BEFORE THE NATIONAL GREEN TRIBUNAL

EASTERN ZONE BENCH AT KOLKATA

APPEAL NO. 04/2020/EZ

IN THE MATTER OF :

BIMAL GOGOI & ANR.

Vs

UNION OF INDIA & ORS.

INDEX OF PAPERS

(VOLUMNE – I)

Sl. No.	Particulars	Pages
1.	Affidavit/Report by the Assam State Pollution Control Board (respondent no.3)	1-10
2.	**Annexure-A**- Copy of the order dated 20th July, 2020 passed by the Hon'ble National Green Tribunal.	11– 14
3.	**Annexure-B**- Copy of the order dated 13th August, 2020 passed by the Hon'ble National Green Tribunal.	15–17
4.	**Annexure-C**- Copies of the Public Hearing Notice dated 21st November, 2019, in English and Local Language, the letter dated 20th December, 2019, from RO, Dibrugarh, PCBA, the Postponement Notice, bearing No. WB/T-204/19-20/59 dated 23rd December, 2019, the newspaper publications on 24th December, 2019, the letter dated 7th February, 2020, from RO, Dibrugarh, PCBA, the Public Hearing Notice in Assamese and English language, dated 10th February, 2020, the Minutes of the Public Hearing and the documents evidencing that the Records of the Public Hearing sent to District Authority.	18–40

5.	**Annexure-D**-Copy of the Draft EIA report and Executive Summary, uploaded in the Website of the Assam State Pollution Control Board.	41– 272

Filed by:-

ASSAM STATE POLLUTION CONTROL BOARD
Through its Member Secretary

Bamunimaidam, Guwahati – 781021, Assam

[Email : membersecretary@pcbassam.org]

FILED BY:

Sri Sushovit Dutt Majumdar

Advocate, High Court Kolkata

Kolkata, Pin – 700 039

DATE -

BEFORE THE NATIONAL GREEN TRIBUNAL

EASTERN ZONE BENCH AT KOLKATA

APPEAL NO. 04/2020/EZ

IN THE MATTER OF :

1. **BIMAL GOGOI** — **APPELLANT NO. 1**
   CHANDMARI, MAJAR ALI
   P.O. GOLAGHAT.
   PIN 785621. DIST GOLAGHAT. ASSAM

2. **MRIDU PABAN PHUKON** — **APPELLANT NO. 2**
   MILAN NAGAR' NAHARKATIA
   P.O. NAHARKATIA
   DIST. DIBRUGARH
   PIN: 786610, ASSAM, INDIA

VERSUS

1. **UNION OF INDIA**
   THROUGH ITS SECRETARY
   MINISTRY OF ENVIRONMENT, FOREST AND CLIMATE CHANGE
   INDIRA PARYAVARAN BHAWAN, JOR BAGH ROAD
   NEW DELHI – 110 003 [EMAIL : SECY.MOEF@NIC.IN]

2. **OIL INDIA LIMITED**
   THROUGH ITS CHAIRMAN CUM MANAGING DIRECTOR
   CORPORATE OFFICE, PLOT NO. 19
   NEAR FILM CITY, SECTOR 16A, NOIDA – 2O1301, UP
   [EMAIL : OILINDIA@OILINDIA.IN]

3. **ASSAM STATE POLLUTION CONTROL BOARD**
   THROUGH ITS MEMBER SECRETARY
   BAMUNIMAIDAM, GUWAHATI – 781021, ASSAM
   [EMAIL : MEMBERSECRETARY@PCBASSAM.ORG]

4. **ASSAM STATE BIODIVERSITY BOARD**
   THROUGH THE MEMBER SECRETARY
   [EMAIL :ASSAMBIOBOARD@GMAIL.COM]
   ARANYA BHAWAN, 2ND FLOOR
   NEAR SRIMANTASANKARADEVAKALASHETRA
   PANJABARI, GUWAHATI – 781037, ASSAM

RESPONDENTS

NOTARY GOVERNMENT OF INDIA
Pinky Baruah
Kamrup
Regd No.-13516
Expiry Date-
6-11-23

AFFIDAVIT/ REPORT ON BEHALF OF THE RESPONDENT NO. 3 ABOVENAMED IN TERMS OF THE ORDERS PASSED BY THE HON'BLE TRIBUNAL

I, Shri Dhwajendra Nath Das, son of Late Balo Ram Das, aged about 59 years, by faith Hindu, by occupation Service, working for gain at Bamunimaidam, Guwahati – 781021, Assam, do hereby solemnly affirm and say as follows:-

1. I am the member secretary of the respondent no. 3 above named. I am acquainted with the facts and circumstances of the case. I am also duly authorised and competent to affirm this affidavit on behalf of the respondent no. 3 above named.

