EXECUTIVE SUMMARY (ENGLISH)

ENVIRONMENTAL IMPACT ASSESSMENT FOR PROPOSED EXPLORATORY DRILLING OF SEVEN (07) WELLS & TESTING OF HYDROCARBONS AT JORHAT DISTRICT, ASSAM.

OIL INDIA LIMITED
DULIAJAN, ASSAM

PROJECT REFERENCE NUMBER:
IN/ES-EIA/2014-286
.VERSION 1.0

CONTRACT NO: 6108699/DCO/NN
TENDER NO: DCO4597P15

PREPARED BY:
SGS India Private Limited
226 Udyog Vihar Phase I
Gurgaon – 122 016, Haryana, India

Tel: +91 124 6776300
Fax: +91 124 6776403/04

http://www.sgsigroup.in/
CONTENTS

Executive Summary ..................................................................................................................3

1.0 Introduction .......................................................................................................................3

2.0 Project Description ............................................................................................................4

2.1 Project cost and Implementation details ...........................................................................5

2.2 Utilities .............................................................................................................................5

3.0 Description of Environment ............................................................................................6

3.1 Baseline Environmental conditions ..................................................................................6

3.1.1 Ambient Air quality .....................................................................................................6

3.1.2 Noise Level ..................................................................................................................7

3.1.3 Water Quality ..............................................................................................................7

3.1.4 Soil Quality ..................................................................................................................7

3.1.5 Ecology & Biodiversity ...............................................................................................7

3.1.6 Baseline socio-economic conditions ..........................................................................8

4.0 Anticipated Environmental Impact And Management plan ...........................................8

4.1 Impact Assessment ..........................................................................................................8

5.0 Risk Analysis ...................................................................................................................10

6.0 Consequence Analysis ....................................................................................................10

7.0 Risk Mitigation To Control Hazards ................................................................................11

8.0 Environmental Monitoring Program ................................................................................12

9.0 Environmental Management Plan (EMP) .........................................................................12
**EXECUTIVE SUMMARY**

1.0 INTRODUCTION

Consortium of M/s Oil India Limited (herein after referred in as OIL) & M/s Oil and Natural Gas Corporation Limited (herein after referred in as ONGC) has been awarded onshore Block AA-ONN-2009/4 in Jorhat district of Assam state for exploration of hydrocarbons. The Block was awarded under NELP-VIII round of bidding by Ministry of Petroleum and Natural Gas, Government of India. The production sharing contracts for the block was signed on 30th June 2010 and Petroleum Exploration License (PEL) was granted with effective from 09.12.2011 for seven years. OIL is the operator for this Block and propose to carryout exploratory drilling of seven wells with testing.

As per notification dated 14 September 2006, proposed exploratory drilling of seven wells and testing of Hydrocarbons within block is designated as “Category A” project and require environment clearance from Ministry of Environment and Forest, Govt. of India, Delhi.

Ministry of Environment and Forest & Climate Change (MoEF&CC) issued Terms of Reference (TOR) for carrying out the EIA/EMP study vide letter No. J-11011/163/2014-IA II (I) dated 9th October, 2014 based on the duly filled Form I along with pre feasibility report submitted and subsequent presentation made to Expert Appraisal Committee (EAC).

**Location and Accessibility**

The Block AA-ONN-2009/4 having an area of 85 sq km is located Jorhat district of Assam in the proven petroliferous Assam-Arakan Basin. The coordinates of the same is given in **Table 1.1:**

The Block AA-ONN-2009/4 lies in the proven petroliferous Assam-Arakan Basin

<table>
<thead>
<tr>
<th>Pt.</th>
<th>Longitude</th>
<th>Latitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>94°15'0.00&quot;E</td>
<td>26°49'0.00&quot;N</td>
</tr>
<tr>
<td>B</td>
<td>94°20'0.30&quot;E</td>
<td>26°49'0.00&quot;N</td>
</tr>
<tr>
<td>C</td>
<td>94°20'0.30&quot;E</td>
<td>26°44'0.00&quot;N</td>
</tr>
<tr>
<td>D</td>
<td>94°15'0.00&quot;E</td>
<td>26°44'0.00&quot;N</td>
</tr>
</tbody>
</table>
2.0 **PROJECT DESCRIPTION**

