	17.2	<20.0	<10.0	0.58	<1.0	<5.0	<0.01	<4.2	<0.5	1.36	<0.1
Week 4	7	31/3/2019	68.2	34.8	6.3	25.2	<20.0	<10.0	0.36	<1.0	<5.0	<0.01	<4.2	<0.5	1.25	<0.1
	8	04/04/2019	80.2	41.2	7.2	18.7	<20.0	18.5	0.23	<1.0	<5.0	0.06	<4.2	<0.5	1.1	<0.1
Week 5	9	07/04/2019	59.8	31.2	6.5	17.9	<20.0	<10.0	0.36	<1.0	<5.0	0.03	<4.2	<0.5	2.04	<0.1
	10	11/04/2019	62.1	33.4	<6.0	23.8	<20.0	15.3	0.27	<1.0	<5.0	0.07	<4.2	<0.5	1.99	<0.1
Week 6	11	14/04/2019	48.6	21.3	<6.0	20.5	<20.0	<10.0	0.43	<1.0	<5.0	0.05	<4.2	<0.5	2.35	<0.1
	12	21/04/2019	49.9	24.1	7.3	23.3	<20.0	11.5	0.57	<1.0	<5.0	0.05	<4.2	<0.5	2.51	<0.1

Week 7	13	23/04/2019	69.9	37.6	<6.0	19.7	<20.0	10.6	0.41	<1.0	<5.0	<0.01	<4.2	<0.5	2.04	<0.1
	14	25/04/2019	61.8	30.3	6.3	21.4	22.6	<10.0	0.26	<1.0	<5.0	<0.01	<4.2	<0.5	2.38	<0.1
Week 8	15	28/04/2019	70.5	33.8	6.6	29.3	<20.0	<10.0	0.51	<1.0	<5.0	0.03	<4.2	<0.5	1.2	<0.1
	16	02/05/2019	83.7	41.6	<6.0	31.2	<20.0	16.7	0.39	<1.0	<5.0	0.01	<4.2	<0.5	1.52	<0.1
Week 9	17	05/05/2019	69.9	38.6	6.6	19.3	<20.0	<10.0	0.48	<1.0	<5.0	<0.01	<4.2	<0.5	1.8	<0.1
	18	09/05/2019	69.9	38.6	6.6	19.3	<20.0	<10.0	0.48	<1.0	<5.0	<0.01	<4.2	<0.5	1.8	<0.1
Week 10	19	12/05/2019	72.2	29.7	<6.0	26.3	<20.0	16.5	0.27	<1.0	<5.0	<0.01	<4.2	<0.5	1.27	<0.1
	20	16/05/2019	54.5	33.8	<6.0	18.4	25.4	<10.0	0.19	<1.0	<5.0	<0.01	<4.2	<0.5	1.54	<0.1
Week 11	21	19/05/2019	31.2	14.5	<6.0	23	<20.0	19.6	0.54	<1.0	<5.0	<0.01	<4.2	<0.5	1.05	<0.1
	22	23/05/2019	67.3	41.8	6.2	30.7	20.5	<10.0	0.24	<1.0	<5.0	<0.01	<4.2	<0.5	2.14	<0.1
Week 12	23	26/05/2019	75.5	36.2	<6.0	15.2	<20.0	14.5	0.47	<1.0	<5.0	<0.01	<4.2	<0.5	1.16	<0.1
	24	30/05/2019	50.2	28.8	7.5	27.4	22.9	<10.0	0.31	<1.0	<5.0	<0.01	<4.2	<0.5	2.41	<0.1
Week 13	25	6/2/2019	32.2	21.3	6.6	16.7	<20.0	<10.0	0.21	<1.0	<5.0	<0.01	<4.2	<0.5	1.33	<0.1
	26	6/6/2019	50.3	31.2	<6.0	24..9	<20.0	<10.0	0.54	<1.0	<5.0	<0.01	<4.2	<0.5	2	<0.1

AQ3/B1(26°03'57.42"N 93°46'54.90"E)

	S.N.	Date	PM10 (µg/m3)	PM2.5 (µg/m3)	SO2 (µg/m3)	NO2 (µg/m3)	O3 (µg/m3)	NH3 (µg/m3)	CO (mg/m3)	As (ng/m3)	Ni (ng/m3)	Pb (µg/m3)	C6H6 (µg/m3)	BaP (ng/m3)	HC as methne (ppm)	HC as non-methane (ppm)
Week 1	1	13/3/2019	68.3	33.6	7.4	20.6	<20.0	<10.0	0.31	<1.0	10.2	0.02	<4.2	<0.5	1.2	<0.1
	2	16/3/2019	66	30.2	6.9	29.8	21.2	18.9	0.37	<1.0	<5.0	0.03	<4.2	<0.5	1.48	<0.1
Week 2	3	20/3/2019	72	36.3	7.5	24.5	<20.0	<10.0	0.23	<1.0	<5.0	<0.01	<4.2	<0.5	1.1	<0.1
	4	23/3/2019	58.6	25.4	6.2	17.6	<20.0	<10.0	0.63	<1.0	<5.0	<0.01	<4.2	<0.5	2.65	<0.1

Week 3	5	27/3/2019	69.3	32.5	7	26.5	<20.0	<10.0	0.34	<1.0	<5.0	<0.01	<4.2	<0.5	2	<0.1
	6	30/3/2019	81.4	40.3	7.6	22.5	24.2	23.3	0.47	<1.0	<5.0	<0.01	<4.2	<0.5	1.56	<0.1
Week 4	7	03/04/2019	59.6	27.9	7.3	33.9	23.4	13.8	0.16	<1.0	<5.0	<0.01	<4.2	<0.5	1.94	<0.1
	8	06/04/2019	60.8	29.9	6.2	29.3	<20.0	15.7	0.27	<1.0	<5.0	<0.01	<4.2	<0.5	2.83	<0.1
Week 5	9	10/04/2019	81	40.2	<6.0	17.8	<20.0	<10.0	0.69	<1.0	<5.0	<0.01	<4.2	<0.5	2.05	<0.1
	10	13/04/2019	63.3	31.5	<6.0	30.3	<20.0	<10.0	0.34	<1.0	<5.0	<0.01	<4.2	<0.5	1.99	<0.1
Week 6	11	17/04/2019	58.6	28.7	6.9	28.6	22.4	11.8	0.55	<1.0	<5.0	<0.01	<4.2	<0.5	1.57	<0.1
	12	20/04/2019	50	24.8	7.5	25.4	<20.0	15.1	0.46	<1.0	<5.0	<0.01	<4.2	<0.5	1.58	<0.1
Week 7	13	24/04/2019	47.8	22.9	6.3	16.3	<20.0	<10.0	0.18	<1.0	<5.0	<0.01	<4.2	<0.5	1.79	<0.1
	14	27/04/2019	78.4	37.7	7.6	22.1	<20.0	17.6	0.62	<1.0	<5.0	<0.01	<4.2	<0.5	1.99	<0.1
Week 8	15	01/05/2019	70.9	35.5	<6.0	27.2	24.6	<10.0	0.36	<1.0	<5.0	<0.01	<4.2	<0.5	1.86	<0.1
	16	04/05/2019	87.3	52.6	<6.0	20.7	23.9	<10.0	0.25	<1.0	<5.0	<0.01	<4.2	<0.5	2.54	<0.1
Week 9	17	08/05/2019	67.1	25.3	6.8	27.2	25.4	11.4	0.34	<1.0	<5.0	<0.01	<4.2	<0.5	2.25	<0.1
	18	11/05/2019	53.2	32.4	<6.0	32	21.7	17.6	0.31	<1.0	<5.0	<0.01	<4.2	<0.5	2.03	<0.1
Week 10	19	15/05/2019	46.6	30.2	<6.0	23.4	<20.0	<10.0	0.55	<1.0	<5.0	<0.01	<4.2	<0.5	1.18	<0.1
	20	18/05/2019	78.7	46.5	7.3	19.5	24.1	13.5	0.45	<1.0	<5.0	<0.01	<4.2	<0.5	2.04	<0.1
Week 11	21	22/05/2019	61.6	37.6	6.2	25.8	<20.0	<10.0	0.24	<1.0	<5.0	<0.01	<4.2	<0.5	2.02	<0.1
	22	25/05/2019	57.1	24.7	<6.0	19.9	26.6	<10.0	0.65	<1.0	<5.0	<0.01	<4.2	<0.5	2.28	<0.1
Week 12	23	29/05/2019	80.8	51.2	6.9	30.1	22.2	14.7	0.27	<1.0	<5.0	<0.01	<4.2	<0.5	1.77	<0.1
	24	01/06/2019	42.2	30.4	7.1	22.2	<20.0	<10.0	0.38	<1.0	<5.0	<0.01	<4.2	<0.5	1.81	<0.1
Week 13	25	6/5/2019	36.8	22.5	<6.0	13.1	<20.0	<10.0	0.36	<1.0	<5.0	<0.01	<4.2	<0.5	1.94	<0.1
	26	6/8/2019	60.4	26.7	6.2	30.1	<20.0	17.5	0.47	<1.0	<5.0	<0.01	<4.2	<0.5	1.67	<0.1

AQ4/B1(25°57'50.58"N, 93°42'41.03"E)																	
	S.N.	**Date**	**30.1**	**PM2.5 (µg/m3)**	**SO2 (µg/m3)**	**NO2 (µg/m3)**	**O3 (µg/m3)**	**NH3 (µg/m3)**	**CO (mg/m3)**	**As (ng/m3)**	**Ni (ng/m3)**	**Pb (µg/m3)**	**C6H6 (µg/m3)**	**BaP (ng/m3)**	**HC as methne (ppm)**	**HC as non-methane (ppm)**
Week 1	1	11/3/2019	78.2	40.2	6.2	26.4	<20.0	<10.0	0.24	<1.0	<5.0	0.02	<4.2	<0.5	1.23	<0.1
	2	15/3/2019	73.5	37.5	6.6	25.4	<20.0	<10.0	0.5	<1.0	<5.0	<0.02	<4.2	<0.5	1.28	<0.1
Week 2	3	18/3/2019	66.3	30.8	<6.0	19.2	<20.0	<10.0	0.34	<1.0	<5.0	0.01	<4.2	<0.5	1.71	<0.1
	4	22/3/2019	76.2	36.9	6.3	24.8	20.7	<10.0	0.43	<1.0	<5.0	<0.01	<4.2	<0.5	1.26	<0.1
Week 3	5	25/3/2019	56.9	29.9	<6.0	20.5	<20.0	<10.0	0.32	<1.0	<5.0	<0.01	<4.2	<0.5	1.72	<0.1
	6	29/3/2019	71.9	37.1	6.8	28.5	<20.0	<10.0	0.5	<1.0	<5.0	<0.01	<4.2	<0.5	1.78	<0.1
Week 4	7	1/4/2019	55.4	29.2	<6.0	17.4	<20.0	<10.0	0.56	<1.0	<5.0	<0.01	<4.2	<0.5	1.45	<0.1
	8	05/04/2019	82	40.1	6.5	21.1	<20.0	18.9	0.19	<1.0	<5.0	<0.01	<4.2	<0.5	1.76	<0.1
Week 5	9	08/04/2019	60.4	28.4	7.1	19.8	<20.0	<10.0	0.34	<1.0	<5.0	<0.01	<4.2	<0.5	1.6	<0.1
	10	12/04/2019	61.8	30.6	6.6	31.2	22.2	<10.0	0.45	<1.0	<5.0	<0.01	<4.2	<0.5	2.05	<0.1
Week 6	11	15/04/2019	71.1	34.6	7.7	29.7	<20.0	17.5	0.29	<1.0	<5.0	<0.01	<4.2	<0.5	2.94	<0.1
	12	19/04/2019	59.5	29.1	<6.0	15.2	<20.0	<10.0	0.54	<1.0	<5.0	<0.01	<4.2	<0.5	1.79	<0.1
Week 7	13	22/04/2019	73.2	33.7	<6.0	28.8	<20.0	<10.0	0.22	<1.0	<5.0	<0.01	<4.2	<0.5	2.02	<0.1

	14	26/04/2019	79.7	37.6	6	33.1	23.7	<10.0	0.36	<1.0	<5.0	<0.01	<4.2	<0.5	1.31	<0.1
Week 8	15	29/04/2019	66.6	30.9	<6.0	20.8	24.9	15.5	0.45	<1.0	<5.0	<0.01	<4.2	<0.5	2.79	<0.1
	16	03/05/2019	75.2	45.6	6.6	16.8	<20.0	16.8	0.75	<1.0	<5.0	<0.01	<4.2	<0.5	1.82	<0.1
Week 9	17	06/05/2019	57.6	31.7	7	28.6	<20.0	<10.0	0.33	<1.0	<5.0	<0.01	<4.2	<0.5	1.29	<0.1
	18	10/05/2019	57.6	29.7	6.4	19	<20.0	<10.0	0.27	<1.0	<5.0	<0.01	<4.2	<0.5	1.67	<0.1
Week 10	19	13/05/2019	68.2	36.4	<6.0	29.4	<20.0	20.4	0.44	<1.0	<5.0	<0.01	<4.2	<0.5	1.34	<0.1
	20	17/05/2019	41.6	28.5	7.3	16.7	24.9	<10.0	0.75	<1.0	<5.0	<0.01	<4.2	<0.5	2.15	<0.1
Week 11	21	20/05/2019	79.1	48.3	<6.0	32.1	21.5	16.8	0.32	<1.0	<5.0	<0.01	<4.2	<0.5	2	<0.1
	22	24/05/2019	43.6	21.2	<6.0	17.6	<20.0	14.4	0.39	<1.0	<5.0	<0.01	<4.2	<0.5	1.51	<0.1
Week 12	23	27/05/2019	74.3	44.7	6.1	22.9	<20.0	17.5	0.44	<1.0	<5.0	<0.01	<4.2	<0.5	1.61	<0.1
	24	31/05/2019	37.5	18.6	<6.0	24.1	24.8	<10.0	0.25	<1.0	<5.0	<0.01	<4.2	<0.5	2.24	<0.1
Week 13	25	6/3/2019	65.7	29.6	<6.0	20.3	<20.0	19.2	0.48	<1.0	<5.0	<0.01	<4.2	<0.5	2.06	<0.1
	26	6/7/2019	30.1	19.4	6.5	14.2	<20.0	<10.0	0.31	<1.0	<5.0	<0.01	<4.2	<0.5	1.89	<0.1

AQ5/B1(26°02'08.64"N 93°46'20.62"E)																
	S.N.	**Date**	**PM10 (µg/m3)**	**PM2.5 (µg/m3)**	**SO2 (µg/m3)**	**NO2 (µg/m3)**	**O3 (µg/m3)**	**NH3 (µg/m3)**	**CO (mg/m3)**	**As (ng/m3)**	**Ni (ng/m3)**	**Pb (µg/m3)**	**C6H6 (µg/m3)**	**BaP (ng/m3)**	**HC as methne (ppm)**	**HC as non-methane (ppm)**
Week 1	1	10/3/2019	72.5	36.9	7.2	24.6	21.5	<10.0	0.28	<1.0	<5.0	0.03	<4.2	<0.5	1.42	<0.1
	2	14/3/2019	77.3	38.2	8.5	32.2	<20.0	<10.0	0.23	<1.0	<5.0	0.02	<4.2	<0.5	0.82	<0.1
Week 2	3	17/3/2019	76.2	41.5	6.8	16.8	<20.0	<10.0	0.36	<1.0	<5.0	0.02	<4.2	<0.5	1.89	<0.1
	4	21/3/2019	78.9	40.2	7.4	29.8	<20.0	<10.0	0.48	<1.0	<5.0	<0.01	<4.2	<0.5	1.14	<0.1
Week 3	5	24/3/2019	55.4	24.2	<6.0	19.3	<20.0	<10.0	0.26	<1.0	<5.0	<0.01	<4.2	<0.5	1.35	<0.1

	6	28/3/2019	66	32	6.5	18.5	<20.0	<10.0	0.33	<1.0	<5.0	<0.01	<4.2	<0.5	2.02	<0.1
Week 4	7	31/3/2019	75.8	37.2	6.8	28.8	22.8	26.6	0.25	<1.0	<5.0	<0.01	<4.2	<0.5	1.48	<0.1
	8	04/04/2019	48.8	24.8	6.6	34.6	<20.0	<10.0	0.66	<1.0	<5.0	<0.01	<4.2	<0.5	1.31	<0.1
Week 5	9	07/04/2019	80.8	43.3	7.3	22.1	<20.0	18.2	0.36	<1.0	<5.0	<0.01	<4.2	<0.5	1.41	<0.1
	10	11/04/2019	56.7	28.7	<6.0	30.6	25.3	<10.0	0.45	<1.0	<5.0	0.05	<4.2	<0.5	1.1	<0.1
Week 6	11	14/04/2019	60.9	30.9	<6.0	36.3	<20.0	<10.0	0.16	<1.0	<5.0	0.03	<4.2	<0.5	1.36	<0.1
	12	21/04/2019	72.2	36.7	6.8	21.5	21.6	11.3	0.28	<1.0	<5.0	0.03	<4.2	<0.5	2.06	<0.1
Week 7	13	23/04/2019	51.5	25.4	6	27.7	<20.0	<10.0	0.29	<1.0	<5.0	0.06	<4.2	<0.5	2.51	<0.1
	14	25/04/2019	79.7	40.1	<6.0	19.8	24.8	16.6	0.77	<1.0	<5.0	0.05	<4.2	<0.5	2.4	<0.1
Week 8	15	28/04/2019	76	38.9	<6.0	16.2	<20.0	17.3	0.41	<1.0	<5.0	0.02	<4.2	<0.5	2.78	<0.1
	16	02/05/2019	55.9	27.6	8.1	23.8	<20.0	<10.0	0.555	<1.0	<5.0	0.05	<4.2	<0.5	2.04	<0.1
Week 9	17	05/05/2019	56.7	32.9	7.2	23.3	<20.0	21.2	0.26	<1.0	<5.0	<0.01	<0.5	<0.5	2.25	<0.1
	18	09/05/2019	63.8	26.6	<6.0	18.9	<20.0	<10.0	0.35	<1.0	<5.0	<0.01	<4.2	<0.5	1.77	<0.1
Week 10	19	12/05/2019	34.2	16.6	6.3	21.2	<20.0	19.8	0.28	<1.0	<5.0	<0.01	<4.2	<0.5	2.18	<0.1
	20	16/05/2019	34.2	16.6	6.3	21.2	<20.0	19.8	0.28	<1.0	<5.0	<0.01	<4.2	<0.5	2.18	<0.1
Week 11	21	19/05/2019	40.2	26.3	<6.0	13.5	25.1	<10.0	0.33	<1.0	<5.0	<0.01	<4.2	<0.5	1.56	<0.1
	22	23/05/2019	68.1	25.7	7.7	19.7	<20.0	12.2	0.54	<1.0	<5.0	<0.01	<4.2	<0.5	1.54	<0.1
Week 12	23	26/05/2019	52.2	20.1	6.6	24.2	24.3	19.6	0.67	<1.0	<5.0	<0.01	<4.2	<0.5	1.96	<0.1
	24	30/05/2019	72.4	30.9	<6.0	28.9	22.5	<10.0	0.22	<1.0	<5.0	<0.01	<4.2	<0.5	2.16	<0.1
Week 13	25	6/2/2019	40.5	17.8	6.2	25.5	<20.0	<10.0	0.24	<1.0	<5.0	<0.01	<4.2	<0.5	1.51	<0.1
	26	6/6/2019	64.2	36.5	<6.0	16.2	<20.0	<10.0	0.19	<1.0	<5.0	<0.01	<4.2	<0.5	1.55	<0.1