2. It appears from the records that, on or about 28th June, 2020, the appellants herein, filed the instant appeal, being Appeal No. 04/2020/EZ. No copy of the said Appeal, or the orders passed therein, was received by the answering respondent, and therefore, the answering respondent was not aware of the contents of the said Appeal and/or the directions passed by this Hon'ble Tribunal, from time to time, in the said Appeal.

3. However, on or about 18th August, 2020, the answering respondent came to know about the Orders passed by the Hon'ble Tribunal, from a newspaper publication, made in "The Assam Tribune", dated 18th August, 2020, wherefrom the answering respondent became aware of the above proceeding and immediately took steps in the matter, by requesting the

NOTARY GOVERNMENT OF INDIA Pinky Baruah Kamrup Regd No. 13516 Expiry Date- 6-11-23

Learned Advocate for the Appellants ,to serve a copy of the Appeal and the Learned Advocate for the Appellants was kind enough to share the same with the Learned Advocate of the answering respondent, on 21st August, 2020. It is only on that stage the answering respondent became aware of the contents of the instant Appeal and the Orders passed therein, by this Hon'ble Tribunal.

4. From the perusal of the said Appeal and the Orders passed therein, it was revealed that, after hearing the Learned Advocate of the Appellants, on 20th July, 2020, by an Order dated 20th July, 2020, inter alia, the Hon'ble National Green Tribunal, Eastern Zone Bench at Kolkata was pleased to direct the answering respondent, i.e., Assam State Pollution Control Board (State PCB) to submit a report dealing with the specific questions raised by the Appellants, in the said Appeal. A photocopy of the said Order dated 20th July, 2020 is annexed hereto and marked with the letter "A".

5. Further perusal of the said Appeal and the Orders passed therein, also revealed that, since no copy of the said Report was available before the Hon'ble National Green Tribunal, Eastern Zone Bench at Kolkata, at the time of hearing of the said Appeal, on 13th August, 2020, and none appeared for the answering respondent, at the time of the said hearing, despite notice, by an Order dated 13th August, 2020, inter alia, the Chairman and the Member Secretary of the State PCB was directed to be personally present before the Hon'ble National Green Tribunal, Eastern Zone Bench at Kolkata, on the next date of hearing, i.e., 17th September,

NOTARY GOVERNMENT OF INDIA Pinky Baruah Kamrup Regd No.-13516 Expiry Date- 6-11-23

2020. A photocopy of the said Order dated 13th August, 2020 is annexed hereto and marked with the letter "B".

6. This instant affidavit is being filed by the answering respondent, in such circumstances, and in order to comply with the directions of the Hon'ble National Green Tribunal, Eastern Zone Bench at Kolkata, contained in the aforesaid Orders dated 20th July, 2020 and 13th August, 2020. It is needless to mention that, the answering respondent has deepest of respect and regard for this Hon'ble Tribunal and has not violated any Order or direction passed by this Hon'ble Tribunal, at any point of time, willfully and/or knowingly, and the non - compliance of any Order or direction of the Hon'ble Tribunal, if any, was completely unintentional. The laches on the part of the answering respondent were not intentional at all, and the answering respondent undertakes to carry out and/or act in terms of all the orders and/or directions of this Hon'ble Tribunal, which are already passed, or yet to be passed, in this instant proceeding, or any other proceeding, at any point of time, as may be directed by the Hon'ble Tribunal. The answering respondent was not aware of the instant proceeding, till as late as, 18th August, 2020, and only upon becoming aware of the same, the answering respondent acted promptly, and without any delay. Infact, this instant affidavit is being filed at the earliest opportunity, in terms of the directions of the Hon'ble Tribunal, contained in the Order dated 20th July, 2020.

7. It is also relevant to point out that, the Chairman and the answering respondent were willing to be present personally before this Hon'ble

GOVERNMENT OF INDIA
Pinky Baruah
Kamrup
Regd No. 13516
Expiry Date
6-11-23

Tribunal, at the time of hearing, on 17th September, 2020, however, due to COVID-19 pandemic, it will be difficult and risky for the Chairman and Member Secretary of the undersigned to travel from Guwahati to Delhi and hence, by an email dated 31st August, 2020, the Learned Advocate of the answering respondent, and also the answering respondent duly requested the Learned Registrar of the Hon'ble Tribunal, to allow the Chairman and the answering respondent, to appear before the Hon'ble Tribunal through virtual mode, and further requested the Learned Registrar to send online links for the hearing, scheduled on 17th September, 2020, to the Chairman and the answering respondent, alongwith the Learned Advocate of the answering respondent.