The Block AA-ONN-2009/4 is geologically located in the vicinity of already proven fields in Assam Plains and Belt of Schuppen, with major oil fields like Lakwa, Geleki, Rudrasagar, Amguri in east and Borhola-Champang and Khoraghat fields in south-west having established Miocene-Oligocene-Eocene (Tipam-Barail-Tura) hydrocarbon system.

Project activity involves

- ✓ Well site preparation, construction of access roads,
- ✓ Well drilling and testing,
- ✓ Site closure and decommissioning of wells not indicative of potential hydrocarbon reserves.

The other details are described in brief as per given hereunder:

i) **Well kick situation**

While drilling, if the formation pressure exceeds the hydrostatic pressure exerted by the drilling fluid, formation fluids break out into the well bore.

ii) **Blowout**

Uncontrolled “well control situation” eventually leads to a blowout. Blow out can cause a partial or total destruction of drilling rig. Blowouts are often associated with hydrocarbon spill followed by fire.

iii) **Well control**

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.

- **Drilling Fluids (Mud)**

If the drill bit penetrates a formation containing oil, gas or water under pressure, drilling mud 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 API standard specifications. Water Based Mud (WBM) will be used for all the wells considering environmental constraints and hazards.
Drill Cutting

The drill cuttings, cut by the bit, shall be removed from the mud by the shale shakers and centrifuges and transferred to the mud tank. Once the mud shall be cleaned, it is pumped down the drill string again.

i) Drill-stem testing

If the geologist detects the presence of oil or gas in the drill cuttings, a drill-stem test is frequently performed to evaluate the formation or zone from which the oil show was observed.

ii) Surface Testing & Flaring

In case hydrocarbons are detected in the well, the quantity and quality will be tested. The fluids & gases coming out from the well will be flared.

iii) Well logging

Drilling operations continue until the predetermined total depth of the well is reached. The drill string is removed from the well bore to allow the insertion of logging tools, which are lowered all the way to the bottom of the hole by means of a special cable.

iv) Completing the well

When drill-stem testing and well-logging operations have been completed and the results have been analyzed, the company management must decide whether to complete the well as a producing well or to plug it as a dry hole.

v) Restoration of Cutting Containment Area

At the conclusion of well testing at each drilling site, solar drying will dewater the waste pits. All residual solids and liner will be covered with thick column of native soil. The cutting mud is inert and with HDPE (High Density Poly-Ethylene) linings of the pit in place.

2.1 PROJECT COST AND IMPLEMENTATION DETAILS

The proposed exploratory drilling period is expected to be about 60 Days and testing period of 30 days.

The estimated cost of the project is 43.2 Million USD (~272 crores).

2.2 UTILITIES

Water Requirements and Source: The water requirement for the survey team and the domestic needs of the temporary residential camp will be to the order of around 10 kilolitres per day (KLD).
**Power Requirement:** There will be four (04) Dg Sets of capacity 1200 KVA each installed at the rig while one (01) DG set of 100 KVA for the campsite. At any point of time three DG set of 100 KVA will be operational and one will be kept as standby.

**Waste Disposal:** Conduits will be laid to collect wastewater from kitchens, toilets, bathing and washing areas. Wastewater from toilets shall be sent to soak pit after passing through Septic tank while same from other sources shall be sent to soak pit for final disposal.