AQ6/B1(25°57'08.21"N 93°44'45.54"E)																	
	S.N.	**Date**	**PM10 (µg/m3)**	**PM2.5 (µg/m3)**	**SO2 (µg/m3)**	**NO2 (µg/m3)**	**O3 (µg/m3)**	**NH3 (µg/m3)**	**CO (mg/m3)**	**As (ng/m3)**	**Ni (ng/m3)**	**Pb (µg/m3)**	**C6H6 (µg/m3)**	**BaP (ng/m3)**	**HC as methne (ppm)**	**HC as non-methane (ppm)**
Week 1	1	13/3/2019	74.3	39.4	6.8	23.8	<20.0	<10.0	0.19	<1.0	13.7	0.02	<4.2	<0.5	1.22	<0.1
	2	20/3/2019	59.3	24.5	<6.0	18.6	<20.0	<10.0	0.34	<1.0	<5.0	0.01	<4.2	<0.5	1.94	<0.1
Week 2	3	23/3/2019	80.2	42.3	7	19.5	<20.0	<10.0	0.43	<1.0	<5.0	<0.01	<4.2	<0.5	2.31	<0.1
	4	27/3/2019	64.5	30.9	6.2	18.2	<20.0	<10.0	0.37	<1.0	<5.0	<0.01	<4.2	<0.5	2.01	<0.1
Week 3	5	30/3/2019	62.3	29.4	<6.0	17.5	<20.0	<10.0	0.28	<1.0	<5.0	<0.01	<4.2	<0.5	1.2	<0.1
	6	2/4/2019	69.8	32.4	<6.0	16.4	<20.0	<10.0	0.52	<1.0	<5.0	<0.01	<4.2	<0.5	1.91	<0.1
Week 4	7	03/04/2019	59.4	29.3	6.2	28.9	<20.0	11.2	0.26	<1.0	<5.0	0.04	<4.2	<0.5	1.2	<0.1
	8	06/04/2019	48.6	24.3	7.4	33.3	21.4	<10.0	0.78	<1.0	<5.0	0.02	<4.2	<0.5	1.52	<0.1
Week 5	9	10/04/2019	76.6	38.8	7	27.6	<20.0	15.3	0.65	<1.0	<5.0	0.03	<4.2	<0.5	1.31	<0.1
	10	13/04/2019	71.9	37.6	6.3	13.5	<20.0	14.5	0.45	<1.0	<5.0	0.02	<4.2	<0.5	2.51	<0.1
Week 6	11	17/04/2019	51.6	25.2	<6.0	32.7	25.6	<10.0	0.34	<1.0	<5.0	0.03	<4.2	<0.5	2.04	<0.1
	12	20/04/2019	57.8	27.7	<6.0	21.9	<20.0	<10.0	0.29	<1.0	<5.0	0.1	<4.2	<0.5	1.31	<0.1
Week 7	13	24/04/2019	45.9	22.2	6.6	26.7	23.3	<10.0	0.38	<1.0	<5.0	<0.01	<4.2	<0.5	2.04	<0.1
	14	27/04/2019	54.4	26.8	<6.0	34.1	<20.0	<10.0	0.42	<1.0	<5.0	0.06	<4.2	<0.5	2.38	<0.1
Week 8	15	01/05/2019	70.7	36.9	7.5	14.2	<20.0	12.7	0.33	<1.0	<5.0	<0.01	<4.2	<0.5	2.83	<0.1
	16	04/05/2019	81.8	41.2	6.1	29.8	<20.0	18.2	0.26	<1.0	<5.0	0.05	<4.2	<0.5	1.99	<0.1
Week 9	17	08/05/2019	54.3	33.6	<6.0	15.6	<20.0	<10.0	0.65	<1.0	<5.0	<0.01	<4.2	<0.5	1.63	<0.1
	18	11/05/2019	39.4	18.5	6.2	24.5	20.9	16.2	0.27	<1.0	<5.0	<0.01	<4.2	<0.5	1.69	<0.1
Week 10	19	15/05/2019	76.6	48.7	7.1	29.2	21.7	<10.0	0.32	<1.0	<5.0	<0.01	<4.2	<0.5	2.35	<0.1

	20	18/05/2019	60.5	29.1	<6.0	23.6	<20.0	<10.0	0.28	<1.0	<5.0	<0.01	<4.2	<0.5	1.78	<0.1
Week 11	21	22/05/2019	78.6	49.7	8.2	15.7	26.5	16.7	0.47	<1.0	<5.0	<0.01	<4.2	<0.5	1.61	<0.1
	22	25/05/2019	50.1	22.8	<6.0	28.4	21.5	20.2	0.76	<1.0	<5.0	<0.01	<4.2	<0.5	2.43	<0.1
Week 12	23	29/05/2019	37.5	23.7	6.5	12.5	<20.0	<10.0	0.38	<1.0	<5.0	<0.01	<4.2	<0.5	2.28	<0.1
	24	01/06/2019	71.3	44.6	7	16.9	22.7	16.7	0.26	<1.0	<5.0	<0.01	<4.2	<0.5	1.69	<0.1
Week 13	25	6/5/2019	41.9	18.7	6.8	17.3	<20.0	13.6	0.26	<1.0	<5.0	<0.01	<4.2	<0.5	1.46	<0.1
	26	6/8/2019	30.1	20.5	<6.0	20.1	<20.0	<10.0	0.34	<1.0	<5.0	<0.01	<4.2	<0.5	1.62	<0.1

AQ7/B1(26°00'38.68"N 93°49'56.95"E)

	S.N.	**Date**	**PM10 (µg/m3)**	**PM2.5 (µg/m3)**	**SO2 (µg/m3)**	**NO2 (µg/m3)**	**O3 (µg/m3)**	**NH3 (µg/m3)**	**CO (mg/m3)**	**As (ng/m3)**	**Ni (ng/m3)**	**Pb (µg/m3)**	**C6H6 (µg/m3)**	**BaP (ng/m3)**	**HC as methne (ppm)**	**HC as non-methane (ppm)**
Week 1	1	11/3/2019	76	38.4	7.2	22.8	21.2	16.3	0.26	<1.0	<5.0	0.02	<4.2	<0.5	1.77	<0.1
	2	15/3/2019	60.4	25.8	<6.0	19.2	<20.0	<10.0	0.36	<1.0	<5.0	0.02	<4.2	<0.5	1.71	<0.1
Week 2	3	18/3/2019	78.6	37.5	6.6	29.6	23.3	<10.0	0.26	<1.0	<5.0	0.02	<4.2	<0.5	2.14	<0.1
	4	22/3/2019	61.6	26.4	6.2	18.7	<20.0	<10.0	0.36	<1.0	<5.0	<0.01	<4.2	<0.5	2.7	<0.1
Week 3	5	25/3/2019	80	39.6	7.4	28.7	21.8	29.6	0.43	<1.0	<5.0	<0.01	<4.2	<0.5	1.19	<0.1
	6	29/3/2019	66.6	30.4	6.3	18.3	<20.0	<10.0	0.34	<1.0	<5.0	<0.01	<4.2	<0.5	2.03	<0.1
Week 4	7	2/4/2019	77	39.3	7.2	28.5	<20.0	23.2	0.23	<1.0	<5.0	<0.01	<4.2	<0.5	1.8	<0.1
	8	05/04/2019	59.4	27.4	<6.0	18.8	20.8	<10.0	0.29	<1.0	<5.0	0.04	<4.2	<0.5	1.57	<0.1
Week 5	9	08/04/2019	50.3	28.7	6.4	23.3	23.4	<10.0	0.34	<1.0	<5.0	0.01	<4.2	<0.5	2.38	<0.1
	10	12/04/2019	77.7	37.1	7.5	16.7	<20.0	<10.0	0.55	<1.0	<5.0	<0.01	<4.2	<0.5	1.99	<0.1
Week 6	11	15/04/2019	72.3	35.8	<6.0	22.7	<20.0	13.2	0.21	<1.0	<5.0	<0.01	<4.2	<0.5	2.35	<0.1
	12	19/04/2019	55.6	23.9	6.9	14.3	<20.0	16.2	0.34	<1.0	<5.0	0.02	<4.2	<0.5	1.99	<0.1

Week 7	13	22/04/2019	58.7	27.6	<6.0	23.5	<20.0	11.2	0.16	<1.0	<5.0	0.01	<4.2	<0.5	2.05	<0.1
	14	26/04/2019	60.7	33.9	<6.0	30.1	26.9	18.2	0.27	<1.0	<5.0	0.01	<4.2	<0.5	1.79	<0.1
Week 8	15	29/04/2019	56.1	25.5	8.2	35.7	<20.0	<10.0	0.38	<1.0	<5.0	<0.01	<4.2	<0.5	1.94	<0.1
	16	03/05/2019	75.6	38.7	7.1	28.6	<20.0	14.1	0.44	<1.0	<5.0	<0.01	<4.2	<0.5	1.04	<0.1
Week 9	17	06/05/2019	47.7	33.5	6.7	30.7	<20.0	<10.0	0.48	<1.0	<5.0	<0.01	<4.2	<0.5	2.3	<0.1
	18	10/05/2019	66.3	27.3	<6.0	26.5	<20.0	17.8	0.36	<1.0	<5.0	<0.01	<4.2	<0.5	2.78	<0.1
Week 10	19	13/05/2019	34.5	22.7	8.2	19.3	<20.0	<10.0	0.77	<1.0	<5.0	<0.01	<4.2	<0.5	1.78	<0.1
	20	17/05/2019	69.8	44.6	<6.0	12.2	23.3	<10.0	0.55	<1.0	<5.0	<0.01	<4.2	<0.5	1.81	<0.1
Week 11	21	20/05/2019	44.5	20.6	<6.0	17.9	<20.0	<10.0	0.61	<1.0	<5.0	<0.01	<4.2	<0.5	1.54	<0.1
	22	24/05/2019	56.6	31.7	6.8	26.2	25.6	18.5	0.43	<1.0	<5.0	<0.01	<4.2	<0.5	1.71	<0.1
Week 12	23	27/05/2019	63.1	28.6	<6.0	31.1	22.5	<10.0	0.22	<1.0	<5.0	<0.01	<4.2	<0.5	1.9	<0.1
	24	31/05/2019	73.9	42.3	7.3	24.9	<20.0	14.7	0.27	<1.0	<5.0	<0.01	<4.2	<0.5	1.95	<0.1
Week 13	25	6/3/2019	39.7	16.8	<6.0	24.3	<20.0	<10.0	0.42	<1.0	<5.0	<0.01	<4.2	<0.5	1.27	<0.1
	26	6/7/2019	43.1	26.3	7.5	17.4	<20.0	<10.0	0.28	<1.0	<5.0	<0.01	<4.2	<0.5	1.46	<0.1

AQ8/B1(25°59'58.75"N 93°46'23.34"E)																
	S.N.	**Date**	**PM10 (µg/m3)**	**PM2.5 (µg/m3)**	**SO2 (µg/m3)**	**NO2 (µg/m3)**	**O3 (µg/m3)**	**NH3 (µg/m3)**	**CO (mg/m3)**	**As (ng/m3)**	**Ni (ng/m3)**	**Pb (µg/m3)**	**C6H6 (µg/m3)**	**BaP (ng/m3)**	**HC as methne (ppm)**	**HC as non-methane (ppm)**
Week 1	1	10/3/2019	59.6	26.4	6.8	23.6	<20.0	<10.0	0.47	<1.0	<5.0	0.04	<4.2	<0.5	1.04	<0.1
	2	AAQ8/B1	69.3	36.6	6.5	26.1	21.9	23.3	0.36	<1.0	<5.0	<0.01	<4.2	<0.5	1.48	<0.1
Week 2	3	AAQ8/B1	62	28.3	<6.0	22.2	<20.0	<10.0	0.26	<1.0	<5.0	<0.01	<4.2	<0.5	1.44	<0.1
	4	24/3/2019	74.3	34.9	<6.0	24.5	<20.0	<10.0	0.21	<1.0	7.4	0.09	<4.2	<0.5	2.38	<0.1

Week 3	5	28/3/2019	78.9	39.8	7.4	29.4	<20.0	19.6	0.28	<1.0	<5.0	<0.01	<4.2	<0.5	1.72	<0.1
	6	31/3/2019	63.2	30.9	7.1	28.1	<20.0	24.2	0.52	<1.0	<5.0	<0.01	<4.2	<0.5	2.2	<0.1
Week 4	7	2/4/2019	72.4	33.6	6.6	18.7	22.2	<10.0	0.37	<1.0	<5.0	<0.01	<4.2	<0.5	1.96	<0.1
	8	04/04/2019	54.3	28.1	<6.0	25.5	<20.0	<10.0	0.45	<1.0	<5.0	<0.01	<4.2	<0.5	2.94	<0.1
Week 5	9	07/04/2019	58.1	30.7	<6.0	15.2	21.4	12.3	0.38	<1.0	<5.0	0.02	<4.2	<0.5	1.79	<0.1
	10	11/04/2019	79.4	37.1	7.5	29.5	<20.0	14.7	0.53	<1.0	<5.0	<0.01	<4.2	<0.5	1.76	<0.1
Week 6	11	14/04/2019	80.4	41.7	6.2	21.3	<20.0	16.8	0.22	<1.0	<5.0	<0.01	<4.2	<0.5	2.02	<0.1
	12	21/04/2019	53.9	28.1	<6.0	22.2	<20.0	<10.0	0.65	<1.0	<5.0	<0.01	<4.2	<0.5	1.6	<0.1
Week 7	13	23/04/2019	61.2	29.1	<6.0	28.3	<20.0	17.3	0.24	<1.0	<5.0	<0.01	<4.2	<0.5	2.05	<0.1
	14	25/04/2019	50.7	26.1	6.6	16.4	<20.0	<10.0	0.19	<1.0	<5.0	<0.01	<4.2	<0.5	1.86	<0.1
Week 8	15	28/04/2019	57.7	27.4	6.1	17.7	21.2	13.1	0.44	<1.0	<5.0	<0.01	<4.2	<0.5	1.58	<0.1
	16	02/05/2019	72.7	34.7	7.5	26.1	<20.0	11.7	0.29	<1.0	<5.0	<0.01	<4.2	<0.5	1.99	<0.1
Week 9	17	05/05/2019	64.6	29.6	<6.0	18.5	<20.0	21.2	0.37	<1.0	<5.0	<0.01	<4.2	<0.5	1.59	<0.1
	18	09/05/2019	52.4	34.5	<6.0	24.4	<20.0	<10.0	0.21	<1.0	<5.0	<0.01	<4.2	<0.5	1.65	<0.1
Week 10	19	12/05/2019	41.1	27.6	7.9	29.3	<20.0	<10.0	0.42	<1.0	<5.0	<0.01	<4.2	<0.5	1.77	<0.1
	20	16/05/2019	75.5	51.8	<6.0	24.8	<20.0	17.2	0.34	<1.0	<5.0	<0.01	<4.2	<0.5	1.67	<0.1
Week 11	21	19/05/2019	58.9	35.2	6.2	16.7	<20.0	<10.0	0.29	<1.0	<5.0	<0.01	<4.2	<0.5	2.35	<0.1
	22	23/05/2019	71.8	47.3	7.2	16.6	26.3	<10.0	0.51	<1.0	<5.0	<0.01	<4.2	<0.5	2.06	<0.1
Week 12	23	26/05/2019	37.2	24.6	<6.0	17.9	<20.0	13.5	0.46	<1.0	<5.0	<0.01	<4.2	<0.5	1.62	<0.1
	24	30/05/2019	61.7	40.2	6.3	25.3	20.9	<10.0	0.62	<1.0	<5.0	<0.01	<4.2	<0.5	1.81	<0.1
Week 13	25	6/2/2019	40.2	25.3	<6.0	19.3	<20.0	<10.0	0.38	<1.0	<5.0	<0.01	<4.2	<0.5	1.59	<0.1
	26	6/6/2019	50.7	21.8	<6.0	27.6	<20.0	<10.0	0.22	<1.0	<5.0	<0.01	<4.2	<0.5	1.53	<0.1

Appendix 3.3: Ambient Noise Monitoring Results

Appendix 3.3-Noise Monitoring Data

	NQ-1 (NEPALI BASTI ,BALIPATHAR)	NQ-2 (ROMON RINGTIGAON)	NQ-3 (SATSANG VILLAGE)	NQ-4 (GOUTAM BASTI)	NQ-5 (EKRANI BASTI)	NQ-6 (SANTIGAON)	NQ-7 (PANCHLAMA RDGAON)	NQ-8 (GHARIALDUB I)
Coord inate	26°7'34.57"N, 93°49'31.19"E	26°09'32.13"N 93°46'54.90"E	26°03'57.42"N 93°46'54.90"E	25°57'50.58"N, 93°42'41.03"E	26°02'08.64"N 93°46'20.62"E	25°57'08.21"N 93°44'45.54"E	26°00'38.68"N 93°49'56.95"E	25°59'58.75"N 93°46'23.34"E
Date	28.05.2019	30.05.2019	29.05.2019	31.05.2019	01.06.2019	02.06.2019	03.06.2019	05.06.2019
Day Time								
Lday	52.95	51.8	53.9	53.8	54.8	56.4	51.0	56.1
MAX(day)	55.80	56.1	58.7	58.5	58.8	60.7	55.6	60.7
MIN(d ay)	46.80	44.1	45.1	45.2	46.8	43.9	42.4	46.1
Night Time								
Lnight	44.6	44.1	44.7	45.0	45.4	44.7	43.0	45.0
MAX(Night)	47.5	45.8	47.9	49.7	48.9	49.0	46.9	48.7
MIN(Night)	38.9	40.6	41.3	39.9	40.0	40.0	40.1	42.1

Appendix 3.4: Ground Water Quality Monitoring Results

Appendix 3.4-Ground Water Quality Monitoring Data

S. N.	Parameters	Unit	Method	GW1/B1 25°52'17.0 0"N 93°48'41.2 0"E	GW2/B1 26°0'36.80 "N 93°49'23.9 0"E	GW3/B1 26°0'38.50 "N 93°50'33.5 0"E	GW4/B1 25°56'20.2 0"N 93°57'36.9 0"E	GW5/B1 26°03'52.4 1"N 93°47'28.3 5"E	GW6/B1 25°57'06.4 0"N 93°45'17.5 0"E	GW7/B1 25°59'12.7 0"N 93°54'50.0 0"E	GW8/B1 26°10'21.2 0"N 93°46'45.6 0"E
	Dates			**15/05/2019**	**15/05/2019**	**15/05/2019**	**15/05/2019**	**14/05/2019**	**14/05/2019**	**15/05/2019**	**13/05/2019**
	Depth of Groundwater										
	Whether Tubewell/borewell/dugwell			**(OPEN WELL)**	**(TUBE WELL)**	**(TUBE WELL)**	**(OPEN WELL)**	**(TUBE WELL)**	**(TUBE WELL)**	**(TUBE WELL)**	**(OPEN WELL)**
(I)	**Organolaptic Physical Parameters**										
1	**Colour**	**Hazen**	APHA (23rd Edition) 2120B, 2017	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2	**Odour**	-	APHA(23rd Edition) 2150B, 2017	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable
3	**Taste**	**None**	IS 3025 (Part 8)-1983 Rffm:2012	Not Done	Not Done	Not Done	Not Done	Not Done	Not Done	Not Done	Not Done
4	**Temperature**	**Deg C**	APHA 23rd EDITION, 2550 B, 2017	25	25	25	25	25	25	25	25
5	**pH**	-	APHA(23rd Edition) 4500-H⁺-B, 2017	7.05 at 25 deg C	7.39 at 25 deg C	8.44 at 25 deg C	7.86 at 25 deg C	7.65 at 25 deg C	8.24 at 25 deg C	7.89 at 25 degC	7.34 at 25 deg C
6	**Turbidity**	**NTU**	APHA (23rd Edition) 2130B, 2017	11	4.8	3.5	4.4	18	3.8	3.1	3.7
7	**Total Dissolved Solids**	**mg/l**	APHA(23rd Edition) 2540C, 2017	168	186	318	110	170.2	290	42	120
8	**Electrical Conductivity**	**µS/Cm**	APHA (23rd Edition) 2510B, 2017	243	286	513	167	257	467	64	181
9	**Salinity**	**None**	APHA (23rd Edition)2520B, 2017	0.14 in respect to KCl equivalent salinity 35	0.16 In respect to KCl equivalent salinity 35	0.29 In respect to KCl equivalent salinity 35	0.09 In respect to KCl equivalent salinity 35	0.15 In respect to KCl equivalent salinity 35	0.27 In respect to KCl euivalent salinity 35	0.04 In respect to KCl equivalent salinity 35	0.10 In respect to KCl equivalent salinity 35
10	**Dissloved oxygen**	**mg/l**	APHA (23rd Edition) 4500-O-C/G, 2017	5.4	5.4	5.4	5.3	5.0	5.2	5.4	5.1
(II)	**General Parameters**										
11	**Aluminium(Al)**	**mg/l**	APHA (23rd Edition)3120B 2017 (ICP OES)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
12	**Anionic Detergent (as MBAS)**	**mg/l**	APHA (23rd Edition)5540 C,2017	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
13	**Barium (Ba)**	**mg/l**	APHA (23rd Edition)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05