8. I shall now deal with the questions raised, by the Appellants, in the said Appeal, being Appeal No. 04/2020/EZ, which, inter alia, doubt the functions of the answering responsibility, in terms of the directions of this Hon'ble Tribunal, contained in the Order darted 20th July, 2020.

9. I state and submit that, in the relevant paragraph of the instant Appeal, it has been sought to allege that, the answering respondent has not conducted any public hearing and no detailed report was given by the answering respondent. In this context, it is my respectful submission that, the Notice for Public Hearing for the project, in question, was duly published on 22nd November, 2019, for conducting Public Hearing on 24th December, 2019, for the proposed Khagorijan, North Hapjan, Tinsukia, Dhola Doomdooma, Pengeree, Jorajan, Naharkatia-Deohal-Bogapani, Nagajan & ERD Baghjan. The first public hearing was initiated on 24th December, 2019, which was

NOTARY GOVERNMENT OF INDIA
Pinky Baruah
Kamrup
Regd No.-13516
Expiry Date-
6-11-23

later postponed to another date, due to prevailing situation at that time (Anti CAA agitation all over the State of Assam). In such circumstances, the proposed Public Hearing, for the above project, had to be postponed in consultation with the district Administration, Tinsukia. Pursuant to such, the Public Hearing date for the abovementioned project was again re-fixed on 12th March, 2020, and the Public Hearing Notice for the same was published on 11th February, 2020, in both English and Assamese Newspaper. Though the said Public Hearing was finally held on 12th March, 2020, at the scheduled time, but no proposal regarding ERD Baghjan, was submitted by the respondent no. 2, i.e., Oil India Limited, Duliajan, in the said Public Hearing, instead, the respondent no. 2 presented the proposals of the followings, except ERD Baghjan, which were duly categorized in the minutes of the Public Hearing :

(a) Khagorijan.

(b) North Hapjan,

(c) Tinsukia,

(d) DholaDoomdoomaPengeree,

(e) Jorajan,

(f) Naharkatia-Deohal-Bogapani. and

(g) Nagajan

NOTARY
Pinky Baruah
Kamrup
Regd No.-13516
Exp. Date-
6.1.23
GOVERNMENT OF INDIA

Immediately after completion of the said Public Hearing, a nation wide lockdown was declared for Covid-19 pandemic and entire department of the answering respondent became standstill. Later on, when the functioning was again started in a limited manner, due to scarcity of stuffs, the records of the Public Hearing, could not be sent to the District Authority, before 8th June, 2020, for public display. Needless to mention

that, the said records could not be sent to the district authority earlier, due to National & State level Lockdown for COVID-19 pandemic. The photocopies of the Public Hearing Notice dated 21st November, 2019, in English and Local Language, the letter dated 20th December, 2019, from RO, Dibrugarh, PCBA, the Postponement Notice, bearing No. WB/T-204/19-20/59 dated 23rd December, 2019, the newspaper publications on 24th December, 2019, the letter dated 7th February, 2020, from RO, Dibrugarh, PCBA,the Public Hearing Notice in Assamese and English language, dated 10th February, 2020, the Minutes of the Public Hearing and the documents evidencing that the Records of the Public Hearing sent to District Authority, are annexed hereto and collectively marked with the letter "C".

10. I also state and submit that, in the relevant paragraph of the instant Appeal, it has been further alleged that, the answering respondent has not uploaded the draft Environment Impact Assessment (EIA) Report on the website of the answering respondent. In this context, it is my respectful submission that, at the time of publishing initial Public Hearing Notice in the news papers, as mentioned above, this answering respondent also uploaded the Draft EIA Report & Executive Summary, in the official Website of the answering respondent. The photocopies of the Draft EIA report and Executive Summary, uploaded in the Website of the Assam State Pollution Control Board, are annexed hereto and marked with the letter "D".