### 3.0 Description of Environment

The proposed activities shall be confined to block only which has a total area of 84 Km2. The environmental monitoring was carried out for ambient air quality, water quality, soil and sediments quality, noise levels, traffic density and meteorology. No Reserved Forest, Protected forest and Wildlife Sanctuary/ National Park are present within the Block area. Holongapar Gibbon WL sanctuary is about 8 km South east and 3km from the block boundary.

### 3.1 Baseline Environmental Conditions

Baseline environmental studies for various environmental attributes were carried out during the months, from February 2015 to May 2015 covering summer season.

#### 3.1.1 Ambient Air Quality

The ambient air quality monitoring for PM10, Sulphur Dioxide, Nitrogen Dioxide, Benzene, Toluene, Ethylbenzene, p-Xylene, o-Xylene, Methane, Ethane, Propane, n-Butane, iso-Butane, Pentane were carried out at 8 locations in order to assess the present air quality of the study area and its conformity to standards specified by MoEF&CC. Monitoring was conducted at a frequency of twice a week at each station for 24 hours for three months. The baseline air quality found to be as follows;

Out of the eight (08) locations within the study area, maximum concentration for PM10 of 58.2 µg/m³ was recorded at Dhekiakhowa Namghar. The minimum concentration of 17.2 µg/m³ was recorded at Bhakat Gaon. Concentration of SO2 was found to be below the detection limits in all locations and NOx varied from 8.9 to 27.9 µg/m³. Maximum concentrations for NOx were recorded as 27.9 µg/m³ at Meleng Grant and minimum concentration of 8.9 µg/m³ was recorded at Dhekiakhowa Namghar. The VOCs (Benzene, Toluene, Ethylbenzene, p-Xylene, o-Xylene, Methane, Ethane, Propane, n-Butane, iso-Butane, Pentane) of all the location is not detected.
3.1.2 Noise Level

Ambient noise monitoring was carried at residential zone of 8 locations surrounding the plant site. Monitored noise level in residential areas reveal that the daytime equivalent sound pressure level (Leqday) varied between 40.0 (Norahiloidari) and 62.0 dBA (Dhekuakhowa Namghar) while the equivalent sound pressure level during night (Leqnight) varied from 37 (Norahiloidari) to 58.0 dBA (Dhekuakhowa Namghar).

3.1.3 Water Quality

To assess the water quality within the study area, total 15 water samples were collected, out of which 7 are from surface water & 8 ground water samples and analysed for the physicochemical parameters and compared with IS: 10500 (Indian Standards/Specifications for Drinking Water), to evaluate their suitability for drinking purpose in absence of main source.

The groundwater quality of the study area conforms to the IS 10500:2012 standards for Drinking Water Quality at almost all locations.

The surface water quality of the study area conforms to the Class E as recommended by CPCB at almost all locations.

3.1.4 Soil Quality

The analysis of soil quality was carried out to assess the existing soil quality status by collecting grab soil samples from 8 locations including the block area. The soil texture are mostly sandy loam to silty and clay-loam in texture and contain large percentage of Sand and clay and hence possess low water holding capacity. All the soil samples found to be rich in Nutrient content. The Organic Carbon content in the study area observed as 0.02 % to 0.05 %.

3.1.5 Ecology & Biodiversity

No forest areas (reserved and protected) exist within the block area. Holongapar Gibbon WL sanctuary is about 8 km South east and 3km from the block boundary. The tree species recorded in the plantation area were Mangifera indica, Azadirachta indica, Cocos nucifera, Acacia nilotica, Acacia auriculiformis, Bombax malabaricum, Butea monosperma etc. No rare and endangered species were found within the study area. It is observed that Tree community has higher diversity. While the shrub community shows less diversity but more evenness than of herbaceous community. It is also observed that most of the quadrates have controlled generation of plant species with older strands. Higher tree species diversity can be interpreted as a greater number of successful species and a more stable ecosystem.
where more ecological niches are available and the environment is less likely to be hostile, environmental change is less likely to be damaging to the ecosystem as a whole. The study area is marked with moderate population of flora and fauna. Rhesus Monkey, Common Indian Mongoose, Large Indian squirrel, Large Malay squirrel, Indian rabbit, Common five Stripped Squirrel was observed during primary survey. Total of 58 species of avifauna were identified and recorded from the entire block area and surrounding area.