			3120B, 2017								
14	**Calcium(Ca)**	**mg/l**	APHA (23rd Edition) 3500 Ca B,2017	20	16	16	16	28.0	32	4.80	20.0
15	**Chloramines (as Cl2)**	**mg/l**	IS 3025 (Part 26)-1986	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
16	**Chloride**	**mg/l**	APHA (23rd Edition)4500-Cl B 2017	20	10	10	15	10	20	10	15
17	**Copper(Cu)**	**mg/l**	APHA (23rd Edition)3120B 2017 (ICP OES)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
18	**Fluoride as F**	**mg/l**	APHA (23rd Edition)4500 - F C/D, 2017	0.23	0.24	0.30	0.28	0.29	0.31	0.26	0.28
19	**Free Residual Chlorine**	**mg/l**	IS 3025 (Part 26)-1986	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
20	**Iron (Fe)**	**mg/l**	APHA (23rd Edition)3500 Fe B 2017	0.80	0.28	0.20	0.26	1.3	0.19	0.21	0.20
21	**Maganisium(Mg)**	**mg/l**	APHA (23rd Edition) 3500 Mg B,2017	7.20	9.60	14.40	4.80	14.40	9.60	1.92	7.20
22	**Manganese(Mn)**	**mg/l**	APHA (23rd Edition)3120B 2017 (ICP OES)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
23	**Mineral Oil**	**mg/l**	IS 3025 (Part 39)1991	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
24	**Nitrate**	**mg/l**	APHA (23rd Edition) 4500-NO3-E, 2017	19	<0.5	3.9	1.7	7.3	3.6	<0.5	1.7
25	**Phenol**	**mg/l**	APHA (23rd Edition)5530C 2017 (Chloroform Extraction)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
26	**Selenium (Se)**	**mg/l**	APHA (23rd Edition) 3120 B, 2017	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
27	**Sulphate**	**mg/l**	APHA (23rd Edition) 4500-SO4 E 2017	30	<1.0	2.6	2.3	14.7	3.7	<1.0	2.9
28	**Potassium**	**mg/l**	APHA (23rd Edition) 3500 K B 2017	10	9.7	16	5.8	8.6	12	1.2	6.2
29	**Total Phosphorous**	**mg/l**	APHA (23rd Edition) 4500- P B, D 2017	4.58	9.41	7.90	6.78	10.7	8.03	7.20	7.52
30	**Sodium**	**mg/l**	APHA (23rd	29.2	29	40	10	28	30	6.3	11

			Edition) 3500 Na B 2017								
31	**Total Alakalinity**	**mg/l**	APHA (23rd Edition), 2320B, 2017	30.0	160	280	80	120	240	16.0	90
32	**Total Hardness**	**mg/l**	APHA (23rd Edition) 2340 C 2017	80	80	100	60	130	120	20.0	80
33	**Total Nitrogen**	**mg/l**	IS 14684 (1999)	4.4	<0.3	0.9	0.40	1.6	0.83	<0.3	0.84
34	**Zinc(Zn)**	**mg/l**	APHA (23rd Edition)3 120B 2017	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
(III)	**Toxic Substances**										
35	**Cadmium (Cd)**	**mg/l**	APHA (23rd Edition)3 120B 2017	<0.001	<0.005	<0.005	<0.001	<0.001	<0.001	<0.001	<0.001
36	**Cyanide (as CN)**	**mg/l**	APHA (23rd Edition)4 500 CN-F 2017	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
37	**Lead (Pb)**	**mg/l**	APHA (23rd Edition)3 120B 2017	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
38	**Mercury (Hg)**	**mg/l**	IS 3025(Part 48)-1994; Rffm:2014	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
39	**Molybdenum (as Mo)**	**mg/l**	APHA (23rd Edition), 3120 B, 2017	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
40	**Nickel (as Ni)**	**mg/l**	APHA (23rd Edition), 3120 B, 2017	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
41	**Hexavalent Chromium(Cr+6)**	**mg/l**	APHA 23rd Edtn-2017, 3500 Cr B	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
42	**Arsenic(As)**	**mg/l**	APHA (23rd Edition)3 120B 2017 (ICP OES)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
(IV)	**Pesticides Residues**										
43	**Alchor**	**µg/l**	AOAC 990.06	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
44	**Atrazine**	**µg/l**	AOAC 990.06	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
45	**Aldrin**	**µg/l**	AOAC 990.06	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
46	**Dialdrin**	**µg/l**	AOAC 990.06	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
47	**α-HCH**	**µg/l**	AOAC 990.06	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
48	**β-HCH**	**µg/l**	AOAC 990.06	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
49	**Butachlore**	**µg/l**	AOAC 990.06	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
50	**Chlorpyrifos**	**µg/l**	AOAC 990.06	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
51	**δ-HCH**	**µg/l**	AOAC 990.06	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

52	**2,4 Dichlorophenoxyacetic acid**	**µg/l**	US EPA 515	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
53	**p,p DDT**	**µg/l**	AOAC 990.06	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
54	**o,p DDT**	**µg/l**	AOAC 990.06	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
55	**o,p DDE**	**µg/l**	AOAC 990.06	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
56	**p,p DDE**	**µg/l**	AOAC 990.06	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
57	**o,p DDD**	**µg/l**	AOAC 990.06	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
58	**p,p DDD**	**µg/l**	AOAC 990.06	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
59	**Endosulphan sulphate**	**µg/l**	AOAC 990.06	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
60	**Alpha-Endosulfan**	**µg/l**	AOAC 990.06	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
61	**Beta-Endosulfan**	**µg/l**	AOAC 990.06	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
62	**Ethion**	**µg/l**	AOAC 990.06	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
63	**γ-HCH (Lindane)**	**µg/l**	AOAC 990.06	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
64	**Iso Protron**	**µg/l**	US EPA 532	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
65	**Malathion**	**µg/l**	AOAC 990.06	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
66	**Methyl Parathion**	**µg/l**	AOAC 990.06	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
67	**Monocrotphos**	**µg/l**	AOAC 990.06	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
68	**Phorate**	**µg/l**	AOAC 990.06	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
69	**Pesticides as Lindane**	**mg/l**	AOAC 990.06	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
(V)	**Bacteriological Parameters**										
70	**Total Coliform**	**MPN/100ml**	IS 1622 : 1981 (RA 2014)	DETECTED	NOT DETECTED	NOT DETECTED	DETECTED	NOT DETECTED	NOT DETECTED	NOT DETECTED	DETECTED
71	**Faecal Coliform**	**MPN/100ml**	IS 1622 : 1981 (RA 2014)	DETECTED	NOT DETECTED	NOT DETECTED	NOT DETECTED	NOT DETECTED	NOT DETECTED	NOT DETECTED	NOT DETECTED

Appendix 3.5: Surface Water Quality Monitoring Results

Appendix 3.5-Surface Water Quality Monitoring Data

S. N.	Parameters	Unit	Method	SW1/B1 26°10'05.00"N, 93°49'30.00"E	SW2/B1 26°03'57.20"N, 93°48'00.08"E	SW3/B1 25°57'02.00"N, 93°45'29.40"E	SW4/B1 25°54'26.00"N, 93°57'52.80"E	SW5/B1 26°01'17.60"N, 93°54'06.20"E	SW6/B1 25°51'57.80"N, 93°51'19.10"E	SW7/B1 26°0'38.60"N, 93°49'19.80"E	SW8/B1 25°51'54.00"N, 93°46'55.40"E
	Dates			13/05/2019	14/05/2019	14/05/2019	15/05/2019	15/05/2019	15/05/2019	15/05/2019	15/05/2019
	Whether Tank/pond/lake/river			(RIVER WATER)	(RIVER WATER)	(RIVER WATER)	(RIVER WATER)	(RIVER WATER)	(POND WATER)	(RIVER WATER)	(RIVER WATER)
	Parameters										
1	Colour	Hazen	APHA (23rd Edition) 2120B, 2017	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2	Odour	None	APHA(23rd Edition) 2150B, 2017	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable
3	Taste	µg/l	IS 3025 (Part 8)-1983 Rffm:2012	Not Done	Not Done	Not Done	Not Done	Not Done	Not Done	Not Done	Not Done
4	Temperature	Deg C	APHA 23rd EDITION, 2550 B, 2017	25	25	25	25	25	25	25	25
5	pH value	None	APHA(23rd Edition) 4500-H^+-B, 2017	7.37 at 25 deg C	7.58 at 25 deg C	7.41 at 25 deg C	7.44 at 25 deg C	7.73 at 25 deg C	7.33 at 25 deg C	7.32 at 25 deg C	7.61 at 25 deg C
6	Conductivity	us/cm	APHA (23rd Edition) 2510B, 2017	206	221	430	246	265.6	124.5	118.2	144
7	DO	mg/l	APHA (23rd Edition)-4500-O, 2017	6.2	6.3	6.4	6.2	6.4	6.1	6.5	6.2
8	Turbidity	N.T.U.	APHA (23rd Edition) 2130B, 2017	33	64	37	98	151	42	18	85
9	Total Dissolved Solids (as TDS)	mg/l	APHA(23rd Edition) 2540C, 20017	148	164	275	180	176	82	80	240
10	Biochemical Oxygen Demand (as BOD)	mg/l	APHA (23rd Edition) 5210B, 2017	<2.0	<2.0	<2.0	<2.0	<2.0	3.8	<2.0	2.2
11	Chemical Oxygen Demand (COD)	mg/l	APHA (23rd Edition) 5220B, 2017	8	8	<4.0	<4.0	<4.0	24	<4.0	12
12	Total Hardness (as $CaCO_3$)	mg/l	APHA (23rd Edition) 2340 C, 2017	56.0	72.0	120	90.0	100	50.0	40.0	60.0
13	Alkalinity (as $CaCO_3$)	mg/l	APHA (23rd Edition) 2320B, 2017	48	64.0	100	80.0	90	30	30	120
14	Sodium (as Na)	mg/l	APHA (23rd Edition) 3500 Na B, 2017	11	12	20	17	23	2.5	7.6	5.22
15	Potassium (as K)	mg/l	APHA (23rd Edition) 3500 K B, 2017	3.6	4.4	5.7	2.5	3.0	2.7	2.5	2.0
16	Sodium Adsorption Ration (as SAR)	None	IS 11624, 1986, RA2015	0.6	0.6	0.8	0.8	1.0	0.2	0.5	0.3
17	Free Ammonia	mg/l	APHA (23rd Edition) 4500NH3-B, 2017	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
18	Phosphorus	mg/l	APHA (23rd Edition), 4500P-D, 2017	5.54	6.40	6.45	9.28	10.63	4.05	3.26	9.6
19	Total Nitrogen	mg/l	APHA (23rd Edition) 4500N C, 2017	4.0	4.8	4.5	3.36	5.0	2.5	1.7	5.2
20	Aluminium (as Al)	mg/l	APHA (23rd Edition)3120B 2017 (ICP OES)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

21	Anionic Detergents (as MBAS)	mg/l	APHA (23rd Edition)5540 C,2017	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
22	Barium (as Ba)	mg/l	APHA (23rd Edition) 3120 B, 2017	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
23	Calcium (as Ca)	mg/l	APHA (23rd Edition) 3500 Ca B,2017	14.4	16	32.0	28.0	32.0	12.0	12.0	16.0
24	Chloramines (as Cl2)	mg/l	IS 3025 (Part 26)- 1986	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
25	Chloride (as Cl)	mg/l	APHA (23rd Edition) 4500-Cl B, 2017	18.2	8.08	30.29	10.10	10.10	5.05	10.10	20.19
26	Copper (as Cu)	mg/l	APHA (23rd Edition)3120B 2017 (ICP OES)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
27	Fluoride (as F)	mg/l	APHA (23rd Edition)4500 - F C/D, 2017	0.22	0.35	0.32	0.25	0.29	0.28	0.84	0.15
28	Free Residual Chlorine	mg/l	IS 3025 (Part 26)-1986	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
29	Iron (as Fe)	mg/l	APHA (23rd Edition)3500 Fe B, 2017	3.6	12	4.01	11	20	6.8	3.3	5.84
30	Magnesium (as Mg)	mg/l	APHA (23rd Edition) 3500 Mg B, 2017	4.8	7.68	9.60	4.80	4.80	4.80	2.40	4.80
31	Manganese (as Mn)	mg/l	APHA (23rd Edition)3120B 2017 (ICP OES)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
32	Mineral Oil	mg/l	IS 3025 (Part 39)1991	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
33	Nitrate (as NO3)	mg/l	APHA (23rd Edition) 4500- NO3-E, 2017	16.04	20.06	19.96	16.20	20.48	8.67	6.21	22
34	Selenium (as Se)	mg/l	APHA (23rd Edition) 3120 B, 2017	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
35	Sulphate (as SO4)	mg/l	APHA (23rd Edition) 4500-SO4 E 2017	33.84	40.2	42.6	34.26	36.12	16.15	12.12	26.67
36	Cadmium (as Cd)	mg/l	APHA (23rd Edition)3120B 2017	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
37	Cyanide (as CN)	mg/l	APHA (23rd Edition)4500 CN- F 2017	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
38	Lead (as Pb)	mg/l	APHA (23rd Edition) 3120B, 2017	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
39	Mercury (as Hg)	mg/l	IS 3025(Part 48)-1994; Rffm:2014	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
40	Molybdenum (as Mo)	mg/l	APHA (23rd Edition) 3120B, 2017	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
41	Arsenic(as As)	mg/l	APHA (23rd Edition)3120B 2017 (ICP OES)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
42	Nickel (as Ni)	mg/l	APHA (23rd Edition) 3120B, 2017	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
43	Zinc (as Zn)	mg/l	APHA (23rd Edition) 3120B, 2017	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02

44	Hexavalent Chromium (as Cr+6)	mg/l	APHA 23rd Edtn-2017, 3500 Cr B	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
45	Salinity	None	APHA (23rd Edition) 2520B, 2017	0.13 In Respect to KCL equivalent salinity 35.	0.14 In respect to KCl equivalent salinity 35	0.25 In respect to KCl equivalent salinity 35	0.14 In respect to KCl equivalent salinity 35.	0.15 In respect to KCl equivalent salinity 35.	0.07 In respect to KCl equivalent salinity 35.	0.07 In respect to KCl equivalent salinity 35	0.08 In respect to KCl equivalent salinity 35
46	Phenol	mg/l	APHA (23rd Edition)5530C 2017 (Chloroform Extraction)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
47	Bromoform	µg/l	APHA (23rd Edition) 6232 B	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
48	Dibromochloromethane	µg/l	APHA (23rd Edition) 6232 B	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
49	Bromodichloromethane	µg/l	APHA (23rd Edition) 6232 B	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
50	Chloroform	µg/l	APHA (23rd Edition) 6232 B	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
51	Alachlor	µg/l	AOAC 990.06	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
52	Atrazine	µg/l	AOAC 990.06	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
53	Aldrin	µg/l	AOAC 990.06	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
54	Dieldrin	µg/l	AOAC 990.06	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
55	Alpha-HCH	µg/l	AOAC 990.06	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
56	Beta-HCH	µg/l	AOAC 990.06	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
57	Butachlor	µg/l	AOAC 990.06	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
58	Chlorpyrifos	µg/l	AOAC 990.06	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
59	Delta-HCH	µg/l	AOAC 990.06	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
60	2,4-Dichlorophenoxyacetic acid	µg/l	US EPA 515	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
61	p,p DDD	µg/l	AOAC 990.06	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
62	o,p-DDT	µg/l	AOAC 990.06	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
63	p,p-DDT	µg/l	AOAC 990.06	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
64	o,p-DDE	µg/l	AOAC 990.06	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
65	p,p-DDE	µg/l	AOAC 990.06	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
66	o,p-DDD	µg/l	AOAC 990.06	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
67	Endosulfan sulfate	µg/l	AOAC 990.06	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

68	Alpha -endosulfan	µg/l	AOAC 990.06	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
69	Beta-Endosulfan	µg/l	AOAC 990.06	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
70	Ethion	µg/l	AOAC 990.06	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
71	Gama-HCH(Lindane)	µg/l	AOAC 990.06	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
72	Isoproturon	µg/l	US EPA 532	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
73	Malathion	µg/l	AOAC 990.06	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
74	Methyl parathion	µg/l	AOAC 990.06	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
75	Monocrotophos	µg/l	AOAC 990.06	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
76	Phorate	none	AOAC 990.06	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
77	Polychlorinated biphenyls (as PCB)	mg/l	US EPA 8082	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
78	Polynuclear Aromatic Hydrocarbons (as PAH)	mg/l	APHA 6440C	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
79	Total coliform	MPN /100 ml	APHA (23rd Edition) 9221 B	140	110	70	50	90	33	80	130
80	Faecal coliform	/100 ml	APHA (23rd Edition) 9221 E	DETECTED	DETECTED	DETECTED	DETECTED	DETECTED	DETECTED	DETECTED	DETECTED
81	Zooplankton	/1lit	APHA 23rd Edition, 10200	Absent	Absent	Present	Absent	Present	Absent	Present	Absent
I.	Cyclops	/1lit	-	-	-	2000	-	-	-	-	-
II.	Keratella	/1lit	-	-	-	1000	-	-	-	-	-
III.	Bythotrephes longimanus	/1lit	-	-	-	-	-	2000	-	2000	-
IV.	Monia	/1lit	-	-	-	-	-	-	-	-	-
82	Phytoplankton	/1lit	APHA 23rd Edition, 10200	Present	Present	Present	Present	Present	Present	Present	Present
I.	Synedra	/1lit	-	3000	-	-	-	-	-	-	
II.	Phormidium	/1lit	-	4000	-	-	-	-	-	-	3000
III.	Oscillatoria	/1lit	-	3000	-	-	3000	-	-	-	-
IV.	Zygnema	/1lit	-	-	1000	-	-	-	-	-	-
V.	Closteridium	/1lit	-	-	1000	-	-	-	-	-	-

VI.	Cladophora	/1lit	-	-	2000	-	-	-	2000	2000	-
VII.	Desmium	/1lit	-	-	-	2000	-	-	-	-	-
VIII.	Anabaena	/1lit	-	-	-	2000	-	6000	-	-	-
IX.	Phormidium	/1lit	-	-	-	2000	-	-	-	-	-
X.	Spirogyra	/1lit	-	-	-	1000	-	-	-	-	-
XI.	Cladophora	/1lit	-	-	-	-	5000	-	-	-	-
XII.	Navicula	/1lit	-	-	-	-	2000	-	-	-	-
XIII.	Fragilaria	/1lit	-	-	-	-	-	3000	-	-	1000
XIV.	Ulothrix	/1lit	-	-	-	-	-	2000	4000	4000	-
XV.	Microcoleus	/1lit	-	-	-	-	-	-	2000	-	-
XVI.	Hildenbrandia	/1lit	-	-	-	-	-	-	-	-	2000

Appendix 3.6: Soil Monitoring Results

Appendix 3.6-Soil Monitoring Data

Parameters	**Unit**	**S1/B1**	**S2/B1**	**S3/B1**	**S4/B1**	**S5/B1**	**S6/B1**	**S7/B1**	**S8/B1**
Dates		**13/05/2019**	**13/05/2019**	**14/05/2019**	**14/05/2019**	**13/05/2019**	**14/05/2019**	**15/05/2019**	**15/05/2019**
Coordinate		26°10'07.40" N, 93°46'48.90" E	25°56'26.25" N, 93°54'56.75" E	26° 1'55.56"N, 93°46'2.01" E	25°56'57.10 "N, 93°44'43.20 "E	26°02'06.00 "N, 93°44'18.00 "E	25°58'55.92 "N, 93°44'17.17 "E	25°52'28.80 "N, 93°48'49.30 "E	25°51'58.20 "N, 93°51'20.10 "E
If Agriculture what crop is sown		**(AGRICULTU RAL LAND)**	**TEA GARDEN**	**(AGRICULT URAL LAND)**	**(AGRICULTU RAL LAND)**	**(FOREST LAND)**	**TEA GARDEN**	**(AGRICULTU RAL LAND)**	**(FOREST LAND)**
Acidity	None	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Alkalinity (as CaCO3)	mg/kg	100	480	120	80	480	120	140	100
Antimony (as Sb)	mg/kg	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25
Arsenic(as As)	mg/kg	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25
Available Nitrogen (as N)	mg/kg	202	179	218	280	106	330	420	314
Available Phosphorus (as P)	mg/kg	3.2	4.2	3.7	4	3.4	4.5	4.9	3
Available Potassium (as K)	mg/kg	76	100	71	62	285	169	267	99
Barium (as Ba)	mg/kg	55	55	24	51	56	71	51	17
Boron (as B)	None	8	15	4	7	15	9	7	3
Bulk Density	g/cc	1.11	1.18	1.14	1.25	1.21	1.05	1.03	1.18
Cadmium (as Cd)	mg/kg	<2	<2	<2	<2	<2	<2	<2	<2
Calcium (as Ca)	mg/kg	600	2050	950	450	2750	1500	950	350
Carbonate	mg/kg	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil

Cation Exchange Capacity	meq/100 gm	10	25	10	8	25	18	12	8
Chloride (as Cl)	mg/kg	40	40	50	70	40	70	30	30
Cobalt (as Co)	mg/kg	<2	<2	<2	3	<2	<2	<2	<2
Copper (as Cu)	mg/kg	11	17	8	17	17	21	17	4
Cyanide (as CN)	mg/kg	<1	<1	<1	<1	<1	<1	<1	<1
Electrical conductivity	us/cm	38.7 (1:2) at 25 deg C	202 (1:2) at 25 deg C	56.8 (1:2) at 25 deg C	118 (1:2) at 25 deg C	219 (1:2) at 25 deg C	135 (1:2) at 25 deg C	173 (1:2) at 25 deg C	33.9 (1:2) at 25 deg C
Hexavalent Chromium (as Cr+6)	mg/kg	<2	<2	<2	<2	<2	<2	<2	<2
Infiltration Capacity	mm/Hr	6.2	7.8	8.9	16	10	3.6	2.2	12
Iron (as Fe)	mg/kg	9	84	37	60	8	98	14	30
Lead (as Pb)	mg/kg	7	12	5	11	12	12	12	4
Magnesium (as Mg)	mg/kg	300	1230	90	150	900	690	360	210
Manganese (as Mn)	mg/kg	240	210	67	230	200	250	242	198
Mercury (as Hg)	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Moisture	%	22	25	20	15	24	27	34	19
Molybdenum (as Mo)	None	<2	<2	<2	<2	<2	<2	<2	<2
Nickel (as Ni)	mg/kg	12	63	17	57	64	26	57	11
Organic Matter	%	0.59	0.36	0.56	1.12	0.51	1.4	1.9	0.97
Particle Size Distribution	mg/kg	Sand:34% Silt:28% Clay:38%	Sand:52% Silt:22% Clay:26%	Sand:47% Silt:21% Clay:32%	Sand:40% Silt:36% Clay:24%	Sand:53% Silt:14% Clay:33%	Sand:32% Silt:27% Clay:41%	Sand:27% Silt:21% Clay:52%	Sand:38% Silt:36% Clay:26%
Permeability	Cm/hr	0.9	1.2	1.5	2.4	1.8	0.11	0.09	2
Total Phosphorus	mg/kg	47	102	74	284	64	56	28	85
Sodium (as Na)	mg/kg	43	60	49	25	31	64	25	19

Sodium Adsorption Ration (as SAR)	None	0.23	0.05	0.18	0.13	0.04	0.21	0.03	0.06
Specific gravity	None	2.26	2.35	2.7	2.45	2.46	2.33	2.49	2.52
Sulphate (as SO4)	mg/kg	<15	<15	<15	<15	<15	<15	<15	<15
Texture	None	Clay Loam	Sandy Clay Loam	Sandy Clay Loam	Loam	Sandy Clay Loam	Clay	Clay	Loam
Thiocyanate	mg/kg	<5	<5	<5	<5	<5	<5	<5	<5
Total Nitrogen (as N)	mg/kg	588	538	655	829	319	991	1613	941
Total Organic Carbon	%	0.34	0.21	0.32	0.65	0.3	0.83	1.1	0.56
Total Porosity	%	50.9	49.7	57.8	49	52	54.9	58.9	53.2
Total Potassium	mg/kg	362	612	334	188	532	324	474	284
Trivalent Chromium as Cr-III (TCLP)	None	<2	<2	<2	<2	<2	<2	<2	<2
Water Holding capacity	%	43	40	37	26	33	48	52	30
Zinc (as Zn)	mg/kg	9	38	9	37	38	41	36	10
pH value	None	6.12 (1:2.5) at 25 deg C	8.13 (1:2.5) at 25 deg C	6.02 (1:2.5) at 25 deg C	4.48 (1:2.5) at 25 deg C	8.32 (1:2.5) at 25 deg C	5.28 (1:2.5) at 25 deg C	5.68 (1:2.5) at 25 deg C	5.19 (1:2.5) at 25 deg C

Appendix 3.7: Traffic Survey Results

Appendix 3.7- Traffic Data

LOCATION : T1 -NH39 AT JABRAJAN IB(UP)
Date of Monitoring :04.06.19

WORKING DAY

S.NO.	TIME	MOTORIZED VEHICLES			NON-MOTORIZED	TOTAL
		Heavy Motor Vehicles	Light Motor Vehicles	Two/Three Wheelers	VEHICLES	
	(Hours)	(Truck,Bus,Dumper,Tanker,Trailer)	(Car,Jeep,Van,Metador, Tractor,Tempo)	(Scooter,M.Cycle,Auto, Moped)	Bicycle, Tricycle	NUMBERS
1	09.00-10.00	6	25	35	8	74
2	10.00-11.00	8	30	40	2	80
3	11.00-12.00	12	28	35	6	81
4	12.00-13.00	10	12	36	2	60
5	13.00-14.00	3	15	32	0	50
6	14.00-15.00	6	16	20	0	42
7	15.00-16.00	10	11	22	0	43
8	16.00-17.00	12	15	18	0	45
9	17.00-18.00	10	10	18	0	38
10	18.00-19.00	11	8	20	0	39
11	19.00-20.00	3	5	10	0	18
12	20.00-21.00	4	4	10	0	18
13	21.00-22.00	3	3	8	0	14
14	22.00-23.00	0	2	15	0	17
15	23.00-00.00	0	0	0	0	0
16	00.00-1.00	0	0	0	0	0
17	1.00-2.00	1	0	0	0	1
18	2.00-3.00	0	0	1	0	1
19	3.00-4.00	2	2	5	0	9
20	4.00-5.00	5	3	4	0	12
21	5.00-6.00	3	6	3	0	12
22	6.00-7.00	1	10	10	0	21
23	7.00-8.00	5	12	15	12	44
24	8.00-9.00	6	18	18	3	45
Total Numbers		**121**	**235**	**375**	**33**	**764**

LOCATION :T1 -NH39 AT JABRAJAN IB(DN)

Date of Monitoring : 04.06.19

WORKING DAY

S.NO.	TIME	MOTORIZED VEHICLES			NON-MOTORIZED	TOTAL
	(Hours)	Heavy Motor Vehicles	Light Motor Vehicles	Two/Three Wheelers	VEHICLES	NUMBERS
		(Truck,Bus,Dumper,Tanker,Trailer)	(Car,Jeep,Van,Metador, Tractor,Tempo)	(Scooter,M.Cycle,Auto, Moped)	Bicycle, Tricycle	
1	09.00-10.00	12	30	45	3	90
2	10.00-11.00	15	25	38	8	86
3	11.00-12.00	5	20	42	1	68
4	12.00-13.00	8	10	41	3	62
5	13.00-14.00	6	10	44	0	60
6	14.00-15.00	20	20	42	2	84
7	15.00-16.00	10	10	25	0	45
8	16.00-17.00	11	12	20	0	43
9	17.00-18.00	12	14	18	0	44
10	18.00-19.00	13	10	10	0	33
11	19.00-20.00	5	5	20	0	30
12	20.00-21.00	5	3	5	0	13
13	21.00-22.00	2	4	8	0	14
14	22.00-23.00	0	0	4	0	4
15	23.00-00.00	0	0	0	0	0
16	00.00-1.00	0	0	0	0	0
17	1.00-2.00	0	0	0	0	0
18	2.00-3.00	0	0	0	0	0
19	3.00-4.00	0	0	4	0	4
20	4.00-5.00	2	5	3	0	10
21	5.00-6.00	3	8	10	0	21
22	6.00-7.00	1	2	8	0	11

23	7.00-8.00	5	10	25	10	50
24	8.00-9.00	8	25	30	6	69
Total Numbers		**143**	**223**	**442**	**33**	**841**

LOCATION : T1 -NH39 AT JABRAJAN IB(UP)

Date of Monitoring : 26.05.19

HOLIDAY

S.NO.	TIME	MOTORIZED VEHICLES			NON-MOTORIZED	TOTAL
		Heavy Motor Vehicles	Light Motor Vehicles	Two/Three Wheelers	VEHICLES	
	(Hours)	(Truck,Bus,Dumper,Tanker,Trailer)	(Car,Jeep,Van,Metador, Tractor,Tempo)	(Scooter,M.Cycle,Auto, Moped)	Bicycle, Tricycle	NUMBERS
1	09.00-10.00	3	18	20	3	44
2	10.00-11.00	4	12	18	0	34
3	11.00-12.00	2	15	15	2	34
4	12.00-13.00	0	8	18	0	26
5	13.00-14.00	0	6	10	0	16
6	14.00-15.00	2	4	12	0	18
7	15.00-16.00	3	5	8	0	16
8	16.00-17.00	4	11	10	0	25
9	17.00-18.00	0	9	12	0	21
10	18.00-19.00	0	10	16	6	32
11	19.00-20.00	3	8	20	0	31
12	20.00-21.00	4	5	10	0	19
13	21.00-22.00	0	3	8	0	11
14	22.00-23.00	3	2	7	0	12
15	23.00-00.00	0	0	0	0	0
16	00.00-1.00	0	0	0	0	0
17	1.00-2.00	0	0	0	0	0
18	2.00-3.00	0	0	2	0	2
19	3.00-4.00	0	3	4	0	7
20	4.00-5.00	2	5	8	0	15
21	5.00-6.00	4	6	10	0	20
22	6.00-7.00	3	8	18	0	29
23	7.00-8.00	6	10	10	0	26
24	8.00-9.00	7	12	12	2	33
Total Numbers		**50**	**160**	**248**	**13**	**471**

LOCATION :T1 -NH39 AT JABRAJAN IB(DN)

Date of Monitoring : 26.05.19

HOLIDAY

S.NO.	TIME	MOTORIZED VEHICLES			NON-MOTORIZED	TOTAL
	(Hours)	Heavy Motor Vehicles	Light Motor Vehicles	Two/Three Wheelers	VEHICLES	NUMBERS
		(Truck,Bus,Dumper,Tanker,Trailer)	(Car,Jeep,Van,Metador, Tractor,Tempo)	(Scooter,M.Cycle,Auto, Moped)	Bicycle, Tricycle	
1	09.00-10.00	2	10	12	5	29
2	10.00-11.00	2	12	10	7	31
3	11.00-12.00	1	18	12	4	35
4	12.00-13.00	2	12	10	4	28
5	13.00-14.00	1	10	20	3	34
6	14.00-15.00	0	6	10	4	20
7	15.00-16.00	0	10	11	3	24
8	16.00-17.00	2	3	15	2	22
9	17.00-18.00	1	6	10	1	18
10	18.00-19.00	2	12	12	3	29
11	19.00-20.00	0	5	20	2	27
12	20.00-21.00	3	4	2	0	9
13	21.00-22.00	0	3	8	0	11
14	22.00-23.00	0	0	10	0	10
15	23.00-00.00	0	0	2	0	2
16	00.00-1.00	0	2	0	0	2
17	1.00-2.00	0	0	0	0	0
18	2.00-3.00	0	0	0	0	0

19	3.00-4.00	0	4	5	0	9
20	4.00-5.00	3	0	6	0	9
21	5.00-6.00	2	6	7	0	15
22	6.00-7.00	0	11	8	2	21
23	7.00-8.00	2	14	12	4	32
24	8.00-9.00	0	18	10	6	34
Total Numbers		**23**	**166**	**212**	**50**	**451**

LOCATION :T2 -NH39 AT SARAIJAN (DN)

Date of Monitoring : 05.06.19

WORKING DAY

S.NO.	**TIME**	**MOTORIZED VEHICLES**			**NON-MOTORIZED**	**TOTAL**
	(Hours)	**Heavy Motor Vehicles**	**Light Motor Vehicles**	**Two/Three Wheelers**	**VEHICLES**	**NUMBERS**
		(Truck,Bus,Dumper,Tanker,Trailer)	(Car,Jeep,Van,Metador, Tractor,Tempo)	(Scooter,M.Cycle,Auto, Moped)	Bicycle, Tricycle	
1	09.00-10.00	6	32	42	8	88
2	10.00-11.00	3	33	32	4	72
3	11.00-12.00	7	25	34	6	72
4	12.00-13.00	4	18	20	12	54
5	13.00-14.00	2	22	30	0	54
6	14.00-15.00	10	25	31	3	69
7	15.00-16.00	6	18	40	2	66
8	16.00-17.00	2	12	42	0	56
9	17.00-18.00	1	15	18	0	34
10	18.00-19.00	3	20	16	6	45
11	19.00-20.00	4	10	10	0	24
12	20.00-21.00	3	15	5	0	23
13	21.00-22.00	1	4	3	0	8
14	22.00-23.00	0	4	2	0	6
15	23.00-00.00	0	0	0	0	0
16	00.00-1.00	0	0	0	0	0
17	1.00-2.00	0	0	0	0	0
18	2.00-3.00	0	0	0	0	0
19	3.00-4.00	0	3	4	0	7
20	4.00-5.00	0	2	5	0	7
21	5.00-6.00	3	1	3	0	7
22	6.00-7.00	8	0	10	0	18
23	7.00-8.00	3	8	15	10	36
24	8.00-9.00	2	20	32	8	62
Total Numbers		**68**	**287**	**394**	**59**	**808**

LOCATION : T2 -NH39 AT SARAIJAN (UP & DOWN COMBINED)

Date of Monitoring : 05.06.19

WORKING DAY

S.NO.	**TIME**	**MOTORIZED VEHICLES**			**NON-MOTORIZED**	**TOTAL**
		Heavy Motor Vehicles	**Light Motor Vehicles**	**Two/Three Wheelers**	**VEHICLES**	
	(Hours)	(Truck,Bus,Dumper,Tanker,Trailer)	(Car,Jeep,Van,Metador, Tractor,Tempo)	(Scooter,M.Cycle,Auto, Moped)	Bicycle, Tricycle	**NUMBERS**
1	09.00-10.00	9	52	72	10	143
2	10.00-11.00	7	51	42	7	107
3	11.00-12.00	9	55	54	10	128
4	12.00-13.00	5	33	38	12	88
5	13.00-14.00	4	42	40	0	86
6	14.00-15.00	14	35	52	3	104
7	15.00-16.00	7	38	55	7	107
8	16.00-17.00	4	30	60	10	104
9	17.00-18.00	4	30	40	0	74
10	18.00-19.00	4	30	34	6	74
11	19.00-20.00	6	22	20	0	48
12	20.00-21.00	4	23	13	0	40
13	21.00-22.00	2	8	12	0	22

14	22.00-23.00	0	6	4	0	10
15	23.00-00.00	0	0	4	0	4
16	00.00-1.00	0	0	1	0	1
17	1.00-2.00	0	0	0	0	0
18	2.00-3.00	0	1	0	0	1
19	3.00-4.00	2	5	4	0	11
20	4.00-5.00	3	5	8	0	16
21	5.00-6.00	6	3	5	0	14
22	6.00-7.00	10	8	18	7	43
23	7.00-8.00	5	20	21	12	58
24	8.00-9.00	6	35	48	10	99
Total Numbers		**111**	**532**	**645**	**94**	**1382**

LOCATION :T2 -NH39 AT SARAIJAN (DN)

Date of Monitoring : 26.05.19

HOLIDAY

	(Hours)	**Heavy Motor Vehicles**	**Light Motor Vehicles**	**Two/Three Wheelers**	**VEHICLES**	**NUMBERS**	
		(Truck,Bus,Dumper,Tanker,Trailer)	(Car,Jeep,Van,Metador, Tractor,Tempo)	(Scooter,M.Cycle,Auto, Moped)	Bicycle, Tricycle		
1	09.00-10.00	3	15	10	3	31	58
2	10.00-11.00	2	12	18	2	34	53
3	11.00-12.00	0	18	12	5	35	59
4	12.00-13.00	2	10	6	0	18	30
5	13.00-14.00	4	12	0	0	16	36
6	14.00-15.00	0	10	8	0	18	23
7	15.00-16.00	2	10	10	0	22	34
8	16.00-17.00	0	10	15	0	25	30
9	17.00-18.00	0	12	16	0	28	34
10	18.00-19.00	0	8	5	3	16	29
11	19.00-20.00	3	12	15	0	30	46.5
12	20.00-21.00	2	10	5	0	17	29
13	21.00-22.00	1	3	2	0	6	11
14	22.00-23.00	0	2	0	0	2	3
15	23.00-00.00	0	0	3	0	3	3
16	00.00-1.00	0	0	0	0	0	0
17	1.00-2.00	0	0	0	0	0	0
18	2.00-3.00	0	0	0	0	0	0
19	3.00-4.00	0	3	0	0	3	4.5
20	4.00-5.00	0	2	3	0	5	6
21	5.00-6.00	2	4	7	0	13	22
22	6.00-7.00	0	5	8	0	13	15.5
23	7.00-8.00	3	13	10	3	29	55
24	8.00-9.00	2	15	15	2	34	54.5
Total Numbers		**26**	**186**	**168**	**18**	**398**	**636**

LOCATION : T2 -NH39 AT SARAIJAN (UP & DOWN COMBINED)

Date of Monitoring : 26.05.19

HOLIDAY

S.NO.	**TIME**	**MOTORIZED VEHICLES**			**NON-MOTORIZED**	**TOTAL**
		Heavy Motor Vehicles	**Light Motor Vehicles**	**Two/Three Wheelers**	**VEHICLES**	
	(Hours)	(Truck,Bus,Dumper,Tanker,Trailer)	(Car,Jeep,Van,Metador, Tractor,Tempo)	(Scooter,M.Cycle,Auto, Moped)	Bicycle, Tricycle	**NUMBERS**
1	09.00-10.00	4	20	20	5	49
2	10.00-11.00	6	22	30	2	60
3	11.00-12.00	0	26	22	5	53
4	12.00-13.00	2	25	24	0	51
5	13.00-14.00	8	22	6	0	36
6	14.00-15.00	0	22	20	0	42
7	15.00-16.00	2	21	22	0	45
8	16.00-17.00	3	15	25	0	43
9	17.00-18.00	0	20	23	0	43
10	18.00-19.00	2	11	15	3	31

11	19.00-20.00	3	26	25	3	57
12	20.00-21.00	2	20	8	0	30
13	21.00-22.00	3	5	4	0	12
14	22.00-23.00	0	5	1	0	6
15	23.00-00.00	0	0	3	0	3
16	00.00-1.00	0	0	0	0	0
17	1.00-2.00	0	0	0	0	0
18	2.00-3.00	0	0	0	0	0
19	3.00-4.00	0	3	0	0	3
20	4.00-5.00	0	2	3	0	5
21	5.00-6.00	5	6	7	0	18
22	6.00-7.00	2	9	11	3	25
23	7.00-8.00	4	23	14	5	46
24	8.00-9.00	3	27	27	3	60
Total Numbers		**49**	**330**	**310**	**29**	**718**

LOCATION :T2 -SARAIJAN TO DILLAI TINALI ROAD AT SARAIJAN(DN)

Date of Monitoring : 05.06.19

WORKING DAY

S.NO.	TIME	MOTORIZED VEHICLES			NON-MOTORIZED	TOTAL
	(Hours)	Heavy Motor Vehicles	Light Motor Vehicles	Two/Three Wheelers	VEHICLES	NUMBERS
		(Truck,Bus,Dumper,Tanker,Trailer)	(Car,Jeep,Van,Metador, Tractor,Tempo)	(Scooter,M.Cycle,Auto, Moped)	Bicycle, Tricycle	
1	09.00-10.00	1	9	12	2	24
2	10.00-11.00	0	6	15	3	24
3	11.00-12.00	4	2	10	0	16
4	12.00-13.00	3	6	8	0	17
5	13.00-14.00	2	7	8	0	17
6	14.00-15.00	3	4	7	2	16
7	15.00-16.00	0	3	9	0	12
8	16.00-17.00	2	4	10	0	16
9	17.00-18.00	1	3	12	0	16
10	18.00-19.00	3	4	6	0	13
11	19.00-20.00	1	3	4	0	8
12	20.00-21.00	1	4	3	2	10
13	21.00-22.00	0	3	2	0	5
14	22.00-23.00	0	1	4	0	5
15	23.00-00.00	0	0	0	0	0
16	00.00-1.00	0	0	0	0	0
17	1.00-2.00	0	0	0	0	0
18	2.00-3.00	0	0	0	0	0
19	3.00-4.00	0	0	2	0	2
20	4.00-5.00	0	0	4	0	4
21	5.00-6.00	2	3	3	0	8
22	6.00-7.00	3	2	6	0	11
23	7.00-8.00	4	6	10	2	22
24	8.00-9.00	6	4	12	0	22
Total Numbers		**36**	**74**	**147**	**11**	**268**

LOCATION : T2 -SARAIJAN TO DILLAI TINALI ROAD AT SARAIJAN(UP & DOWN COMBINED)
Date of Monitoring : 05.06.19

WORKING DAY

S.NO.	TIME	MOTORIZED VEHICLES			NON-MOTORIZED	TOTAL
		Heavy Motor Vehicles	Light Motor Vehicles	Two/Three Wheelers	VEHICLES	
	(Hours)	(Truck,Bus,Dumper,Tanker,Trailer)	(Car,Jeep,Van,Metador, Tractor,Tempo)	(Scooter,M.Cycle,Auto, Moped)	Bicycle, Tricycle	NUMBERS
1	09.00-10.00	3	15	27	4	49
2	10.00-11.00	2	8	23	3	36
3	11.00-12.00	5	5	15	0	25
4	12.00-13.00	7	10	16	3	36
5	13.00-14.00	2	9	15	0	26