NOTARY Pinky Baruah Kamrup Regd No.-13510 Expiry Date 6-11-23 GOVERNMENT OF INDIA

11. I also state and submit that, in the relevant paragraph of the instant Appeal, it has been further alleged that, the answering respondent has suggested to

exempt the Public Hearing. In this context, it is my respectful submission that, such contention and/or allegation is incorrect and absurd, since, during the Public Hearing conducted on 12th March, 2020, except ERD, Baghjan, presentations were submitted for the various afore stated sites by the respondent no. 2 Oil India Limited, Duliajan. The, respondent no. 2 Oil India Limited, Duliajan, till date has not made any official communication / intimation to this answering respondent, regarding non submission of proposal on ERD Baghjan, in the Public Hearing, held on 12th March, 2020. It is therefore evident that the answering respondent did not and/or could not suggest to exempt the Public Hearing, which was actually held, in terms of the rules and regulations.

12. Moreover, the EIA Notification page 7 III, Stage (3) suggests that :

(a) in case the State Pollution Control Board or the Union territory Pollution Control Committee concerned does not undertake and complete the public hearing within the specified period, and/or does not convey the proceedings of the public hearing within the prescribed period directly to the regulatory authority concerned as above, the regulatory authority shall engage another public agency or authority which is not subordinate to the regulatory authority, to complete the process within a further period of forty five days;

NOTARY Pinky Baruah Kamrup Read Expire GOVERNMENT

(b) If the public agency or authority nominated under the sub paragraph (iii) above reports to the regulatory authority concerned that owing to the local situation, it is not possible to conduct the public hearing in a manner which will enable the views of the concerned local persons to be

freely expressed, it shall report the facts in detail to the concerned regulatory authority, which may, after due consideration of the report and other reliable information that it may have, decide that the public consultation in the case need not include the public hearing.

I crave leave to rely on and refer to the copy of the EIA Notification, at the time of hearing, if necessary, at all. However, evidently, the public hearing was held on 12th March, 2020. It is therefore a difficult imagination that, the answering respondent has suggested to exempt the Public Hearing, when the same answering respondent has held such Public Hearing within the scheduled time period.

13. I also state and submit that, the answering respondent does not have any role or power in granting EC to such projects as per EIA Notification, 2006, except conducting the aforesaid Public Hearing with the help of district Administration, and forwarding the Public Hearing documents to the MoEF & CC. The answering respondent therefore can not be held liable, if there has been any contravention to any of the norms, while proceeding with the project, in question.

14. In the light of the above, I state and submit that, the answering respondent has performed it's duties, in terms of the procedures, mentioned under various relevant rules, and there has been no default on the part of the answering respondent.

NOTARY GOVERNMENT OF INDIA
Pinky Baruah
Kamrup
Regd No.-13516
Expiry Date-
6-11-23

15. I have reserved my statements, only to the questions directed towards the answering respondent. The answering respondent does not and/or can not have any comment and/or clarification, for other respondents, who have been made parties to this instant proceeding. I crave leave to make further submissions on this context, at the time of hearing, if necessary, at all.

16. The statements made in paragraphs 1 to 12 are true to my knowledge and are based on the information, derived from the records, which I believe to be true, and the rest are my respectful submissions before this Learned Tribunal.

NOTARY Pinky Baruah Kamrup Regd No.-13516 Expiry Date-6-11-23 GOVERNMENT OF IN

Dhwjendra Nath Das.
DEPONENT

VERIFICATION

I, the deponent herein above, do hereby verify that the contents of the above affidavit are true and correct to the best of my knowledge and belief, that no part of it is false and nothing material has been concealed therefrom.

Verified at Guwahati on this 7th day of September, 2020.

Serial No. 01
Date 07.08.2020

Dhwjendra Nath Das.
DEPONENT

Solemnly affirmed before me this Da
certify that I read over and explained the
contents to the declarant and that the
declarant seemed perfectly to understand

Identified by

Pinky Da 7/9/2020

Advocate's Clerk

PINKY BARUAH NOTARY Guwahati, Kamrup Regd. No.- 13516 Expiry Date:06-11-2023

Item No. 01

BEFORE THE NATIONAL GREEN TRIBUNAL PRINCIPAL BENCH, NEW DELHI (Through Video Conferencing)

Appeal No. 04/2020/EZ (I.A. No. 34/2020/EZ)

Bimal Gogoi Appellant(s)

Versus

Union of India & Ors.

Respondent(s) Date of hearing: 20.07.2020

CORAM: **HON'BLE MR. JUSTICE S. P. WANGDI, JUDICIAL MEMBER HON'BLE DR. NAGIN NANDA, EXPERT MEMBER**

For Appellant (s): Mr. Ritwick Dutta, Advocate.