3.1.6 Baseline socio-economic conditions

The study area from centre of block covers total 59 rural villages and two census town i.e. Jorhat and Chekonidhara from East Jorhat and Central Jorhat development block of Jorhat district. These development blocks are the part of Teok revenue circle. Total population in the study area is 163943; out of which about 117055 people (from 27127 households) lie within core zone while 46888 people (from 10451 households) resides within buffer zone. The scheduled caste population core and buffer zone is nearly same i.e. 7.0% and 7.3% respectively. The scheduled tribe population was found to be insignificant. Sex ratio in the study area is 946 females per 1000 male, which is below sex ratio of Johat district (Rural) and Assam state (Rural) i.e. 968 and 960 females per thousand males and similar with national average (940) as per the latest reports of Census Directorate 2011. The literacy rate in core and buffer zone is 91.6% and 90.3% respectively, which is higher than average literacy rate of Jorhat district (rural) i.e. 80% as well as that of Assam state (rural) i.e., 69.3%. This trend is same for gender wise literacy as well.

4.0 Anticipated environmental impact and management plan

The proposed project activity will have impact on soil, water resources & water quality, ambient air quality, noise, ecology and socio-economic environment in surrounding area due to the generation, handling and disposal of stack emissions, liquid effluents and solid wastes during construction as well as operation phase and various related industrial activities.

4.1 Impact assessment

The impact assessment is given in below Table 3.
### Table 3: Environmental Impacts from Exploratory Drilling Operation

<table>
<thead>
<tr>
<th>Source</th>
<th>Potential impact</th>
<th>Component affected</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roads</td>
<td>Access</td>
<td>H/At/B/Aq/T</td>
<td>Vegetation cleared, possible erosion and changes in surface hydrology; emissions, vibration and (onshore) noise from earth moving equipment; disturbance to local population. Secondary impacts related to influx and settlement through new access routes. Mainly short-term, transient impacts. Potential long-term impacts from access construction.</td>
</tr>
<tr>
<td>Site preparation</td>
<td>Footprint</td>
<td>H/At/B/Aq/T</td>
<td>Requirement for proper site selection to minimize possible impact. Removal of vegetation and topsoil; possible erosion and changes in surface hydrology; drainage and soil contamination; land use conflict; loss of habitat; construction noise, vibration and emissions from vehicles; disturbance to local population, aesthetic visual intrusion. Short term provided adequate decommissioning and rehabilitation.</td>
</tr>
<tr>
<td>Camp and operations</td>
<td>Discharge, Emissions, Waste</td>
<td>H/At/B/Aq/T</td>
<td>Water supply requirements; noise, vibration and emissions from plant equipment and transport; extraneous light; liquid discharges—muds and cuttings; wash water; drainage; soil contamination—mud pits, spillages, leakages; solid waste disposal; sanitary waste disposal, sewage, camp grey water; emissions and discharges from well test operations; additional noise and light from burning/flare. Nature: Short-term, transient. Land-use conflicts, disturbance and interference to local population, special considerations required for native and indigenous population; interactions between workforce and local population; immigration; potential effects on local infrastructure—employment, education, roads, services; hunting, fishing, poaching. Nature: Short-term, transient.</td>
</tr>
<tr>
<td>Decommissioning and aftercare</td>
<td>Footprint</td>
<td>H/B/Aq/T</td>
<td>Proper controls during construction and Operations and careful decommissioning and aftercare should effectively remove risk of long term impacts. Improper controls can result in soil and water contamination; erosion and changes in surface hydrology; wildlife disturbance; loss of habitat; impacts to biodiversity; human and cultural disturbance; secondary impacts to socio-economic infrastructure, immigration, changes in land and resource use.</td>
</tr>
</tbody>
</table>