6	14.00-15.00	3	8	9	8	28
7	15.00-16.00	0	5	11	0	16
8	16.00-17.00	4	10	14	0	28
9	17.00-18.00	2	7	15	0	24
10	18.00-19.00	6	7	8	0	21
11	19.00-20.00	2	9	6	0	17
12	20.00-21.00	1	6	4	2	13
13	21.00-22.00	0	5	5	0	10
14	22.00-23.00	2	1	6	0	9
15	23.00-00.00	0	0	0	0	0
16	00.00-1.00	0	0	0	0	0
17	1.00-2.00	0	0	0	0	0
18	2.00-3.00	0	0	0	0	0
19	3.00-4.00	0	0	4	0	4
20	4.00-5.00	0	0	6	0	6
21	5.00-6.00	2	3	3	0	8
22	6.00-7.00	5	5	6	0	16
23	7.00-8.00	5	8	12	2	27
24	8.00-9.00	8	10	15	2	35
Total Numbers		**59**	**131**	**220**	**24**	**434**

LOCATION :T1 -SARAIJAN TO DILLAI TINALI ROAD AT SARAIJAN(DN)

Date of Monitoring : 26.05.19

HOLIDAY

	(Hours)	**Heavy Motor Vehicles**	**Light Motor Vehicles**	**Two/Three Wheelers**	**VEHICLES**	**NUMBERS**
		(Truck,Bus,Dumper,Tanker,Trailer)	(Car,Jeep,Van,Metador, Tractor,Tempo)	(Scooter,M.Cycle,Auto, Moped)	Bicycle, Tricycle	
1	09.00-10.00	2	4	5	0	11
2	10.00-11.00	0	3	2	0	5
3	11.00-12.00	0	0	8	3	11
4	12.00-13.00	3	2	7	0	12
5	13.00-14.00	0	1	0	0	1
6	14.00-15.00	0	0	0	0	0
7	15.00-16.00	2	0	5	2	9
8	16.00-17.00	0	0	3	0	3
9	17.00-18.00	0	3	8	0	11
10	18.00-19.00	2	6	10	2	20
11	19.00-20.00	0	2	3	0	5
12	20.00-21.00	0	1	2	0	3
13	21.00-22.00	0	0	4	0	4
14	22.00-23.00	0	0	0	0	0
15	23.00-00.00	0	0	0	0	0
16	00.00-1.00	0	0	0	0	0
17	1.00-2.00	0	0	0	0	0
18	2.00-3.00	0	0	0	0	0
19	3.00-4.00	0	2	0	0	2
20	4.00-5.00	3	3	3	0	9
21	5.00-6.00	2	2	4	0	8
22	6.00-7.00	1	4	3	2	10
23	7.00-8.00	4	7	6	2	19
24	8.00-9.00	2	6	8	1	17
Total Numbers		**21**	**46**	**81**	**12**	**160**

LOCATION : T2 -SARAIJAN TO DILLAI TINALI ROAD AT SARAIJAN(UP & DOWN COMBINED)

Date of Monitoring : 26.05.19

HOLIDAY

S.NO.	**TIME**	**MOTORIZED VEHICLES**			**NON-MOTORIZED**	**TOTAL**
		Heavy Motor Vehicles	**Light Motor Vehicles**	**Two/Three Wheelers**	**VEHICLES**	
	(Hours)	(Truck,Bus,Dumper,Tanker,Trailer)	(Car,Jeep,Van,Metador, Tractor,Tempo)	(Scooter,M.Cycle,Auto, Moped)	Bicycle, Tricycle	**NUMBERS**
1	09.00-10.00	2	4	15	0	21
2	10.00-11.00	0	6	10	0	16

3	11.00-12.00	2	0	15	3	20
4	12.00-13.00	3	8	11	0	22
5	13.00-14.00	0	4	0	3	7
6	14.00-15.00	2	0	6	0	8
7	15.00-16.00	5	3	13	4	25
8	16.00-17.00	0	2	3	0	5
9	17.00-18.00	0	3	14	0	17
10	18.00-19.00	2	10	15	2	29
11	19.00-20.00	0	2	9	0	11
12	20.00-21.00	0	5	5	0	10
13	21.00-22.00	0	0	4	0	4
14	22.00-23.00	0	0	0	0	0
15	23.00-00.00	0	0	0	0	0
16	00.00-1.00	0	0	0	0	0
17	1.00-2.00	0	0	0	0	0
18	2.00-3.00	0	0	0	0	0
19	3.00-4.00	0	2	0	0	2
20	4.00-5.00	5	6	5	0	16
21	5.00-6.00	2	4	8	0	14
22	6.00-7.00	5	11	7	2	25
23	7.00-8.00	7	11	11	4	33
24	8.00-9.00	6	14	18	5	43
Total Numbers		**41**	**95**	**169**	**23**	**328**

Appendix 3.8: The List of Mammals

Appendix 3.8-List of Mammals

Table 1: Mammals observed in Study Area

Sr. No.	Common Name	Scientific Name	Family	IUCN, 3.1 Status	WPA 1972 Schedule
1	Hoary - bellied Squirrel	*Callosciurus pygerythrus*	Sciuridae	LC	-

Table 2: List of Mammal Species in the Study Area

Sr. No.	Common Name	Scientific Name	IUCN Status	WPA 1972 Schedule
1	Western Hoolock Gibbon	*Hoolock hoolock*	EN	I
2	Bengal Slow Loris	*Nycticebus bengalensis*	VU	I
3	Rhesus Macaque	*Macaca mulatta*	LC	II
4	Assamese Macaque	*Macaca assamensis*	NT	II
5	Northern Pig-tailed Macaque	*Macaca leonina*	VU	II
6	Stump-tailed Macaque	*Macaca arctoides*	VU	II
7	Capped Langur	*Trachypithecus pileatus*	VU	I
8	Asian Elephant	*Elephas maximus*	EN	I
9	Red Muntjac	*Muntiacus muntjak*	LC	III
10	Sambar	*Rusa unicolor*	VU	III
11	Indian Hog Deer	*Axis porcinus*	EN	I
12	Gaur	*Bos gaurus*	VU	I
13	Wild Water Buffalo	*Bubalus arnee*	EN	I
14	Indian Wild Pig	*Sus scrofa*	LC	III
15	Tiger	*Panthera tigris*	EN	I
16	Common Leopard	*Panthera pardus*	NT	I
17	Clouded Leopard	*Neofelis nebulosa*	VU	I
18	Jungle Cat	*Felis chaus*	LC	II
19	Leopard Cat	*Prionailurus bengalensis*	LC	I
20	Spotted Linsang	*Prionodon pardicolor*	LC	I
21	Common Palm Civet	*Paradoxurus hermaphroditus*	LC	II
22	Binturong	*Arctictis binturong*	VU	I
23	Small Indian Civet	*Viverricula indica*	LC	II
24	Large Indian Civet	*Viverra zibetha*	LC	II
25	Indian Grey Mongoose	*Herpestes edwardsi*	LC	II
26	Small Indian Mongoose	*Herpestes auropunctatus*	LC	II
27	Crab - eating Mongoose	*Herpestes urva*	LC	II
28	Golden Jackal	*Canis aureus*	LC	II
29	Wild Dog/Dhole	*Cuon alpinus*	EN	II
30	Asiatic Black Bear	*Ursus thibetanus*	VU	II
31	Sloth Bear	*Melursus ursinus*	VU	I
32	Sun Bear	*Helarctos malayanus*	VU	I
33	Small-toothed Ferret Badger	*Melogale moschata*	LC	II
34	Large-toothed Ferret Badger	*Melogale personata*	LC	II
35	Hog Badger	*Arctonyx collaris*	VU	Not Evaluated
36	Yellow-throated Marten	*Martes flavigula*	LC	II
37	Eurasian Otter	*Lutra lutra*	NT	II
38	Oriental Small clawed Otter	*Aonyx cinereus*	VU	I
39	Yellow - bellied Weasel	*Mustela kathiah*	LC	II

40	Back - striped Weasel	*Mustela strigidorsa*	LC	II
41	Indian Hare	*Lepus nigricollis*	LC	IV
42	Forrest's Pika	*Ochotona forresti*	LC	Not Evaluated
43	Chinese Pangolin	*Manis pentadactyla*	CR	I
44	Malay Tree Shrew	*Tupaia belangeri*	LC	II
4	Asian Grey Shrew	*Crocidura attenuata*	LC	Not Evaluated
46	House Shrew	*Suncus murinus*	LC	Not Evaluated
47	Pygmy white - toothed Shrew	*Suncus etruscus*	LC	Not Evaluated
48	Short - tailed Mole	*Euroscaptor micrura*	LC	Not Evaluated
49	White - tailed Mole	*Parascaptor leucura*	LC	Not Evaluated
50	Hodgson's Porcupine	*Hystrix brachyura*	LC	II
51	Black Giant Squirrel	*Ratufa bicolor*	NT	II
52	Red Giant Flying Squirrel	*Petaurista petaurista*	LC	II
53	Hoary - bellied Squirrel	*Callosciurus pygerythrus*	LC	II
54	Himalayan Striped Squirrel	*Tamiops mcclellandii*	LC	II
55	Long - tailed Field Mouse	*Apodemus sylvaticus*	LC	V
56	House Mouse	*Mus musculus*	LC	V
57	Bay Bamboo Rat	*Cannomys badius*	LC	V
58	Hoary Bamboo Rat	*Rhizomys pruinosus*	LC	V
59	Indian Mole Rat	*Bandicota bengalensis*	LC	V
60	Black Rat	*Rattus rattus*	LC	V
61	White - footed Himalayan Rat	*Rattus nitidus*	LC	V
62	Indian Flying Fox	*Pteropus giganteus*	LC	V

Appendix 3.9:
The list of Avifauna

Appendix 3.9-List of Avifauna

Sr. no.	Common name	Scientific name	Order	Family	IUCN Status	Schedule as per WPA, 1972
1	Oriental Honey buzzard	*Pernis ptilorhynchus*	Accipitriformes	Accipitridae	LC	Not Assessed
2	Crested Serpent Eagle	*Spilornis cheela*	Accipitriformes	Accipitridae	LC	Not Assessed
3	Red-wattled lapwing	*Vanellus indicus*	Charadriiformes	Charadriidae	LC	Not Assessed
4	Common Pigeon	*Columba livia*	Columbiformes	Columbidae	LC	Not Assessed
5	Spotted Dove	*Stigmatopelia Chinensis*	Columbiformes	Columbidae	LC	IV
6	Thick billed Green Pigeon	*Treron curvirostra*	Columbiformes	Columbidae	LC	IV
7	Emerald Dove	*Chalcophaps indica*	Columbiformes	Columbidae	LC	IV
8	Indian Roller	*Coracias benghalensis*	Coraciiformes	Coraciidae	LC	IV
9	White throated Kingfisher	*Halcyon smyrnensis*	Coraciiformes	Alcedinidae	LC	IV
10	Common Hawk Cuckoo	*Hierococcyx varius*	Cuculiformes	Cuculidae	LC	IV
11	White-breasted waterhen	*Amaurornis phoenicurus*	Gruiformes	Rallidae	LC	Not Assessed
12	Scarlet Minivet	*Pericrocotus speciosus*	Passeriformes	Campephagidae	LC	IV
13	Long tailed Shrike	*lanius schach*	Passeriformes	Laniidae	LC	Not Assessed
14	Spangled Drongo	*Dicrurus hottetottus*	Passeriformes	Dicruridae	LC	IV
15	Black Drongo	*Dicrurus macrocercus*	Passeriformes	Dicruridae	LC	IV
16	Black Hooded oriole	*Oriolus xanthornus*	Passeriformes	Oriolidae	LC	IV
17	Rufous Treepie	*Dendrocitta vagabunda*	Passeriformes	Corvidae	LC	IV
18	Eastern Jungle Crow	*Corvus levillantii*	Passeriformes	Corvidae	LC	IV
19	House Crow	*Corvus splendens*	Passeriformes	Corvidae	LC	IV
20	Great Tit	*Parus major*	Passeriformes	Paridae	LC	IV
21	Black Creasted Bulbul	*Pycnonotus flaviventris*	Passeriformes	Pycnonotidae	LC	IV
22	Red-whiskered Bulbul	*Pycnonotus jocosus*	Passeriformes	Pycnonotidae	LC	IV
23	Red Vented Bulbul	*Pycnonotus cafer*	Passeriformes	Pycnonotidae	LC	IV

24	Plain Prinia	*Prinia inornata*	Passeriformes	Cisticolidae	LC	Not Assessed
25	Great Myna	*Acridotheres grandis*	Passeriformes	Sturnidae	LC	IV
26	Jungle Myna	*Acridotheres fuscus*	Passeriformes	Sturnidae	LC	IV
27	Common Myna	*Acridotheres tristis*	Passeriformes	Sturnidae	LC	IV
28	Asian Pied Starling	*Gracupica contra*	Passeriformes	Sturnidae	LC	IV
29	Oriental Magpie Robin	*Copsychus saularis*	Passeriformes	Muscicapidae	LC	Not Assessed
30	Black backed Forktail	*Enicurus immaculatus*	Passeriformes	Muscicapidae	LC	Not Assessed
31	Golden fronted Leafbird	*Chloropsis aurifrons*	Passeriformes	Chloropseidae	LC	Not Assessed
32	Purple Sunbird	*Cinnyris asiaticus*	Passeriformes	Nectariniidae	LC	IV
33	Crimson Sunbird	*Aethopyga siparaja*	Passeriformes	Nectariniidae	LC	IV
34	House sparrow	*Passer domesticus*	Passeriformes	Passeridae	LC	Not Assessed
35	Eurasian Tree Sparrow	*Passer montanus*	Passeriformes	Passeridae	LC	Not Assessed
36	Baya Weaver	*Ploceus philippinus*	Passeriformes	Ploceidae	LC	IV
37	Chestnut Munia	*Lonchura malacca*	Passeriformes	Estrildidae	LC	IV
38	Indian Pond heron	*Ardeola grayii*	Pelecaniformes	Ardeidae	LC	IV
39	Cattle Egret	*Bubulcus ibis*	Pelecaniformes	Ardeidae	LC	IV
40	Little Egret	*Egretta garzetta*	Pelecaniformes	Ardeidae	LC	IV
41	Lineated Barbet	*Megalaima lineata*	Piciformes	Megalaimidae	LC	IV
42	Blue throated Barbet	*Megalaima asiatica*	Piciformes	Megalaimidae	LC	IV
43	Alexandrian parakeet	*Psittacula eupatria*	Psittaciformes	Psittacidae	NT	IV
44	Rose ringed parakeet	*Psittacula krameri*	Psittaciformes	Psittacidae	LC	IV
45	Blossom Headed parakeet	*Psittacula roseata*	Psittaciformes	Psittacidae	NT	IV
46	Red Breasted parakeet	*Psittacula alexandri*	Psittaciformes	Psittacidae	NT	IV
47	Asian Barred owlet	*Glaucidium cuculoides*	Strigiformes	Strigidae	LC	IV
48	Spotted owlet	*Athene brama*	Strigiformes	Strigidae	LC	IV
49	Asian Palm Swift	*Cypsiurus balasiensis*	Strigiformes	Apodidae	LC	IV
50	Little Cormorant	*Phalacrocorax niger*	Suliformes	Phalacrocoracidae	LC	IV

Appendix 3.10: The list of Reptiles

Appendix 3.10-List of Reptiles

Sr. No.	Common Name	Scientific Name	IUCN Status	Schedule (as per WPA, 1972)
1	Brahminy Worm Snake	*Indotyphlops braminus*	Not Evaluated	IV
2	Common Indian Trinket Snake	*Coelognathus helena*	Not Evaluated	IV
3	Banded Trinket Snake	*Oreocryptophis porphyraceus*	Not Evaluated	IV
4	Green Rat Snake	*Ptyas nigromarginata*	Not Evaluated	IV
5	Indian Rat Snake	*Ptyas mucosa*	Not Evaluated	II
6	Common Wolf Snake	*Lycodon capucinus*	LC	IV
7	Checkered Keelback Water Snake	*Xenochrophis piscator*	Not Evaluated	II
8	Buff-striped Keelback	*Amphiesma stolatum*	Not Evaluated	IV
9	Ornamental Flying Snake	*Chrysopelea ornata*	Not Evaluated	IV
10	Common Indian Cat Snake	*Boiga trigonata*	LC	IV
11	Common Indian Krait	*Bungarus caeruleus*	Not Evaluated	IV
12	King Cobra	*Ophiophagus hannah*	VU	II
13	Monocellate Cobra	*Naja kaouthia*	LC	II
14	Russell's Viper	*Daboia russelii*	Not Evaluated	II
15	Flat-tailed House Gecko	*Hemidactylus platyurus*	Not Evaluated	Not Evaluated
16	Common House Gecko	*Hemidactylus frenatus*	LC	Not Evaluated
17	Brooke's House Gecko/Spotted House Gecko	*Hemidactylus brookii*	Not Evaluated	Not Evaluated
18	Indo –Pacific Gecko	*Hemidactylus garnotii*	Not Evaluated	Not Evaluated
19	Khasi Hills Bent-toed Gecko	*Cyrtodactylus khasiensis*	Not Evaluated	Not Evaluated
20	Tokay Gecko	*Gekko gecko*	LC	Not Evaluated
21	Oriental Garden Lizard	*Calotes versicolor*	Not Evaluated	Not Evaluated
22	Green Fan- throated Lizard	*Ptyctolaemus gularis*	Not Evaluated	Not Evaluated
23	Norvill's Flying Lizard	*Draco norvillii*	Not Evaluated	Not Evaluated

24	White - spotted Supple Skink	*Lygosoma albopunctata*	Not Evaluated	Not Evaluated
25	East Indian Brown Mabuya/Sun Skink	*Eutropis multifasciata*	LC	Not Evaluated
26	Spotted Forest Skink	*Sphenomorphus maculatus*	Not Evaluated	Not Evaluated
27	Indian Forest Skink	*Sphenomorphus indicus*	Not Evaluated	Not Evaluated
28	Khasi Hills Long -tailed Lizard	*Takydromus khasiensis*	Not Evaluated	Not Evaluated
29	Bengal Monitor	*Varanus bengalensis*	LC	I
30	Asian Water Monitor	*Varanus salvator*	LC	I
31	Yellow Monitor	*Varanus flavescens*	LC	I
32	Brahminy terrapin	*Hardella thurjii*	VU	Not Evaluated
33	Eastern hill terrapin	*Melanochelys tricarinata*	VU	Not Evaluated
34	Malayan box turtle	*Cuora amboinensis*	VU	Not Evaluated
35	Asian leaf turtle	*Cyclemys dentata*	NT	Not Evaluated
36	Keeled box turtle	*Cuora mouhotii*	EN	Not Evaluated
37	Elongated Tortoise	*Indotestudo elongata*	CR	Not Evaluated
38	Asian Brown tortoise	*Manouria emys*	CR	Not Evaluated
39	Roofed terrapin	*Pangshura tecta*	LC	Not Evaluated

Appendix 3.11: The list of Amphibians

Appendix 3.11-List of Amphibians

Sr No	Common Name	Scientific Name	IUCN Status	WPA Schedule
1	Little spadefoot toad	*Megophrys parva*	LC	Not Evaluated
2	Common Indian Toad	*Duttaphrynus melanostictus*	LC	Not Evaluated
3	Painted kaloula	*Kaloula taprobanica*	LC	Not Evaluated
4	Ornate microhylid	*Microhyla ornata*	LC	Not Evaluated
5	Red microhylid	*Microhyla rubra*	LC	Not Evaluated
6	East Himalqyan Bush Frog	*Raorchestes annandalii*	LC	Not Evaluated
7	East Asian Tree Frog	*Polypedates leucomystax*	LC	Not Evaluated
8	Giant Tree Frog	*Rhacophorus maximus*	LC	Not Evaluated
9	Himalayan torrent Frog	*Amolops marmoratus*	LC	Not Evaluated
10	No popular common name	*Amolops assamensis*	DD	Not Evaluated
11	Indian bullfrog	*Hoplobatrachus tigerinus*	LC	Not Evaluated
12	Jerdon's bullfrog	*Hoplobatrachus crassus*	LC	Not Evaluated
13	Indian cricket frog	*Fejervarya limnocharis*	LC	Not Evaluated
14	Terai Cricket Frog	*Fejervarya teraiensis*	LC	Not Evaluated
15	Nepal Cricket Frog	*Fejervarya nepalensis*	LC	Not Evaluated
16	Pierre's wart frog	*Fejervarya pierrei*	LC	Not Evaluated
17	Indian burrowing Frog	*Sphaerotheca breviceps*	LC	Not Evaluated
18	Long –tounged Frog	*Hylarana leptoglossa*	LC	Not Evaluated
19	Bhamo Frog	*Humerana humeralis*	LC	Not Evaluated
20	Green Mountain Frog	*Odorrana livida*	DD	Not Evaluated
21	Indian Flying Frog	*Pterorana khare*	VU	Not Evaluated
22	Rivulet Frog	*Limnonectes laticeps*	LC	Not Evaluated
23	Skittering Frog	*Euphlyctis cyanophlyctis*	LC	Not Evaluated