ORDER

1. Case taken up by video conference on *Vidyo App.*

I.A. No. 34/2020/EZ

2. This application is for condonation of delay in filing Appeal No. 04/2020/EZ. Upon consideration of the facts and circumstances stated in the Application and upon hearing the learned Counsel for the Appellant, the Application is allowed and the delay is condoned. The Appeal be taken up for consideration.

Appeal No. 04/2020/EZ

3. This Appeal has been directed against Environmental Clearance (EC) dated 11.05.2020 granted in favour of M/s. Oil India Ltd. (OIL) for drilling seven wells for Hydrocarbon exploration. The primary ground raised in assailing the EC is that the MoEF&CC while considering the case for grant for EC did overlooked the fact that OIL had failed to comply with the direction of the Hon'ble Supreme Court issued *vide* order dated 07.09.2017 in I.A. No. 3934 in W.P. (C) No. 202 of 1995[1] requiring the company to carry out Biodiversity Impact Assessment study through the Assam State Biodiversity Board, as drilling operation was being undertaken in the Dibru–Saikhowa National Park; (ii) no public hearing was conducted which was mandatory under the extant law being EIA Notification, 2006 as the requirement of such hearing was exempted merely on the ground that the project proponent had expressed that it could not be possible to conduct one owing to law and order situation. It is further contended that EIA Notification permits exemption on certain grounds on a report submitted by the State PCB. In the present case no such report has been submitted and under the law, the

[1] *T.N. Godavarman Thirumulpad v. Union of India & Ors.*

Environment Assessment Committee (EAC) has no jurisdiction to grant exemption on its own; (iii) the EIA grossly undermines the risk to the project in the EIA report stating that the risk due to “blowout” is “negligible” and has only considered the “blowout” risk applicable to the U.S. and deliberately did not give data from India in general. It also supressed the recent “blowout” of Baghjan well no. 5 which has resulted in massive irreparable injury to the environment and the people of the surrounding villages.

4. There are also other grounds raised but, for the moment we need not enter into those as we are satisfied that the Appellant has been able to make out a case for our consideration on the facts and circumstance set out above.

5. Heard.

6. Issue notice returnable in thirty days.

7. The Appellant to furnish requisites within one week from hence.

8. However, in view of the prevalent situation caused by the pandemic, the Appellant is at liberty to serve notice by e-mail, apart from the formal notice.

9. In the meanwhile, we direct the MoEF&CC and the State PCB to submit a report dealing with the specific questions raised by the Appellant for our consideration before the next date.

10. List on 13.08.2020.

S.P. Wangdi, JM

Dr. Nagin Nanda, EM

20th July, 2020
Appeal No. 04/2020/EZ
avt

Item No. 02

BEFORE THE NATIONAL GREEN TRIBUNAL PRINCIPAL BENCH, NEW DELHI (Through Video Conferencing)

Appeal No. 04/2020/EZ (I.A. No. 34/2020/EZ)

Bimal Gogoi Appellant(s)

Versus

Union of India & Ors. Respondent(s)

Date of hearing: 13.08.2020

CORAM: **HON'BLE MR. JUSTICE S. P. WANGDI, JUDICIAL MEMBER HON'BLE DR. NAGIN NANDA, EXPERT MEMBER**

For Appellant(s): Mr. Ritwick Dutta, Advocate.

For Respondent(s): Mr.Mr. Gora Chand Roy Choudhury, Advocate for Respondent No.1.
Mr. Parthiv K. Goswami, Mr. Rahul Pratap & Mr. Palak Mahajan Advocates for Respondent No. 2.
Mr. Saurabh Sharma and Ms. Meera Gopal, Advocates for Respondent No.3

ORDER

1. Case taken up by video conference on *Vidyo App.*

2. This Appeal has been directed against Environmental Clearance (EC) dated 11.05.2020 granted in favour of M/s. Oil India Ltd. (OIL) for drilling seven wells for Hydrocarbon exploration. The primary ground raised in assailing the EC is that the MoEF&CC while considering the case for grant

for EC had overlooked the fact that OIL had failed to comply with the direction of the Hon'ble Supreme Court issued *vide* order dated 07.09.2017 in I.A. No. 3934 in W.P. (C) No. 202 of 1995[1] requiring the company to carry out Biodiversity Impact Assessment study through the Assam State Biodiversity Board, as drilling operation was being undertaken in the Dibru–Saikhowa National Park; (ii) no public hearing was conducted which was mandatory under the extant law being EIA Notification, 2006 as the requirement of such hearing was exempted merely on the ground that the project proponent had expressed that it could not be possible to conduct one owing to law and order situation. It is further contended that EIA Notification permits exemption on certain grounds on a report submitted by the State PCB. In the present case no such report has been submitted and under the law, the Environment Assessment Committee (EAC) has no jurisdiction to grant exemption on its own; (iii) the EIA grossly undermines the risk to the project in the EIA report stating that the risk due to "blowout" is "negligible" and has only considered the "blowout" risk applicable to the U.S.