H- Human, socio-economic, culture; Aq-Aquatic; B- Biosphere; T- Terrestrial; At- Atmospheric
5.0 **RISK ANALYSIS**

**MINOR OIL SPILL**

A minor oil spill is confined within the well plinth area. The conditions which can result in minor oil spill are as follows:

- Diesel Fuel Storage System: Oil spillage from tanker unloading, leaking valves, lines and storage tank.
- Exploration or Testing Well Site: Drill stem testing leading to an oil spillage from lines, valves, separator and tank failure.

**MAJOR OIL SPILL**

Significant hydrocarbon inventories are not maintained at a well drilling site. A major spill can, therefore, only arise as a result of an uncontrolled flow from a well either during drilling resulting from a failure of the surface equipment.

**BLOWOUT**

Blowout means uncontrolled violent escape of hydrocarbon fluids from a well. Blowout followed by ignition, which prevents access to the wellhead is a major hazard.

**OTHER HAZARDS AT DRILLING RIG OPERATIONS**

- Setting up the substructure
- Hazards during setting up the Rig floor and Mast or Derrick
- Hazards in Rigging up the Circulation system
- Hazards during installing the Auxiliary equipments.

6.0 **CONSEQUENCE ANALYSIS**

The consequence of igniting a hydrocarbon release during blowout depends on the type of material released, the mass release rate, the timing of the ignition, and the environment into which the hydrocarbon is released. Briefly, typical outcomes are:

- Jet fires: produced by an ignited jet of gas or liquid spray released under pressure;
- Pool fires: produced by ignition of a liquid release that accumulates on the surface and ignites;
- Flash fires: produced by igniting a gas cloud so that a fire propagates through the gas cloud (without generating a significant overpressure);
- Explosions: produced by igniting a gas cloud in conditions where the resultant accelerating flame front produces a significant overpressure.
7.0 **Risk Mitigation To Control Hazards**

- **BLOWOUT**
  - A pit level indicator registering increase or reduction in the drilling mud volume and shall include a visual and audio –warning device near the driller stand.
  - A device to accurately measure the volume of mud required to keep the well filled at all times.
  - A gas detector or explosimeter at the primary shale shaker and connected to audible or visual alarm near the driller stand.
  - A device to ensure filling of well with mud when the string is being pulled out.
  - A control device near driller stand to close the mud pump when well kicks.
  - Blowout prevention drill shall be carried out once every week near the well during drilling.
  - Suitable control valves shall be kept available near the well which can be used in case of emergency to control the well.
  - When running in or pulling out tubing, gate valve and tubing hanger shall be pre-assembled and kept readily available at the well.

- **CONTROL MEASURES FOR H2S DURING DRILLING**

**H2S Detection System:** A four channels H2S gas detection system should be provided. Sensors should be positioned at optimum points for detection, actual locations being decided on site but likely to be:
  - Well Nipple
  - Rig Floor
  - Shaker header tank
  - Substructure cellar

- **SAFETY SYSTEM FOR DRILLING RIGS**

  - Twin stop safety device (crown-o-matic and floor-o-matic)
  - Fall prevention device on mast ladder with safety belt.
  - Emergency Escape device for top man.
  - First aid box with Stretcher and Blanket.
  - Fire bell /siren.
  - Emergency vehicle.
  - Fire extinguishers
  - Flame proof portable hand lamp /safety torch
  - Railling with toe board
  - Guards on all moving parts.
Breathing apparatus (wherever required)
Gas detector for hydrocarbon gas & H2S gas (if required)
Safety lines for power tongs
Rotary brake
Hoisting brake lever with safety chain
Emergency shutoff system for draw works
Safety chain for inclined ramp (To prevent fall of any person)
Safety belt for top-man with lane yard
Railing on stair case at mud tank/walkways and derrick floor

8.0 ENVIRONMENTAL MONITORING PROGRAM

Prior to exploratory drilling of Seven (07) wells, the following aspects shall be identified and information used in consultation with the relevant parties (e.g., Administrative authorities, Department of Archaeological Survey, Divisional & local Forest and Irrigation Departments, and all concerned State government agencies) for logistical and planning purposes with respect to affected area.