24	No local name reported	*Philautus namdaphaensis*	DD	Not Evaluated
25	Terai Tree Frog	*Polypedates teraiensis*	DD	Not Evaluated
26	Hongkong Whipping Frog	*Polypedates megacephalus*	LC	Not Evaluated
27	Nepal Flying Frog	*Rhacophorus maximus*	LC	Not Evaluated
28	Suffry Red webbed Tree Frog	*Rhacophorus suffry*	LC	Not Evaluated
29	Pied Warty Frog	*Theloderma asperum*	LC	Not Evaluated
30	Wuliangshan horned toad	*Xenophrys wuliangshanensis*	DD	Not Evaluated
31	No popular common name	*Xenophrys major*	LC	Not Evaluated

Appendix 3.12: The list of Butterflies

Appendix 3.12-List of Butterflies

Table 1: List of butterflies observed in the study area

Sr.no	Scientific name	Common name	Family	IUCN,3.1 status	WPA, 1972 (Schedule)
1	*Euploea core*	Common Indian Crow	Nymphalidae	Least Concern	Not assessed
2	*Zeltus amasa*	Fluffy Tit	*Zeltus amasa*	Not assessed	Not assessed
3	*Moduza procris*	Commander	Nymphalidae	Not assessed	Not assessed
4	*Danaus chrysippus*	Plain Tiger	Nymphalidae	Least Concern	Not assessed
5	*Danaus genutia*	Common or Striped Tiger	Nymphalidae	Not assessed	Not assessed
6	*Tanaecia lepidea*	Grey Count	Nymphalidae	Not assessed	Not assessed
7	*Catopsilia pomona*	Common Emigrant	Pieridae	Not assessed	Not assessed

Table 2: List of Butterflies recorded in the Study Area

Sr.no	Scientific name	Common name	Family
1	*Halpe zema*	Zema Banded Ace	Hesperiidae
2	*Telicota colon*	Pale Palm-Dart	Hesperiidae
3	*Telicota bambusae*	Dark Palm-Dart	Hesperiidae
4	*Sarangesa dasahara*	Common Small Flat	Hesperiidae
5	*Tapenath waitesi*	Black Angle	Hesperiidae
6	*Tagiades litigiosa*	Water Snow Flat	Hesperiidae
7	*Tagiades japetus*	Common Snow Flat	Hesperiidae
8	*Pseudocoladenia dan*	Fulvous Pied Flat	Hesperiidae
9	*Celaenorrhinus leucocera*	Common Spotted Flat	Hesperiidae

10	*Koruthaialos butleri*	Dark Velvet Bob	Hesperiidae
11	*Iambrix salsala*	Chestnut Bob	Hesperiidae
12	*Scobura cephala*	ExtraForest Bob	Hesperiidae
13	*Aeromachus dubius*	Dingy Scrub Hopper	Hesperiidae
14	*Notocrypta curvifascia*	Restricted Demon	Hesperiidae
15	*Notocrypta feisthamelii*	Spotted Demon	Hesperiidae
16	*Matapa aria*	Common Branded Redeye	Hesperiidae
17	*Oriens goloides*	SmallerDartlet	Hesperiidae
18	*Castalius rosimon*	Common Pierrot	Lycaenidae
19	*Caleta elna*	Elbowed Pierrot	Lycaenidae
20	*Caleta (Pycnophallium) roxus*	Straight Pierrot	Lycaenidae
21	*Discolampa ethion*	Banded Blue Pierrot	Lycaenidae
22	*Hypolycaena erylus*	Common Tit	Lycaenidae
23	*Zeltus amasa*	Fluffy Tit	Lycaenidae
24	*Cheritra freja*	Common Imperial	Lycaenidae
25	*Ticherra acte*	Blue Imperial	Lycaenidae
26	*Araotes lapithis*	Witch	Lycaenidae
27	*Jamides bochus*	Dark Cerulean	Lycaenidae
28	*Leptotes plinius*	Zebra Blue	Lycaenidae
29	*Megisba malaya*	Malayan	Lycaenidae
30	*Acytolepis puspa*	Common Hedge Blue	Lycaenidae
31	*Curetis acuta*	Acute Sunbeam	Lycaenidae
32	*Heliophorus epicles*	Purple Sapphire	Lycaenidae

33	*Anthene emolus*	Common Ciliate Blue	Lycaenidae
34	*Zizina otis*	Lesser Grass Blue	Lycaenidae
35	*Pseudozizeeria maha*	Pale Grass Blue	Lycaenidae
36	*Logania distanti*	Dark Mottle	Lycaenidae
37	*Loxura atymnus*	Yamfly	Lycaenidae
38	*Abisara echerius*	Plum Judy	Rio44dinidae
39	*Zemeros flegyas*	Punchinello	Riodin45idae
40	*Cirrochroa aoris*	Large Yeoman	Nymphalidae
41	*Vagrans egista*	Vagrant	Nymphalidae
42	*Euthaliaa conthea*	Common Baron	Nymphalidae
43	*Euthalia monina*	Powdered Baron	Nymphalidae
44	*Tanaecia julii*	Common Earl	Nymphalidae
45	*Mycalesis perseus*	Common Bushbrown	Nymphalidae
46	*Mycalesis malsarida*	Plain Bushbrown	Nymphalidae
47	*Melanitis leda*	Common Evening Brown	Nymphalidae
48	*Lethe chandica*	Angled Red Forester	Nymphalidae
49	*Mycalesis anaxias*	White-bar Bushbrown	Nymphalidae
50	*Faunis canens*	Common Faun	Nymphalidae
51	*Orsotriaena medus*	Nigger	Nymphalidae
52	*Ariadne ariadne*	Angled Castor	Nymphalidae
53	*Cupha erymanthis*	Rustic	Nymphalidae
54	*Leptosia nina*	Psyche	Nymphalidae
55	*Tanaecia lepidea*	Grey Count	Nymphalidae

56	*Euripus nyctelius*	Courtesan	Nymphalidae
57	*Elymnias hypermnestra*	Common Palmfly	Nymphalidae
58	*Junonia atlites*	Grey Pansy	Nymphalidae
59	*Junonia lemonias*	Lemon Pansy	Nymphalidae
60	*Junonia hierta*	Yellow Pansy	Nymphalidae
61	*Moduza procris*	Commander	Nymphalidae
62	*Athyma selenophora*	Staff Sergeant	Nymphalidae
63	*Athyma inara*	Colour Sergeant	Nymphalidae
64	*Athyma perius*	Common Sergeant	Nymphalidae
65	*Athyma pravara*	Unbroken Sergeant	Nymphalidae
66	*Ypthima huebneri*	Common Four-ring	Nymphalidae
67	*Ypthima baldus*	Common Five-ring	Nymphalidae
68	*Charaxes bernardus*	Tawny Rajah	Nymphalidae
69	*Neptis harita*	DingiestSailer	Nymphalidae
70	*Neptis pseudovikasi*	False DingiSailer	Nymphalidae
71	*Neptis soma*	Sullied/CreamySailer	Nymphalidae
72	*Neptis miah*	Small Yellow Sailer	Nymphalidae
73	*Neptis nata*	Clear Sailer	Nymphalidae
74	*Danaus chrysippus*	Plain Tiger	Nymphalidae
75	*Danaus genutia*	Common or Striped Tiger	Nymphalidae
76	*Tirumala limniace*	Blue Tiger	Nymphalidae
77	*Parantica aglea*	Glassy Tiger	Nymphalidae
78	*Tirumala septentrionis*	Dark Blue Tiger	Nymphalidae

79	*Euploea core*	Common Indian Crow	Nymphalidae
80	*Euploea mulciber*	Striped Blue Crow	Nymphalidae
81	*Euploea radamanthus*	Magpie Crow	Nymphalidae
82	*Hypolimnas misippus*	DanaidEggfly	Nymphalidae
83	*Lebadea martha*	Knight	Nymphalidae
84	*Charaxes athamas*	Common Nawab	Nymphalidae
85	*Rhinopalpa polynice*	Wizard	Nymphalidae
86	*Charaxes arja*	Pallid Nawab	Nymphalidae
87	*Cethosia cyane*	Leopard Lacewing	Nymphalidae
88	*Pantoporia hordonia*	Common Lascar	Nymphalidae
89	*Troides helena*	Common Birdwing	Papilionidae
90	*Graphium sarpedon*	Common Bluebottle	Papilionidae
91	*Papilio paris*	Paris Peacock	Papilionidae
92	*Papilio memnon*	Great Mormon	Papilionidae
93	*Graphium agamemnon*	Tailed Jay	Papilionidae
94	*Papilio demoleus*	Lime Butterfly	Papilionidae
95	*Papilio nephelus*	Yellow Helen	Papilionidae
96	*Catopsilia pyranthe*	Mottled Emigrant	Pieridae
97	*Catopsilia pomona*	Common Emigrant	Pieridae
98	*Ixias pyrene*	Yellow Orange-tip	Pieridae
99	*Hebomoia glaucippe*	Great Orange-tip	Pieridae
100	*Appias lyncida*	Chocolate Albatross	Pieridae
101	*Delias hyparete*	Painted Jezebel	Pieridae

Appendix 3.13:The list ofFishes

Appendix 3.13-List of Fishes

Sr. No.	Common Name	Scientific Name	IUCN Status	WPA, 1972 (Sch.)	Rare/ Endemic to NE India
1	Rohu	*Labeo rohita*	LC	Not Evaluated	NA
2	Minor Carp	*Labeo bata*	LC	Not Evaluated	
3	Kuria labeo	*Labeo gonius*	LC	Not Evaluated	NA
4		*Catla catla*	NA	Not Evaluated	NA
5		*Ctenopharyngodon idella*	NA	Not Evaluated	NA
6		*Cirrhinus mrigala*	LC	Not Evaluated	
7	**Chola Barb**	*Puntius chola*	LC	Not Evaluated	NA
8	Spotfin swamp barb	*Puntius sophore*	LC	Not Evaluated	NA
9		*Puntius conchonius*	LC	Not Evaluated	NA
10		*Puntius ticto*	LC	Not Evaluated	NA
11	Golden mahseer	Tor putitora	EN	Not Evaluated	Rare, Endemic
12	Tor mahseer	*Tor tor*	DD	Not Evaluated	Rare, Endemic
13		*Garra gotyla gotyla*	NA	Not Evaluated	NA
14		*Barilius barna*	LC	Not Evaluated	NA
15		*Botia Dario*	LC	Not Evaluated	NA
16		*Amblypharyngodon mola*	LC	Not Evaluated	NA
17		*Mystus tengra*	NA	Not Evaluated	NA
18		*Mystus cavasius*	LC	Not Evaluated	Rare, Endemic
19		*Mystus vittatus*	LC	Not Evaluated	Rare, Endemic
20		*Wallago atu*	NT	Not Evaluated	

21		*Amblyceps apangi*	LC	Not Evaluated	Rare, Endemic
22		*Clarias batrachus*	LC	Not Evaluated	
23	**Gangetic ailia**	*Ailia coila*	NT	Not Evaluated	NA
24		*Ompok pabda*	NT	Not Evaluated	Rare, Endemic
25	**Bareye Goby**	*Glossogobius giuris*	LC	Not Evaluated	
26	**Spiny eel**	*Mastacembelus armatus*	LC	Not Evaluated	
27		*Colisa fasciatus*	NA	Not Evaluated	NA
28	**Gangetic mudeel**	*Monopterus cuchia*	LC	Not Evaluated	NA
29		*Notopterus notopterus*	LC	Not Evaluated	
30	**Elongate Glass Perchlet**	*Chanda nama*	LC	Not Evaluated	NA
31		*Channa punctatus*	NA	Not Evaluated	NA
32		*Channa striatus*	NA	Not Evaluated	NA
33		*Channa barca*	DD	Not Evaluated	NA
34	**Indian Mottled Eel**	*Anguilla bengalensis*	NT	Not Evaluated	
35	**Indian River Shad**	*Gudusia chapra*	LC	Not Evaluated	NA
36	**Ganges River Gizzard Shad**	*Gonialosa manmina*	LC	Not Evaluated	NA
37	*Catla*	*Gibelion catla*	LC	Not Evaluated	
38	**Mrigal**	*Cirrhinus mrigala*	LC	Not Evaluated	
39	**Katli**	*Neolissochilus hexagonolepis*	NT	Not Evaluated	NA
40	Rosy barb	*Pethia conchonius*	LC	Not Evaluated	NA
41	Indian glass barb	*Laubuka laubuca*	NA	Not Evaluated	NA
42	**Barna Baril**	***Barilius barna***	LC	Not Evaluated	NA

43	Flying barb	*Esomus danrica*	LC	Not Evaluated	NA
44	**Slender Barb**	*Rasbora daniconius*	LC	Not Evaluated	
45		*Gangetic mystus*	NA	Not Evaluated	NA
46	Striped dwarf cat fish	*Mystus vittatus*	NA	Not Evaluated	NA
47	Indian butter catfish	*Ompok bimaculatus*	NA	Not Evaluated	NA
48	Batchwa vacha	*Eutropiichthys vacha*	NA	Not Evaluated	NA
49	Pungas	*Pangasius pangasius*	NA	Not Evaluated	NA
50	**Singee**	*Heteropneustes fossilis*	LC	Not Evaluated	
51	**Blue Panchax**	*Aplocheilus panchax*	LC	Not Evaluated	
52		***Anabas testudineus***	DD	Not Evaluated	NA
53	Dwarf gourami	*Trichogaster lalius*	LC	Not Evaluated	
54	**Dwarf Snakehead**	*Channa gachua*	LC	Not Evaluated	
55	Spotted snake head	***Channa aurantimaculata***	DD	Not Evaluated	NA
56	**Snakehead Murrel**	***Channa striata***	LC	Not Evaluated	NA

Appendix 3.14: Demographic Profile of the Study Area

Appendix 3.14- Demographic profile

Table 1: Demographic Details of Villages in where proposed Wells are located

Name	No of Households	Total Populatio Person	HouseholSize	Total Population Male	Total PopulatioFemale	Sex Ratio / 1000 male	Scheduled Castes population Person	%SC Population	Scheduled Tribes population Person	%ST Population	Literates PopulatioPerson	Literacy Rate	Male Literacy Rate	Female Literacy Rate
Ahovi (Itovi)	0	0	0.00	0	0	0	0	0.00	0	0.00	0	**0**	0	0
Alichiga	203	957	4.71	512	445	869.14	0	0.00	36	3.76	490	61.95	69.12	53.78
Ambari Gaon	16	89	5.56	45	44	977.78	0	0.00	35	39.33	42	58.33	66.67	50.00
Anjok Teron	19	113	5.95	47	66	1404.26	0	0.00	113	100.00	69	70.41	74.42	67.27
Baghgaon	83	372	4.48	194	178	917.53	0	0.00	0	0.00	276	87.90	94.38	81.17
Balipathar	294	1314	4.47	663	651	981.90	0	0.00	693	52.74	871	75.22	80.50	69.63
Bar Deka Timung	62	347	5.60	174	173	994.25	0	0.00	264	76.08	200	66.67	72.67	60.67
Barsewaguri	246	1149	4.67	574	575	1001.74	0	0.00	5	0.44	838	83.72	87.72	79.64
Bill Pathar	37	163	4.41	80	83	1037.50	0	0.00	0	0.00	115	82.73	87.88	78.08
Bokajan Bagan	86	476	5.53	248	228	919.35	0	0.00	0	0.00	320	79.01	86.26	71.13
Bong Sal	17	86	5.06	42	44	1047.62	0	0.00	86	100.00	31	43.06	52.78	33.33
Borholla	122	534	4.38	280	254	907.14	0	0.00	14	2.62	418	89.32	93.44	84.82
Borholla No.2	60	281	4.68	146	135	924.66	0	0.00	0	0.00	200	85.84	90.16	81.08
Borphong Rongpher	10	70	7.00	37	33	891.89	0	0.00	70	100.00	54	90.00	96.77	82.76
Chaluk Pathar No.1	212	1157	5.46	592	565	954.39	0	0.00	6	0.52	750	73.39	79.21	67.14
Chaluk Pathar No.2	99	484	4.89	240	244	1016.67	0	0.00	123	25.41	272	67.33	77.18	57.07
Chandla Chung	0	0	0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0.00	0.00
Chandra Teron	22	118	5.36	56	62	1107.14	0	0.00	115	97.46	81	84.38	87.50	81.25
Christan Gaon	63	357	5.67	170	187	1100.00	0	0.00	352	98.60	209	71.58	81.29	62.75
Christian Gaon	13	75	5.77	40	35	875.00	0	0.00	75	100.00	42	73.68	90.32	53.85
Christian Gaon	8	41	5.13	19	22	1157.89	0	0.00	40	97.56	16	45.71	46.67	45.00
Chungajan Hazari Gaon	63	293	4.65	156	137	878.21	0	0.00	0	0.00	225	86.54	92.20	79.83
Degholi Khokonguri	135	554	4.10	295	259	877.97	0	0.00	24	4.33	333	73.84	78.05	68.78
Deihari Rangpi	36	190	5.28	95	95	1000.00	0	0.00	188	98.95	111	72.55	84.93	61.25
Dharam Sing Bey	34	187	5.50	98	89	908.16	0	0.00	179	95.72	143	87.73	97.67	76.62
Dharampur	176	832	4.73	412	420	1019.42	0	0.00	239	28.73	597	82.46	91.39	73.63
Dhonia pathar	30	125	4.17	61	64	1049.18	0	0.00	117	93.60	79	74.53	90.91	56.86
Dighalganja Nic	66	370	5.61	206	164	796.12	0	0.00	2	0.54	212	66.67	76.70	54.23
Dighbir Basti	27	119	4.41	65	54	830.77	0	0.00	0	0.00	79	80.61	85.45	74.42

Dihingia	851	3671	4.31	1885	1786	947.48	8	0.22	321	8.74	2231	70.53	78.42	62.23
Dilawjan	169	903	5.34	439	464	1056.95	1	0.11	396	43.85	642	79.55	86.34	73.27
Dilawjan Koch Gaon	96	445	4.64	217	228	1050.69	0	0.00	4	0.90	310	80.10	84.32	76.24
Dilawjan Longbui	35	178	5.09	87	91	1045.98	0	0.00	0	0.00	146	89.57	89.74	89.41
Dilawjan-1 Dubi Gaon 2	42	210	5.00	113	97	858.41	0	0.00	14	6.67	144	75.79	80.58	70.11
Durgapur No.1	56	278	4.96	136	142	1044.12	0	0.00	194	69.78	143	60.59	68.75	53.23
Durgapur No.2	26	138	5.31	68	70	1029.41	0	0.00	117	84.78	70	62.50	75.47	50.85
Gautam Basti	232	1208	5.21	651	557	855.61	0	0.00	156	12.91	960	87.99	91.55	83.77
Ghonivi	0	0	0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0.00	0.00
Gogiha (Kikhoyi)	0	0	0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0.00	0.00
Goneshpur	41	191	4.66	93	98	1053.76	0	0.00	191	100.00	132	80.49	90.79	71.59
Habe Timung	9	46	5.11	24	22	916.67	0	0.00	46	100.00	22	57.89	84.21	31.58
Hallo Khuwa	454	2098	4.62	1078	1020	946.20	491	23.40	31	1.48	1287	69.61	78.38	60.38
Hallo Khuwa F.V.	280	1301	4.65	643	658	1023.33	0	0.00	16	1.23	645	57.85	67.75	48.13
Hatimora	124	640	5.16	324	316	975.31	1	0.16	363	56.72	439	79.67	82.80	76.47
Hatimorajan	37	208	5.62	99	109	1101.01	0	0.00	0	0.00	145	77.96	92.22	64.58
Hatovi (S.Hetovi)	0	0	0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0.00	0.00
Havishe Naga	0	0	0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0.00	0.00
Heneto	0	0	0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0.00	0.00
Henevi	0	0	0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0.00	0.00
Hetio (Hetoi)	0	0	0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0.00	0.00
Hoito	0	0	0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0.00	0.00
Holowguri	80	378	4.73	184	194	1054.35	0	0.00	0	0.00	263	79.22	80.38	78.16
Hurhuria	252	1046	4.15	572	474	828.67	292	27.92	189	18.07	565	67.99	76.37	57.75
Jabarajan	374	1886	5.04	978	908	928.43	191	10.13	5	0.27	1373	81.73	86.29	76.77
Janjuri	116	563	4.85	297	266	895.62	63	11.19	191	33.93	389	79.39	89.92	67.67
Jekshe Naga Bosti	0	0	0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0.00	0.00
Jongjung	25	148	5.92	86	62	720.93	0	0.00	148	100.00	61	50.00	61.64	32.65
Joyantipur	58	274	4.72	127	147	1157.48	0	0.00	268	97.81	139	56.73	61.11	53.28
Joypur	45	254	5.64	121	133	1099.17	0	0.00	0	0.00	176	79.64	85.98	73.68
Kacha Khowa	78	408	5.23	201	207	1029.85	0	0.00	177	43.38	218	64.12	73.94	54.86
Kai Terang	6	48	8.00	28	20	714.29	0	0.00	48	100.00	32	76.19	88.00	58.82
Kara Gaon	34	195	5.74	104	91	875.00	0	0.00	89	45.64	73	46.20	52.94	38.36
Kath Katia	568	2545	4.48	1283	1262	983.63	0	0.00	12	0.47	1760	79.17	84.53	73.81
Kathar Engti	67	413	6.16	213	200	938.97	0	0.00	397	96.13	277	82.69	88.10	77.25