and deliberately did not give data from India in general. It

[1] *T.N. Godavarman Thirumulpad v. Union of India & Ors.*

also supressed the recent “blowout” of Baghjan well no. 5 which has resulted in massive irreparable injury to the environment and the people of the surrounding villages.

3. By order dated 20.07.2020, direction was issued to the MoEF&CC and the Assam State Pollution Control Board (State PCB) to submit a report dealing with the specific questions raised by the Appellant for our consideration. Although, Mr. Gora Chand Roy Choudhury, submits that the MoEF&CC has filed the report on 10.08.2020 but it is not before us.

4. Mr. Roy Choudhury, is directed to ensure that the report is filed and placed before us. None appears for the State PCB despite notice.

5. In view of this, we direct the Chairman and the Member Secretary of the State PCB to be personally present before us on the next date.

6. List on 17.09.2020.

S.P. Wangdi, JM

Dr. Nagin Nanda, EM

13th August, 2020
Appeal No. 04/2020/EZ
avt

ANNEXURE C (18)

অসমীয়া প্রতিদিন

সাধাৰণ প্ৰকাশ্য শুনানী বিজ্ঞপ্তি

পৰিবেশ প্ৰভাৱ মূল্যাংকন

ভাৰত চৰকাৰৰ দ্বাৰা ২০০৬ চনৰ ১৪ চেপ্তেম্বৰত জাৰি কৰা পৰিবেশ প্ৰভাৱ মূল্যাংকন অধিসূচনা অনুসাৰি, "প্ৰেচাৰ্ট অইল ইণ্ডিয়া লিমিটেডৰ দ্বাৰা তিনিচুকীয়া জিলাত (খোৱাবিজান, জোৱাজান এলেকা, নাহৰকটিয়া-দেওহাল-বগাপানী-নগাজান, নৰ্থ হাপজান তিনিচুকীয়া ধলা ডুমডুমা পেংগেৰী এলেকা, ইম্ৰাৱডি, বাঘজান) পাইপলাইন স্থাপন, উৎপাদন আৰু ড্ৰিলিঙৰ বাবে নিম্নলিখিত স্থান, তাৰিখ ও সময়ত লোক শুনালীৰ দিন স্থিৰ কৰা হৈছে।

তাৰিখ আৰু সময়	স্থান	খাগবিজান, নৰ্থ হাপজান, তিনিচুকীয়া ধলা ডুমডুমা আৰু ইম্ৰাৱডি, বাঘজান এলেকাৰ বাবে
২৪ ডিচেম্বৰ, ২০১৯ চন, পূৰা ১১.০০ বজাত	পাব্লিক/কমিউনিটি হল, বাঘজান টি.ই., বাঘজান, তিনিচুকীয়া, অসম	
২৭ ডিচেম্বৰ, ২০১৯ চন, পূৰা ১১.০০ বজাত	নৎভাৱনা ক্ষেত্ৰ, বালিজান, ডিগবৈ (বন বিভাগৰ অধীনত)	জোৱাজান, নাহৰকটিয়া-দেওহাল-বগাপানী-নগাজান আৰু পেংগেৰী এলেকাৰ বাবে

এই লোক শুনানিৰ জাননীৰ জৰিয়তে বাইজ, প্ৰতিবেশী আবাসী, বেচৰকাৰী স্বেচ্ছাসেৱী সংস্থা, পৰিবেশ সংৰক্ষণৰ কৰ্মী, প্ৰস্তাৱিত আঁচনিৰ দ্বাৰা সাঙাত্য বিপদ বা ক্ষতি হ'ব পৰা এলেকাৰ নাগৰিক, ওচৰ চুবুৰীয়া, স্থানীয় নিকায়সমূহৰ প্ৰাধিকাৰী আদি সংশ্লিষ্ট সকলো পক্ষকে প্ৰস্তাৱিত আঁচনিৰ দ্বাৰা পৰিবেশৰ ওপৰত পৰিব পৰা সাঙাত্য অশুভ প্ৰভাৱৰ বিষয়ে উপস্থিত থাকি বিবৃতি, পৰামৰ্শ, মতামত, মন্তব্য, অভিযোগ আদি দাড়ি ধৰিবলৈ অনুৰোধ জনোৱা হ'ল। অথবা ভেলে মতামত / পৰামৰ্শ এই জননী প্ৰচাৰৰ এমাহৰ ভিতৰত পৰিবদৰ গুৱাহাটীস্থিত মুখ্য কাৰ্য্যালয়লৈ আগভীয়াকৈ প্ৰেৰণ কৰিব পাৰিব।