- Ecological details;
- Land use pattern;
- Details of land ownership;
- Details of habitat and other infrastructure;
- Pollution and waste management;
- Safe working practices;
- Rehabilitation (when applicable);
- Employment;
- Compensation; and
- Cultural heritage

9.0 ENVIRONMENTAL MANAGEMENT PLAN (EMP)

<table>
<thead>
<tr>
<th>Sl.No</th>
<th>Component</th>
<th>Mitigation measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Land Use</td>
<td>• Consult local authorities and other stakeholders regarding preferred location for drilling sites, camps and access/maximize use of existing infrastructure.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Where possible use existing road/water infrastructure.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• All necessary protocols shall be followed and legal requirements shall be implemented with respect to local regulation pertaining to use of land;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Mark out the site boundaries to ensure that land taken is restricted to pre-agreed area;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Minimize the disturbance of vegetation present in and around</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td><strong>area proposed to be used, if any;</strong></td>
<td><strong>Minimum utilization of land and clearing of site;</strong></td>
<td><strong>In-house audit before and after exploratory drilling: etc</strong></td>
</tr>
<tr>
<td><strong>2 Ecology</strong></td>
<td><strong>Siting to minimize impacts on water resources, conservation interests, settlement, agriculture, sites of historical and archaeological interest and landscape. Consider using site that has been cleared/disturbed previously or of low ecological value, or which may be more easily restored, e.g., agricultural land;</strong></td>
<td><strong>Choose site to encourage natural rehabilitation by indigenous flora/avoid removal of vegetation and topsoil/preserve topsoil, and seed source for decommissioning.</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Mark out site boundaries;</strong></td>
<td><strong>Avoid uprooting vegetation to the possible extent;</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Take account of topography, natural drainage and site runoff. Ensure adequate and proper drainage.</strong></td>
<td><strong>Ensure proper handling and storage of fuels and hazardous materials</strong></td>
</tr>
<tr>
<td></td>
<td><strong>For cleared areas, retain top soil in stockpile where possible on boundary of drilling site for subsequent re-spreading onsite during restoration;</strong></td>
<td><strong>For cleared areas, retain top soil in stockpile where possible on boundary of drilling site for subsequent re-spreading onsite during restoration;</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Retain vegetation on edge of site to serve as seed bank for future site re-vegetation during restoration;</strong></td>
<td><strong>Retain vegetation on edge of site to serve as seed bank for future site re-vegetation during restoration;</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Minimize cleared area and size of site/maximize perimeter to area ratio to aid natural re-vegetation.</strong></td>
<td><strong>Minimize cleared area and size of site/maximize perimeter to area ratio to aid natural re-vegetation.</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Use hand cutting to clear vegetation initially—where necessary be selective in using machinery.</strong></td>
<td><strong>Use hand cutting to clear vegetation initially—where necessary be selective in using machinery.</strong></td>
</tr>
<tr>
<td></td>
<td><strong>All bulldozer operators involved in site preparation shall be trained to observe the defined site boundaries;</strong></td>
<td><strong>All bulldozer operators involved in site preparation shall be trained to observe the defined site boundaries;</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Kerosene oil/LPG shall be used for domestic purpose;</strong></td>
<td><strong>Kerosene oil/LPG shall be used for domestic purpose;</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Distance in case of test flaring as suggested in Chapter-6 shall be maintained;</strong></td>
<td><strong>Distance in case of test flaring as suggested in Chapter-6 shall be maintained;</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Initially land shall be taken on temporary basis and shall be returned back to owner after restoration, in case no economic findings of petroleum hydrocarbons otherwise shall be acquired for development and production activities;</strong></td>
<td><strong>Initially land shall be taken on temporary basis and shall be returned back to owner after restoration, in case no economic findings of petroleum hydrocarbons otherwise shall be acquired for development and production activities;</strong></td>
</tr>
<tr>
<td></td>
<td><strong>In-house audit before and after exploratory drilling operation: etc</strong></td>