Keyezu	0	0	0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0.00	0.00
Khai Basti (Khukhayi)	0	0	0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0.00	0.00
Khetho (Khekhakhu)	0	0	0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0.00	0.00
Khonikor Gaon	373	1707	4.58	857	850	991.83	77	4.51	0	0.00	1375	89.93	93.54	86.23
Khudi (Khutovi)	0	0	0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0.00	0.00
Khugovi	0	0	0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0.00	0.00
Khukeami (Khoaiye)	0	0	0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0.00	0.00
Kiling Gaon	61	364	5.97	183	181	989.07	2	0.55	362	99.45	179	62.81	70.21	55.56
Koch Gaon	65	284	4.37	138	146	1057.97	0	0.00	137	48.24	198	81.15	85.34	77.34
Kolia Dunga	54	259	4.80	128	131	1023.44	0	0.00	0	0.00	166	74.11	78.57	69.64
Kongkat	18	106	5.89	59	47	796.61	0	0.00	89	83.96	45	53.57	63.64	42.50
L.Vihoto	0	0	0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0.00	0.00
Labon Kro	17	101	5.94	51	50	980.39	0	0.00	100	99.01	67	78.82	87.50	71.11
Ladansa	0	0	0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0.00	0.00
Longkicho Engti	32	187	5.84	103	84	815.53	0	0.00	186	99.47	112	74.17	83.54	63.89
Lozhoto	0	0	0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0.00	0.00
Lozhoto	0	0	0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0.00	0.00
Lukto Nepali	0	0	0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0.00	0.00
Lungtuk Engti	28	165	5.89	89	76	853.93	4	2.42	160	96.97	109	81.34	85.90	75.00
Lungtuk Rongpi	8	48	6.00	27	21	777.78	0	0.00	42	87.50	38	95.00	95.65	94.12
Madhyempur	0	0	0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0.00	0.00
Majgaon	152	771	5.07	388	383	987.11	0	0.00	0	0.00	437	63.70	71.81	55.87
Majgaon	152	771	5.07	388	383	987.11	0	0.00	0	0.00	437	63.70	71.81	55.87
Manikpur	68	407	5.99	195	212	1087.18	0	0.00	6	1.47	262	75.72	83.95	68.48
Milonpur	195	994	5.10	469	525	1119.40	7	0.70	0	0.00	465	55.36	65.13	46.89
Moh Khuti	89	440	4.94	232	208	896.55	0	0.00	4	0.91	222	59.84	63.45	55.75
Mohima	99	468	4.73	258	210	813.95	0	0.00	0	0.00	367	88.01	93.97	80.54
Mohonpur	30	138	4.60	69	69	1000.00	0	0.00	137	99.28	100	81.30	89.47	74.24
Mon Teron	8	44	5.50	25	19	760.00	0	0.00	44	100.00	17	51.52	82.35	18.75
Mon Teron	3	16	5.33	7	9	1285.71	0	0.00	16	100.00	13	92.86	100.00	85.71
Mon Teron	39	208	5.33	107	101	943.93	0	0.00	208	100.00	119	70.41	76.67	63.29
Mugabhi	0	0	0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0.00	0.00
Naba Bontipur	66	299	4.53	149	150	1006.71	0	0.00	0	0.00	232	91.34	93.02	89.60
Nababetoni No.3	121	497	4.11	234	263	1123.93	0	0.00	6	1.21	378	86.50	90.64	82.91
Nacheri (Kuhoboto)	0	0	0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0.00	0.00

Naga Juri	203	966	4.76	485	481	991.75	0	0.00	0	0.00	730	84.98	90.09	79.76
Nahorkhona	221	1069	4.84	575	494	859.13	82	7.67	164	15.34	676	73.32	79.22	66.74
Navapur	61	286	4.69	147	139	945.58	16	5.59	269	94.06	212	82.49	85.29	79.34
Nayanjan Gaon	163	776	4.76	363	413	1137.74	0	0.00	203	26.16	507	73.05	84.88	62.70
Nekori Majdolopa	53	356	6.72	174	182	1045.98	0	0.00	344	96.63	127	42.47	46.76	38.75
Neparpeti Baghjan No. 1 & 2	192	961	5.01	481	480	997.92	0	0.00	4	0.42	675	79.69	84.52	74.94
Neparpeti Kachari Gaon	63	280	4.44	153	127	830.07	0	0.00	1	0.36	203	78.68	88.49	67.23
Neparpeti Kathar Gaon	30	155	5.17	69	86	1246.38	0	0.00	7	4.52	98	70.50	80.33	62.82
Netezu	0	0	0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0.00	0.00
New Subha (Shouba)	0	0	0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0.00	0.00
Nikheha (Nikighe)	0	0	0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0.00	0.00
Nikhehoi (Vikhuho) New	0	0	0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0.00	0.00
Nizhevi	0	0	0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0.00	0.00
No.1 Dighali Maji Gaon	114	624	5.47	312	312	1000.00	0	0.00	0	0.00	375	68.68	75.91	61.40
No.2 Dighali Maji Gaon	39	203	5.21	107	96	897.20	0	0.00	0	0.00	141	75.81	81.63	69.32
No.2 Kori	857	4380	5.11	2226	2154	967.65	7	0.16	0	0.00	2578	71.93	78.15	65.47
No.2 Panjan	35	180	5.14	99	81	818.18	0	0.00	0	0.00	138	86.79	96.63	74.29
Noloni Pathar	258	1206	4.67	598	608	1016.72	191	15.84	0	0.00	866	81.01	88.58	73.46
Old Ralong Naga Bosti	0	0	0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0.00	0.00
Old Subha	0	0	0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0.00	0.00
Ouguri	30	133	4.43	68	65	955.88	0	0.00	40	30.08	53	48.18	54.39	41.51
Pach Ghoria	171	815	4.77	428	387	904.21	0	0.00	5	0.61	623	89.38	93.19	85.15
Paniram Terang	158	774	4.90	397	377	949.62	7	0.90	274	35.40	325	50.78	61.40	39.55
Pishikhu	0	0	0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0.00	0.00
Puhekha (Pihekhu)	0	0	0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0.00	0.00
Pukhuri Para	37	190	5.14	93	97	1043.01	0	0.00	189	99.47	125	75.30	79.22	71.91
Rai Pathar	125	540	4.32	280	260	928.57	16	2.96	44	8.15	362	76.69	84.23	68.83
Raiali Matikhola	91	469	5.15	232	237	1021.55	0	0.00	0	0.00	306	73.21	82.09	64.98
Raipur	68	328	4.82	160	168	1050.00	0	0.00	324	98.78	216	75.79	80.99	70.63
Rajapukhuri No.1	60	337	5.62	175	162	925.71	0	0.00	16	4.75	168	57.53	67.52	45.93
Rajapukhuri No.2	56	318	5.68	159	159	1000.00	0	0.00	0	0.00	202	72.92	82.64	62.41
Ram Sing Teron	33	195	5.91	96	99	1031.25	0	0.00	195	100.00	124	75.61	83.72	66.67
Rangmaipur	61	248	4.07	126	122	968.25	0	0.00	205	82.66	167	75.23	85.96	63.89
Rengma Naga/Rengmapani (Hezheto)	1	113	113.00	107	6	56.07	16	14.16	5	4.42	113	100.00	100.00	100.00
Rongagara	531	2817	5.31	1471	1346	915.02	7	0.25	735	26.09	1582	65.81	72.74	58.28

Rongpi Gaon	35	201	5.74	99	102	1030.30	0	0.00	121	60.20	168	97.11	98.78	95.60
Rongpi Gaon	0	0	0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0.00	0.00
Rongpur	94	455	4.84	243	212	872.43	0	0.00	177	38.90	269	69.15	73.04	64.86
Rupohi	20	96	4.80	46	50	1086.96	0	0.00	95	98.96	62	69.66	79.55	60.00
Samaguri	18	85	4.72	43	42	976.74	0	0.00	79	92.94	60	75.95	76.92	75.00
Samukjan	107	502	4.69	253	249	984.19	423	84.26	11	2.19	350	82.74	90.74	74.40
Santipur	18	88	4.89	44	44	1000.00	0	0.00	48	54.55	71	98.61	97.06	100.00
Santipur	51	249	4.88	126	123	976.19	0	0.00	1	0.40	159	72.27	82.24	62.83
Sardeka (Bardeka) Engti	231	1134	4.91	555	579	1043.24	9	0.79	474	41.80	503	53.23	61.14	45.79
Sardoka Engti	237	1082	4.57	578	504	871.97	11	1.02	370	34.20	778	81.64	86.85	75.83
Sariahjan	99	508	5.13	272	236	867.65	2	0.39	204	40.16	355	80.32	84.19	75.96
Sartha Phangcho	43	252	5.86	124	128	1032.26	0	0.00	252	100.00	153	76.88	87.63	66.67
Sarthe Killing	11	57	5.18	29	28	965.52	1	1.75	56	98.25	44	91.67	100.00	85.19
Sarthe Rongpi (Langmili)	18	87	4.83	43	44	1023.26	0	0.00	86	98.85	44	63.77	78.38	46.88
Satsong R F	141	889	6.30	435	454	1043.68	0	0.00	877	98.65	408	54.99	61.37	48.81
Shanti Bosti	60	290	4.83	146	144	986.30	0	0.00	0	0.00	139	62.61	68.97	55.66
Sokhoyi (Shihoto)	0	0	0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0.00	0.00
Sonito	0	0	0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0.00	0.00
Sonowal Gaon	50	246	4.92	138	108	782.61	0	0.00	206	83.74	158	72.81	81.97	61.05
Suhovi (Suhai)	0	0	0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0.00	0.00
Sukanjan	61	332	5.44	177	155	875.71	0	0.00	0	0.00	187	66.31	78.38	52.99
Suratoni	104	476	4.58	247	229	927.13	11	2.31	20	4.20	308	76.62	79.25	73.68
Tengani Deghali Village No.1	73	354	4.85	179	175	977.65	154	43.50	34	9.60	260	84.97	89.02	80.28
Tengani Golaibosti	0	0	0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0.00	0.00
Tengatol Bosti	28	168	6.00	84	84	1000.00	112	66.67	4	2.38	99	73.33	87.50	57.14
Tokughe	0	0	0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0.00	0.00
Tokughe	0	0	0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0.00	0.00
Toshiha	0	0	0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0.00	0.00
Uhazhe (Ghazhi)	0	0	0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0.00	0.00
Uhozhe (Ghakipo)	0	0	0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0.00	0.00
United Naga Village	0	0	0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0.00	0.00
Wokha T.E.	771	3694	4.79	1869	1825	976.46	31	0.84	5	0.14	1929	61.24	67.46	54.86
X-Service	14	72	5.14	35	37	1057.14	0	0.00	0	0.00	45	71.43	77.42	65.63
X-Service Selabar	23	124	5.39	59	65	1101.69	0	0.00	120	96.77	54	50.94	54.90	47.27
Yampha Naga Bosti	71	356	5.01	188	168	893.62	21	5.90	201	56.46	107	36.90	47.40	25.00

Zokohi (Yekiye)	0	0	0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0.00	0.00
Zoshehe (Zuheshe)	0	0	0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0.00	0.00

Table2: Demographic Details of Villages in the 500m Buffer of the Wells

Name	No of Household	Total Population Person	Household Size	Total Population Male	Total Population Female	Sex Ratio / 1000 male	Schedule Castes populatio Person	%SC Populatio	ScheduleTribes populatioPerson	%ST Populatio	Literates PopulatioPerson	LiteracRate	Male Literacy Rate	Female Literacy Rate
Balipathar	294	1314	4.47	663	651	981.90	0	0.00	693	52.74	871	75.22	80.50	69.63
Bokajan Bagan	86	476	5.53	248	228	919.35	0	0.00	0	0.00	320	79.01	86.26	71.13
Chungajan Hazari Gaon	63	293	4.65	156	137	878.21	0	0.00	0	0.00	225	86.54	92.20	79.83
Dilawjan	169	903	5.34	439	464	1056.95	1	0.11	396	43.85	642	79.55	86.34	73.27
Kai Terang	6	48	8.00	28	20	714.29	0	0.00	48	100.00	32	76.19	88.00	58.82
Netezu	0	0	0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0.00	0.00
No.2 Kori	857	4380	5.11	2226	2154	967.65	7	0.16	0	0.00	2578	71.93	78.15	65.47
No.2 Panjan	35	180	5.14	99	81	818.18	0	0.00	0	0.00	138	86.79	96.63	74.29
Paniram Terang	158	774	4.90	397	377	949.62	7	0.90	274	35.40	325	50.78	61.40	39.55
Rongagara	531	2817	5.31	1471	1346	915.02	7	0.25	735	26.09	1582	65.81	72.74	58.28
Sariahjan	99	508	5.13	272	236	867.65	2	0.39	204	40.16	355	80.32	84.19	75.96
Sarthe Killing	11	57	5.18	29	28	965.52	1	1.75	56	98.25	44	91.67	100.00	85.19
Sukanjan	61	332	5.44	177	155	875.71	0	0.00	0	0.00	187	66.31	78.38	52.99
Tengatol Bosti	28	168	6.00	84	84	1000.00	112	66.67	4	2.38	99	73.33	87.50	57.14

Table3: Details of the Working Population in the Villages in the Study Area

Name	No of Households	Total Population Person	Total Worker%	Main worker%	Marginal Worker %	Non-working Population%	Cultivator %	Agricultural Worker (%)	Household workers	Other worker
Ahovi (Itovi)	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0	0
Alichiga	203	957	38.98	98.12	1.88	61.02	50.13	44.24	3	17
Ambari Gaon	16	89	17.98	100.00	0.00	82.02	93.75	0.00	0	1
Anjok Teron	19	113	41.59	48.94	51.06	58.41	95.74	51.06	0	2
Baghgaon	83	372	40.32	74.00	26.00	59.68	82.00	24.67	1	12
Balipathar	294	1314	43.15	65.78	34.22	56.85	25.93	20.46	29	214
Bar Deka Timung	62	347	29.39	83.33	16.67	70.61	56.86	4.90	0	39

Barsewaguri	246	1149	50.74	44.25	55.75	49.26	67.41	39.45	6	96
Bill Pathar	37	163	69.94	5.26	94.74	30.06	66.67	66.67	1	2
Bokajan Bagan	86	476	41.60	99.49	0.51	58.40	23.74	39.39	0	73
Bong Sal	17	86	56.98	100.00	0.00	43.02	97.96	0.00	0	1
Borholla	122	534	55.43	37.84	62.16	44.57	25.68	6.08	31	59
Borholla No.2	60	281	21.71	100.00	0.00	78.29	98.36	0.00	0	1
Borphong Rongpher	10	70	54.29	7.89	92.11	45.71	5.26	5.26	0	6
Chaluk Pathar No.1	212	1157	51.25	16.69	83.31	48.75	72.85	61.89	2	22
Chaluk Pathar No.2	99	484	52.07	84.13	15.87	47.93	58.33	19.05	4	17
Chandla Chung	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0	0
Chandra Teron	22	118	46.61	40.00	60.00	53.39	40.00	1.82	2	5
Christan Gaon	63	357	40.34	47.92	52.08	59.66	39.58	11.81	0	7
Christian Gaon	13	75	45.33	94.12	5.88	54.67	91.18	5.88	0	3
Christian Gaon	8	41	43.90	100.00	0.00	56.10	100.00	0.00	0	0
Chungajan Hazari Gaon	63	293	57.34	48.81	51.19	42.66	88.69	51.19	0	3
Degholi Khokonguri	135	554	32.49	97.22	2.78	67.51	90.00	1.11	1	13
Deihari Rangpi	36	190	30.00	100.00	0.00	70.00	82.46	0.00	0	10
Dharam Sing Bey	34	187	60.96	11.40	88.60	39.04	7.89	6.14	4	16
Dharampur	176	832	70.19	96.92	3.08	29.81	95.72	1.03	1	14
Dhonia pathar	30	125	36.00	73.33	26.67	64.00	66.67	0.00	0	3
Dighalganja Nic	66	370	42.97	72.96	27.04	57.03	66.67	27.04	0	1
Dighbir Basti	27	119	60.50	50.00	50.00	39.50	83.33	45.83	2	7
Dihingia	851	3671	36.34	90.03	9.97	63.66	26.54	22.49	7	667
Dilawjan	169	903	35.55	55.76	44.24	64.45	46.11	11.84	0	47
Dilawjan Koch Gaon	96	445	64.49	2.79	97.21	35.51	91.99	92.33	0	8
Dilawjan Longbui	35	178	27.53	83.67	16.33	72.47	61.22	0.00	0	13
Dilawjan-1 Dubi Gaon 2	42	210	31.43	83.33	16.67	68.57	37.88	42.42	0	5
Durgapur No.1	56	278	55.76	50.97	49.03	44.24	71.61	27.10	11	8
Durgapur No.2	26	138	44.93	62.90	37.10	55.07	46.77	8.06	9	6
Gautam Basti	232	1208	32.20	94.09	5.91	67.80	62.72	14.91	0	86
Ghonivi	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0	0
Gogiha (Kikhoyi)	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0	0
Goneshpur	41	191	70.16	56.72	43.28	29.84	99.25	43.28	0	1
Habe Timung	9	46	65.22	46.67	53.33	34.78	96.67	53.33	0	1
Hallo Khuwa	454	2098	37.85	88.66	11.34	62.15	15.11	49.50	78	180

Hallo Khuwa F.V.	280	1301	46.20	54.74	45.26	53.80	35.94	3.00	44	314
Hatimora	124	640	23.13	89.86	10.14	76.88	77.03	4.73	0	19
Hatimorajan	37	208	62.02	93.02	6.98	37.98	78.29	18.60	0	6
Hatovi (S.Hetovi)	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0	0
Havishe Naga	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0	0
Heneto	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0	0
Henevi	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0	0
Hetio (Hetoi)	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0	0
Hoito	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0	0
Holowguri	80	378	21.16	100.00	0.00	78.84	98.75	0.00	0	1
Hurhuria	252	1046	52.20	48.17	51.83	47.80	90.11	45.24	0	11
Jabarajan	374	1886	40.67	57.50	42.50	59.33	34.42	25.95	24	172
Janjuri	116	563	38.54	64.52	35.48	61.46	76.96	34.56	0	20
Jekshe Naga Bosti	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0	0
Jongjung	25	148	33.11	95.92	4.08	66.89	100.00	4.08	0	0
Joyantipur	58	274	26.28	73.61	26.39	73.72	73.61	0.00	0	0
Joypur	45	254	46.85	37.82	62.18	53.15	38.66	24.37	1	22
Kacha Khowa	78	408	28.43	99.14	0.86	71.57	93.10	2.59	0	4
Kai Terang	6	48	75.00	50.00	50.00	25.00	83.33	50.00	0	6
Kara Gaon	34	195	34.36	100.00	0.00	65.64	46.27	38.81	0	10
Kath Katia	568	2545	37.29	90.73	9.27	62.71	19.49	12.22	35	601
Kathar Engti	67	413	48.18	19.10	80.90	51.82	30.65	19.10	7	23
Keyezu	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0	0
Khai Basti (Khukhayi)	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0	0
Khetho (Khekhakhu)	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0	0
Khonikor Gaon	373	1707	46.22	91.00	9.00	53.78	46.64	9.76	23	343
Khudi (Khutovi)	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0	0
Khugovi	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0	0
Khukeami (Khoaiye)	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0	0
Kiling Gaon	61	364	47.53	53.76	46.24	52.47	45.66	13.29	3	12
Koch Gaon	65	284	27.46	79.49	20.51	72.54	55.13	10.26	1	11
Kolia Dunga	54	259	57.92	44.00	56.00	42.08	42.00	0.00	1	3
Kongkat	18	106	25.47	18.52	81.48	74.53	85.19	74.07	0	4
L.Vihoto	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0	0
Labon Kro	17	101	22.77	95.65	4.35	77.23	65.22	4.35	5	3