যিসকল ইচ্ছুক ব্যক্তি বা প্ৰতিষ্ঠানৰ প্ৰতিনিধিয়ে প্ৰস্তাৱিত প্ৰকল্পৰ বিষয়ে প্ৰস্তুত কৰা পৰিবেশ প্ৰভাৱ মূল্যাংকনৰ বিষয়ে বিতং ভাৱে জানিবলৈ আগ্ৰহ প্ৰকাশ কৰে তেওঁলোকে নিম্নলিখিত স্থানসমূহৰ পৰা পৰিবেশ প্ৰভাৱ মূল্যাংকনৰ বিস্তৃত তথ্য সংগ্ৰহ কৰিব পাৰিব।

(১) জিলা প্ৰশাসনৰ কাৰ্য্যালয়, জিলা-তিনিচুকীয়া, অসম।
(২) জিলা উদ্যোগ কেন্দ্ৰ, জিলা-তিনিচুকীয়া, অসম।
(৩) সভাপতি/ সম্পাদক সংশ্লিষ্ট গাঁও পঞ্চায়ত, যাৰ অধিক্ষেত্ৰৰ অধীনত এলেকাটো পৰে।
(৪) মুখ্য কাৰ্য্যবাহী বিষয়া, জিলা পৰিষদ, জিলা-তিনিচুকীয়া, অসম।
(৫) পৰিবেশ আৰু বন মন্ত্ৰালয়, ভাৰত চৰকাৰৰ আঞ্চলিক কাৰ্য্যালয়, ল-ইট-চিব, লুমবাতজেন, এম.টি.চি. ৰ্কৰ্কচগাঁৱ ওচৰত, চিলং-৭৯৩০২১।
(৬) পৰিবদৰ ডিব্ৰুগড় আঞ্চলিক কাৰ্য্যালয়, অসম।
(৭) পৰিষদৰ মুখ্য কাৰ্য্যালয়, বামুণীমৈদাম, গুৱাহাটী-২১।

প্ৰকল্পৰ ওপৰত প্ৰস্তুত কৰা পৰিবেশ প্ৰভাৱ মূল্যাংকনৰ বিস্তৃত তথ্য পৰিষদৰ নিজা ৱেবচাইট http://www.pcbassam.org ত উপলব্ধ হ'ব।

তাং-২১-১১-২০১৯

স্বাক্ষৰ
সদস্য-সচিব

22.11.2019 (Friday)

(19)

The Assam Tribune

PUBLISHED SIMULTANEOUSLY FROM GUWAHATI & DIBRUGARH

www.assamtribune.com ePaper app for The Assam Tribune Pages 24 Price ₹ 6.00

GUWAHATI, FRIDAY, NOV

POLLUTION CONTROL BOARD, ASSAM

pcba BAMUNIMAIDAM, GUWAHATI-781021

PUBLIC HEARING NOTICE

As per provision of the Government of India's Notification on Environmental Impact Assessment dtd. 14.09.2006, public hearing on Proposed "Drilling, production & Laying of Pipelines in Tinsukia district (Khagorijan, Jorajan area, Naharkotia-Dechal-Bogapani-Nagajan, North Hapjan Tinsukia Dhola Doomdooma Pengree area, ERD, Baghjan) by M/s Oil India Ltd., Duliajan" will be conducted at the following 2 (two) places. The date, time & area covered under the Public Hearing are mentioned below:

Date & Time	Venue	For
24th December, 2019 at 11.00 AM	Public / Community Hall, Baghjan T.E., Baghjan, Tinsukia, Assam,	For Khagorijan, North Hapjan, Tinsukia Dhola Doomdooma & ERD, Baghjan area
27th December, 2019 at 11.00 AM	Sadbhavana Khetra, Saikjan, Digboi (under Forest Deptt.)	For Jorajan, Naharkotia-Dechal-Bogapani-Nagajan & Pengree area

Interested persons of the locality including bonafide residents, environmental activist groups, NGOs within the neighbourhood of the proposed project are hereby requested to attend the aforesaid public hearing on the date, time and venue as stated above for getting their statements, suggestions, comments, views recorded regarding likely environmental impact and mitigation measures if any. Also, they may send their views and opinions within one month from the date of publication of this public hearing notice to the head office of the Board.