<td><strong>In-house audit before and after exploratory drilling operation: etc</strong></td>
</tr>
<tr>
<td><strong>3 Water Resources</strong></td>
<td><strong>Siting to minimize impacts on water resources;</strong></td>
<td><strong>Siting to minimize impacts on water resources;</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Avoid areas prone to flooding;</strong></td>
<td><strong>Avoid areas prone to flooding;</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Where water courses and aquifers are deemed sensitive, consider a fully sealed site, avoid use of mud pits, preferentially use steel tanks, but if used must be lined. Pits if used must be lined;</strong></td>
<td><strong>Where water courses and aquifers are deemed sensitive, consider a fully sealed site, avoid use of mud pits, preferentially use steel tanks, but if used must be lined. Pits if used must be lined;</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Consider aquifer protection and proper plugging;</strong></td>
<td><strong>Consider aquifer protection and proper plugging;</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Adequate water supply arrangement shall be made at drilling site and camp site;</strong></td>
<td><strong>Adequate water supply arrangement shall be made at drilling site and camp site;</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Continuous attempt shall be made to avoid wastage and leakage of water;</strong></td>
<td><strong>Continuous attempt shall be made to avoid wastage and leakage of water;</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Continuous attempt shall be made to optimize/reduce the use of water;</strong></td>
<td><strong>Continuous attempt shall be made to optimize/reduce the use of water;</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Drilling shall not be carried out during monsoon season;</strong></td>
<td><strong>Drilling shall not be carried out during monsoon season;</strong></td>
</tr>
<tr>
<td></td>
<td><strong>If an aquifer is breached, the drilling crew can cement the hole to prevent leakage.</strong></td>
<td><strong>If an aquifer is breached, the drilling crew can cement the hole to prevent leakage.</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
</tbody>
</table>
| 4 | Air Emissions (Dust and gaseous emission) | • Toilets and bathrooms on temporary basis shall be provided at camp site; and  
  • In-house audit before and after exploratory drilling: etc  
  • Emission from flaring of petroleum hydrocarbons, DG sets and other machinery shall confirm the standards as prescribed;  
  • Well testing (flaring) to be undertaken so as to minimize impacts of emissions:  
  • duration of testing minimized by careful planning; and  
  • high combustion efficiency, smokeless flare/burner to be used  
  • Any dry, dusty materials (chemicals, construction materials etc) shall be stored in sealed containers and fenced storage yard;  
  • Detectors for CH4 and H2S shall be placed at adequate locations;  
  • Arrangement of water spray at drilling site and access road to the possible extent shall be made;  
  • Preventive maintenance of vehicles and machinery;  
  • Regular testing of the combustion efficiency of the vehicles/machinery; |
| 5 | Noise and Vibration | • Selection of low noise generating machinery/equipment;  
  • Engineering specifications for machinery/equipment shall be stipulated during tendering as a condition for contractor to maintain noise level not more than 85 dB(A) at 1 m from each source;  
  • Provision of rubber padding/noise isolators/silencers to modulate the noise generated by machinery/equipment, wherever possible;  
  • Use experienced and skilled personnel;  
  • Train personnel of standard operating procedures for handling and shooting of explosives;  
  • The high noise zones within ROW shall be demarcated and temporary enclosures & barriers, if required shall be provided;  
  • Provision of protective devices like ear muff/ plugs to the workers;  
  • Preventive maintenance of machinery/equipment and vehicles;  
  • All employees shall be encouraged to cooperate in using agreed safe work practices;  
  • Information on noise, the risks of exposure to noise and the appropriate control measures shall be disseminated in a manner appropriate to the workplace;  
  • All employees shall receive appropriate training and education as and when required;  
  • In no case, workers shall be exposed more than 85 dB (A) at 1m from source;  
  • Regular monitoring and In-house audit as per details given in this chapter; etc. |
| 6 | Soil and Solid wastes | Soil Erosion  
  • Minimize area and extent of site clearance, by staying within defined boundaries;  
  • Stockpile of topsoil wherever possible at the edge of site;  
  • Limit erosion potential/avoid steep slope and drainage courses/avoid cut and fill techniques/incorporate proper drainage, culverting and bridging techniques; |
- Avoid removing undergrowth where possible so as to retain land stability;