Ladansa	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0	0
Longkicho Engti	32	187	43.32	3.70	96.30	56.68	45.68	46.91	0	2
Lozhoto	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0	0
Lozhoto	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0	0
Lukto Nepali	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0	0
Lungtuk Engti	28	165	49.09	7.41	92.59	50.91	33.33	33.33	0	15
Lungtuk Rongpi	8	48	45.83	77.27	22.73	54.17	27.27	4.55	0	15
Madhyempur	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0	0
Majgaon	152	771	37.09	98.60	1.40	62.91	49.30	48.25	1	4
Majgaon	152	771	37.09	98.60	1.40	62.91	49.30	48.25	1	4
Manikpur	68	407	35.14	70.63	29.37	64.86	53.85	9.79	0	30
Milonpur	195	994	59.86	48.91	51.09	40.14	89.41	49.92	1	18
Moh Khuti	89	440	24.32	88.79	11.21	75.68	88.79	2.80	0	3
Mohima	99	468	33.12	97.42	2.58	66.88	90.32	4.52	0	4
Mohonpur	30	138	21.74	100.00	0.00	78.26	93.33	0.00	0	2
Mon Teron	8	44	59.09	100.00	0.00	40.91	100.00	0.00	0	0
Mon Teron	3	16	25.00	50.00	50.00	75.00	100.00	50.00	0	0
Mon Teron	39	208	29.81	19.35	80.65	70.19	74.19	70.97	2	14
Mugabhi	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0	0
Naba Bontipur	66	299	54.18	50.62	49.38	45.82	81.48	49.38	2	5
Nababetoni No.3	121	497	44.67	68.02	31.98	55.33	72.52	36.04	7	42
Nacheri (Kuhoboto)	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0	0
Naga Juri	203	966	46.27	42.95	57.05	53.73	81.88	45.64	6	21
Nahorkhona	221	1069	54.63	46.23	53.77	45.37	85.45	48.12	0	5
Navapur	61	286	25.52	87.67	12.33	74.48	63.01	2.74	2	22
Nayanjan Gaon	163	776	28.87	89.73	10.27	71.13	80.80	3.57	1	29
Nekori Majdolopa	53	356	71.63	47.06	52.94	28.37	27.06	20.00	0	0
Neparpeti Baghjan No. 1 & 2	192	961	58.69	45.21	54.79	41.31	34.57	20.39	2	119
Neparpeti Kachari Gaon	63	280	35.36	98.99	1.01	64.64	57.58	34.34	0	9
Neparpeti Kathar Gaon	30	155	52.90	48.78	51.22	47.10	54.88	45.12	0	19
Netezu	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0	0
New Subha (Shouba)	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0	0
Nikheha (Nikighe)	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0	0
Nikhehoi (Vikhuho) New	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0	0
Nizhevi	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0	0

No.1 Dighali Maji Gaon	114	624	29.81	88.71	11.29	70.19	86.56	2.15	1	5
No.2 Dighali Maji Gaon	39	203	67.49	61.31	38.69	32.51	89.78	39.42	2	8
No.2 Kori	857	4380	37.53	69.22	30.78	62.47	40.51	32.54	23	256
No.2 Panjan	35	180	35.00	100.00	0.00	65.00	65.08	34.92	0	0
Noloni Pathar	258	1206	43.03	58.00	42.00	56.97	42.00	16.76	3	54
Old Ralong Naga Bosti	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0	0
Old Subha	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0	0
Ouguri	30	133	42.11	83.93	16.07	57.89	10.71	10.71	0	48
Pach Ghoria	171	815	36.32	87.50	12.50	63.68	68.58	11.82	7	53
Paniram Terang	158	774	32.30	55.20	44.80	67.70	50.00	4.80	0	8
Pishikhu	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0	0
Puhekha (Pihekhu)	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0	0
Pukhuri Para	37	190	30.53	98.28	1.72	69.47	86.21	1.72	0	8
Rai Pathar	125	540	78.15	62.56	37.44	21.85	26.54	30.57	7	77
Raiali Matikhola	91	469	57.14	47.39	52.61	42.86	44.40	7.09	0	9
Raipur	68	328	28.05	91.30	8.70	71.95	94.57	7.61	0	4
Rajapukhuri No.1	60	337	35.01	74.58	25.42	64.99	79.66	38.98	0	2
Rajapukhuri No.2	56	318	41.19	87.79	12.21	58.81	90.84	9.92	7	2
Ram Sing Teron	33	195	30.77	76.67	23.33	69.23	76.67	13.33	6	7
Rangmaipur	61	248	28.63	7.04	92.96	71.37	33.80	33.80	0	5
Rengma Naga/Rengmapani (Hezheto)	23	113	100.00	99.12	0.88	0.00	0.88	0.00	0	112
Rongagara	531	2817	40.82	74.09	25.91	59.18	57.39	7.48	36	284
Rongpi Gaon	35	201	31.84	76.56	23.44	68.16	60.94	17.19	0	24
Rongpi Gaon	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0	0
Rongpur	94	455	30.99	77.30	22.70	69.01	72.34	7.09	2	1
Rupohi	20	96	26.04	88.00	12.00	73.96	84.00	0.00	0	1
Samaguri	18	85	35.29	73.33	26.67	64.71	60.00	0.00	0	4
Samukjan	107	502	79.88	98.00	2.00	20.12	51.62	34.66	37	14
Santipur	18	88	54.55	83.33	16.67	45.45	33.33	2.08	21	11
Santipur	51	249	22.09	100.00	0.00	77.91	69.09	5.45	0	14
Sardeka (Bardeka) Engti	231	1134	25.84	48.46	51.54	74.16	57.34	22.53	0	98
Sardoka Engti	237	1082	32.35	72.57	27.43	67.65	12.57	11.71	1	299
Sariahjan	99	508	42.13	64.02	35.98	57.87	5.14	23.36	9	121
Sartha Phangcho	43	252	49.60	4.80	95.20	50.40	89.60	89.60	0	6
Sarthe Killing	11	57	52.63	10.00	90.00	47.37	40.00	40.00	1	4

Sarthe Rongpi (Langmili)	18	87	44.83	46.15	53.85	55.17	100.00	53.85	0	0
Satsong R F	141	889	21.37	87.37	12.63	78.63	62.63	11.58	0	56
Shanti Bosti	60	290	30.69	85.39	14.61	69.31	78.65	2.25	0	6
Sokhoyi (Shihoto)	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0	0
Sonito	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0	0
Sonowal Gaon	50	246	26.42	98.46	1.54	73.58	98.46	0.00	1	0
Suhovi (Suhai)	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0	0
Sukanjan	61	332	62.35	24.64	75.36	37.65	95.17	71.98	7	0
Suratoni	104	476	56.72	8.15	91.85	43.28	29.63	23.70	0	2
Tengani Deghali Village No.1	73	354	39.55	92.86	7.14	60.45	99.29	6.43	1	0
Tengani Golaibosti	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0	0
Tengatol Bosti	28	168	64.88	48.62	51.38	35.12	78.90	49.54	0	21
Tokughe	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0	0
Tokughe	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0	0
Toshiha	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0	0
Uhazhe (Ghazhi)	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0	0
Uhozhe (Ghakipo)	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0	0
United Naga Village	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0	0
Wokha T.E.	771	3694	48.29	80.94	19.06	51.71	20.63	11.10	9	1068
X-Service	14	72	40.28	89.66	10.34	59.72	62.07	34.48	0	2
X-Service Selabar	23	124	58.06	45.83	54.17	41.94	100.00	54.17	0	0
Yampha Naga Bosti	71	356	57.58	61.95	38.05	42.42	97.56	37.56	0	1
Zokohi (Yekiye)	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0	0
Zoshehe (Zuheshe)	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0	0

Table 4: Details of the Working Population in the Villages in which Proposed Wells are Located

Name	No of Households	Total Population Person	Total Workers (%)	Main Workers (%)	Marginal Workers (%)	Non workers (%)	Total Cultivators (%)	Total Agricultural Workers (%)	Household	Other
Balipathar	294	1314	43.15	65.78	34.22	56.85	25.93	31.22	29	214
Bokajan Bagan	86	476	41.60	99.49	0.51	58.40	23.74	39.39	0	73
Chungajan Hazari Gaon	63	293	57.34	48.81	51.19	42.66	88.69	9.52	0	3
Dilawjan	169	903	35.55	55.76	44.24	64.45	46.11	39.25	0	47
Kai Terang	6	48	75.00	50.00	50.00	25.00	83.33	0.00	0	6

Netezu	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0	0
No.2 Kori	857	4380	37.53	69.22	30.78	62.47	40.51	42.52	23	256
No.2 Panjan	35	180	35.00	100.00	0.00	65.00	65.08	34.92	0	0
Paniram Terang	158	774	32.30	55.20	44.80	67.70	50.00	46.80	0	8
Rongagara	531	2817	40.82	74.09	25.91	59.18	57.39	14.78	36	284
Sariahjan	99	508	42.13	64.02	35.98	57.87	5.14	34.11	9	121
Sarthe Killing	11	57	52.63	10.00	90.00	47.37	40.00	43.33	1	4
Sukanjan	61	332	62.35	24.64	75.36	37.65	95.17	1.45	7	0
Tengatol Bosti	28	168	64.88	48.62	51.38	35.12	78.90	1.83	0	21

Table 5: Details of the Working Population in the Villages in 500 Buffer of where Proposed Wells are Located

Name	No of Households	Total Population Person	Total Workers (%)	Main Workers (%)	Marginal Workers (%)	Non workers (%)	Total Cultivators (%)	Total Agricultural Workers (%)	Household	Other
Balipathar	294	1314	43.15	65.78	34.22	56.85	25.93	31.22	29	214
Bokajan Bagan	86	476	41.60	99.49	0.51	58.40	23.74	39.39	0	73
Chungajan Hazari Gaon	63	293	57.34	48.81	51.19	42.66	88.69	9.52	0	3
Dilawjan	169	903	35.55	55.76	44.24	64.45	46.11	39.25	0	47
Kai Terang	6	48	75.00	50.00	50.00	25.00	83.33	0.00	0	6
Netezu	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0	0
No.2 Kori	857	4380	37.53	69.22	30.78	62.47	40.51	42.52	23	256
No.2 Panjan	35	180	35.00	100.00	0.00	65.00	65.08	34.92	0	0
Paniram Terang	158	774	32.30	55.20	44.80	67.70	50.00	46.80	0	8
Pishikhu	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0	0
Rongagara	531	2817	40.82	74.09	25.91	59.18	57.39	14.78	36	284
Sariahjan	99	508	42.13	64.02	35.98	57.87	5.14	34.11	9	121
Sarthe Killing	11	57	52.63	10.00	90.00	47.37	40.00	43.33	1	4
Sukanjan	61	332	62.35	24.64	75.36	37.65	95.17	1.45	7	0
Tengatol Bosti	28	168	64.88	48.62	51.38	35.12	78.90	1.83	0	21

Appendix 3.15 Consultation of the Socio Economic

Consultation with Gaon Burha

A	*Project Title:*	Socio-economic studies for studying the impact of the upcoming proposed development of exploratory and appraisal wells.		
B	*Stakeholder Title:*	Gaon Burha		
C	*Basic details:* The person is head in the village. He carries out administrative roles and basic document processing			
	Location:	Gautam Basti		
	Date	17th May 2019		
D	*Attended By*			
	Sr.	Name		Designation
	1.	Mr. Ganesh Rongpi (09401851167)		Gaon Burha
	2.	Mr. Utpal Goswami		Social Expert
	3.	Mr. Aziz Hasan		Project Lead
E	*Purpose of Consultation*			
	• To understand the socio-economic condition of the village • To know basic facilities availed by the people • To study cultural aspects of the village • To understand attitude towards any development project • To understand problems of the villagers and their needs			
F	***Key Points Inferred*** • Poor road connectivity and damage to crops by elephants was discussed. • The Gaon Burha elaborated upon the shyness of the Karbi folk. • The importance of better transparency in expenditure of govt. scheme funds was also highlighted. • Bus stop is available. • Electricity is available most of the time. • Positive response towards new industry and except to get employment there.			

Consultation with Municipality Offcier, Bokajan

A	*Project Title:*	Socio-economic studies for studying the impact of the upcoming proposed development of exploratory and appraisal wells	
B	*Stakeholder Title:*	Junior Assistant, Bokajan Municipal Board	
C	*Basic details: :* The Bokajan Municipal Board is the provider of basic amenities in the town and is a reliable source of pertinent information		
	Location:	Bokajan	
	Date	17th May 2019	
D	*Attended By*		
	Sr.	Name	Designation
	1.	Mr. S. Sing Engti (09678766649)	Junior Assistant, Bokajan Municipal Board
	2.	Mr. Utpal Goswami	Project Manager/Social Expert
	3.	Mr. Aziz Hasan	Project Lead
E	*Purpose of Consultation*		
	To understanding the baseline condition of various public amenties and ascertain the gaps • Any other relevant issue pertaining to the socioeconomic condition of the residents		
F	***Key Points Inferred:*** • Mr. S. Sing Engti mentioned that No issues are related to basic facilities like drinking water, roads, transport, shops and sanitation occur in the region. • The officer mentioned that presence of cement factory has uplifted the economic condition of the people. • Human- elephant conflicts are reported in the region.		

Consultation with School Community

A	*Project Title:*	Socio-economic studies for studying the impact of the upcoming proposed development of exploratory and appraisal wells.	
B	*Stakeholder Title:*	Gaon Burha	
C	*Basic details:* The head master of Bokajan Govt. LP School is a reliable source of information regarding the education facilities available locally.		
	Location:	Bokajan	
	Date	17th May 2019	
D	*Attended By*		
	Sr.	Name	Designation
	1.	Mr. Ashish Kumar Roy (09435811851)	Head Master, Bokajan Govt. LP School
	2.	Mr. Utpal Goswami	Project manager/Social expert
	3.	Mr. Aziz Hasan	Project Lead
E	*Purpose of Consultation*		
	• Understanding the available facilities with respect to education To enlist the gaps		
F	***Key Points Inferred:*** • The headmaster mentioned that all the basic material for education like books and uniform are provided by the school. • The school is well equip with basic facilities like drinking water and toilet. • The children are provided mid may meal. Proper teachers are available for teaching. • Boy and girl child both attend school. • No issues of attendance were noted during rainy season. • The lower caste children get scholarship yearly.		

Consultation with Bokajan Block Primary Health Centre LHS

A	*Project Title:*	A Socio-economic studies for studying the impact of the upcoming proposed development of exploratory and appraisal wells	
B	*Stakeholder Title:*	Gaon Burha	
C	*Basic details: :* The interviewee was a reliable source of information regarding the available health related facilities and the local morbidity pattern		
	Location:	Bokajan	
	Date	17th May 2019	
D	*Attended By*		
	Sr.	Name	Designation
	1.	Ms. Reena Dutta (07086694894)	LHS
	2.	Mr. Utpal Goswami	Project Manager
	3.	Mr. Aziz Hasan	Project Lead
E	*Purpose of Consultation*		
	• To understand the common diseases and morbidity pattern		
F	***Key Points Inferred:*** • The hospital has 14 nurses and 3 lab assistants. • The laboratory tests in the hospital are done free of charge. • The hospital largely caters to delivery cases. Seasonal fever, cough and cold were reportedly the major concerns. • Incidence of TB and malaria was was also reported. • Skin infections are also common. Occasional cases of elephant injury and other accidents were reported. Local residents complained of poor air quality, eye and skin irritation and frequent coughing and lung related problems • The Cement factory had its own hospital for its staff.		

Consultation with Village Community

A	*Project Title:*	Socio-economic studies for studying the impact of the upcoming proposed development of exploratory and appraisal wells	
B	*Stakeholder Title:*	Gaon Burha	
C	A *Basic details:* The person is head person in the village. He carries out administrative roles and basic document processing.		
	Location:	Satsong Gaon	
	Date	18th May 2019	
D	*Attended By*		
	Sr.	Name	Designation
	1.	Mr. Jeeten Engti	Gaon Burha
	2.	Mr. Utpal Goswami	Project Manager/Socila Expert
	3.		
E	*Purpose of Consultation*		
	• To understand the socio-economic condition of the village • To know basic facilities availed by the people • To study cultural aspects of the village • To understand attitude towards any development project • To understand problems of the villagers and their needs		
F	***Key Points Inferred:*** • The Gaon Burha elaborated upon the number of houeholds and social structure in the village. • He described the availability of basic amenities in the village, but claimed that they were not adequate. • He also rued the lack of better roads and drinking water facilities.		

Appendix 7.1 Leak Sizes, Inventories and Hazardous Chemicals within the Isolatable Sections

Appendix 7.1- information on leak sizes, inventories and hazardous chemicals within the isolatable sections.

Table 1: Inventory used, Time Assumptions, Leak Sizes, & Flow Rate Etc.

S. No	Isolatable Section	Line Size	Flow rate/Capacity	Temperature (deg C)	Pressure (bar)	physical state	Leak Sizes (mm)	ESDV closure time utilized for inventory (in min)	Remark Comments
1	From Well Fluid from Well to Inlet of Heater Separator	200 mm	2000 BOPD	25	55	2 Phase- Liquid and Gas	Small Leak : 5 mm Medium Leak : 25 mm Large Leak : 100 mm Catastrophic : 200 mm	5 minute 3 minute 2 minute 1 minute	
2	Heater Treater Separator – Oil Case	200 mm	2000 BOPD (10.5 * 6.5 m)	75	3	Liquid	Small Leak : 5 mm Medium Leak : 25 mm Large Leak : 100 mm Catastrophic : 200 mm	5 minute 3 minute 2 minute 1 minute	This section is modelled (100% as oil)
3	Heater Treater Separator – Gas Case	200 mm	5 mmscfd (10.5 * 6.5 m)	75	3	Gas	Small Leak : 5 mm Medium Leak : 25 mm Large Leak : 100 mm Catastrophic : 200 mm	5 minute 3 minute 2 minute 1 minute	1. This section is modelled (100% as Gas) 2. Dimensions are taken from Layout Block

S. No	Isolatable Section	Line Size	Flow rate/Capacity	Temperature (deg C)	Pressure (bar)	physical state	Leak Sizes (mm)	ESDV closure time utilized for inventory (in min)	Remark Comments
4	Oil from Heater Treater Separator to inlet of Oil Storage Tanks including coaleser separator	150	6* 2.5	75	3	Liquid	Small Leak : 5 mm Medium Leak : 25 mm Large Leak : 100 mm Catastrophic : 150 mm	5 minute 3 minute 2 minute 1 minute	Dimensions are taken from Layout Block
5	From XSV of tank inlet to pump inlet including Oil Storage Tank	150	1000 bbls	75	Atm	Liquid	Small Leak : 5 mm Medium Leak : 25 mm Large Leak : 100 mm Catastrophic : 150 mm	5 minute 3 minute 2 minute 1 minute	
6	From Oil Transfer pump outlet to tanker loading Facility	150	1000 bbls	75	10	Liquid	Small Leak : 5 mm Medium Leak : 25 mm Large Leak : 100 mm Catastrophic : 150 mm	5 minute 3 minute 2 minute 1 minute	10 bar is considered as per best practice
7	Oil Tanker Failure	-	10 KL	Amb	Atm	Liquid	Catastrophic Rupture	-	

S. No	Isolatable Section	Line Size	Flow rate/Capacity	Temperature (deg C)	Pressure (bar)	physical state	Leak Sizes (mm)	ESDV closure time utilized for inventory (in min)	Remark Comments
8	Diesel Storage Tank	100	60 KL	Amb	Atm	Liquid	Small Leak : 5 mm Medium Leak : 25 mm Large Leak : 50 mm Catastrophic : 100 mm	5 minute 3 minute 2 minute 1 minute	
9	Fuel Gas System	200	5 mmscfd	75	3	Gas	Small Leak : 5 mm Medium Leak : 25 mm Large Leak : 100 mm Catastrophic : 200 mm	5 minute 3 minute 2 minute 1 minute	
10	Flare System	200	5 mmscfd	75	1.2	Gas	Small Leak : 5 mm Medium Leak : 25 mm Large Leak : 100 mm Catastrophic : 200 mm	5 minute 3 minute 2 minute 1 minute	