**Fuel, Lubricants and Chemical Management**
- All fuels, lubricants, surface treatment materials, welding rods/gases, chemicals etc to be placed in controlled storage i.e. properly fenced area and in clearly marked vessels and containers;
- Storage and liquid impoundment areas for fuels, construction materials, solvents, chemicals and waste should be designed with secondary containment (e.g., dykes and berms) to prevent spills and the contamination of soil, groundwater, and surface waters;
- Impervious liners shall be in place for fuel, lubricants and chemicals storage area;
- Impervious liners shall be in place for pits for storage of drill cutting and mud;
- Effective bunds capable of containing 110% of the volume of the largest container within and enclosing all potentially contaminating materials to be used for fuel lubricants and chemicals storage area;
- Non-contaminated and potentially contaminated run-off shall be kept separate. Non-contaminated run-off will be routed to off-site areas via silt traps. Potentially contaminated surface run-off shall be routed through oil traps.
- In-house audit shall be carried out before and after exploratory drilling operation.

### 7 Employment and Socio Economic
- Preference shall be given to locals for temporary direct and indirect employment;
- Local employment (unskilled) should be provided in a manner, giving fair representation to all section;
- Where ever local skilled labour is available, should be preferred to be hired for the respective job;
- Local suppliers for machineries and construction materials shall be given preference;
- Local transporters shall be preferred for transportation of machinery/materials.
- Close monitoring on the type of loss to local habitats, if any. In case of any loss to locals, adequate compensation shall be provided as per the law or on mutually agreed terms;
- Third part audit after completion of activities;

### 8 Occupational Health & Safety
- Due care shall be taken to maintain continuous water supply in the water spraying system and all efforts would be made to suppress the dust generated during drilling operation to the possible extent;
- Any worker found to develop symptoms of dust related diseases will be changed over to other activities in cleaner areas;
- General Safety Measures
- Employees shall be provided with helmets, safety boots, eye and ear protection, and snug fitting gloves as appropriate;
- Masks and dust-proof clothing shall be provided to personnel; and
<table>
<thead>
<tr>
<th>9</th>
<th>House keeping</th>
</tr>
</thead>
<tbody>
<tr>
<td>• The facilities should be kept clean, maintained, and operated in a safe and environmentally sound manner;</td>
<td></td>
</tr>
<tr>
<td>• Facilities should be cordoned off in a manner to prevent access to the facility by the general public, livestock, where appropriate.</td>
<td></td>
</tr>
<tr>
<td>• Signs should be posted in conspicuous locations to notify employees and the public of any dangerous situations such as, flammable conditions, high voltage, and toxic.</td>
<td></td>
</tr>
<tr>
<td>• All equipment should be painted and/or kept clean to present an acceptable appearance and to provide protection from external corrosion.</td>
<td></td>
</tr>
<tr>
<td>• Waste receptacles should be provided at appropriate locations for collecting discarded paper, rags, etc. and emptied on a regular basis.</td>
<td></td>
</tr>
</tbody>
</table>