To know details of the proposed Project, interested public, groups etc. may go through the Executive Summary of Draft Environmental Impact Assessment (EIA) report and Draft Environmental Impact Assessment (EIA) Report available at the following places:

i) The Deputy Commissioner's Office, Tinsukia district, Assam.
ii) District Industry Center, Tinsukia district, Assam.
iii) President/Secretary of the concerned Gaon Panchayat under whose jurisdiction the proposed site falls.
iv) Chief Executive Officer, Zilla Parishad, Tinsukia district, Assam.
v) Ministry of Environment & Forests, Govt. of India, Regional Office, Law-U-Sib, Lumbathgen, Near MTC Workshop, Shillong-793021.
vi) Regional Office, of the Board at Dibrugarh, Assam.
vii) The Head Office of the Board, Bamunimaidam, Guwahati-21.

The Executive Summary of EIA report and Draft Environmental Impact Assessment (EIA) will also be available in the Board's Website at http://www.pcbassam.org.

Date: 21/11/2019

Sd/-
Member Secretary (I/c)

22.11.2019 (Friday)

pcba

Pollution Control Board:: Assam
Regional Office- Dibrugarh, P.O &Dist- Dibrugarh. Phone No-0373-2325527
E-mail-apcbdibrugarh@gmail.com,ro_dibrugarh@pcbassam.org
Website: www.pcbassam.org

No.RO/DBR/T-4474/19-20/6 Dated Dib,the 20th Dec'2019.

To
The Member Secretary,
Pollution Control Board,Assam,
Bamunimaidam,Ghy-21.

Sub:-Public Hearing.

Sir,

With reference to the above, I have the honour to inform that, the Public Hearing of M/S-OIL,Duliajan for proposed drilling, production, installation of production and pipeline facilities at khagorijan,North Hapjan, Tinsukia, Dhola, Doomdooma-Pengeri, ERD Baghjan,Jorajan, Nahorkatia-deohali-Bogapani & Nagajan have been postponed due to prevailing situation in the entire State in discussion with Tinsukia District administration. Future Date & time will be fixed after discussion with district administration.

The above is for favour of kind information.

Yours faithfully

20/12/19

(H.Pegu)
Regional Executive Engineer(I/C)
Dated Dib,the 20th Dec'2019

MEMO:NO:RO/DBR/T- 4474/19-20/ 6-A
Copy to:The G.M.(HSE), OIL,Duliajan,Dist:Dibrugarh for favour of information.

(H.Pegu)
Regional Executive Engineer(I/C)
DIBRUGARH

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pcba

POLLUTION CONTROL BOARD :: ASSAM
BAMUNIMAIDAM, GUWAHATI-21

POSTPONEMENT NOTICE

No. WB/T-204/19-20/59 Dated Guwahati, the 23rd Dec. 2019

The proposed Public Hearing on "Drilling, production & Laying of Pipelines in Tinsukia district (Khagorijan, Jorajan area, Naharkotia-Deohal-Bogapani-Nagajan, North Hapjan Tinsukia Dhola Doomdooma Pengree area, ERD, Baghjan) by M/s Oil India Ltd., Duliajan" scheduled to be held on 24.12.2019 and 27.12.2019 respectively, has been postponed due to prevailing situation in the State.

Fresh date for the same will be notified later on.

Member-Secretary (i/c)
Dated Guwahati, the 23rd Dec. 2019

Memo No. WB/T-204/19-20/59-A

Copy to :

1. The Deputy Commissioner, Tinsukia district, Assam for kind information.
2. PA to the Chairman, PCBA for kind appraisal of the Hon'ble Chairman.
3. The Chief General Manager (HSE), M/s Oil India Limited, Duliajan, Assam-786602 for kind information.
4. The District Industry Center, Tinsukia district, Assam for information.
5. President/Secretary of the concerned Gaon Panchayat under whose jurisdiction the proposed site falls for information.
6. The Chief Executive Officer, Zilla Parishad, Tinsukia district, Assam for information.
7. The Ministry of Environment & Forests, Govt. of India, Regional Office, Law-U-Sib, Lumbatngen, Near MTC Workshop, Shillong-793021 for information.
8. The HoIT, IT Section, Head Office, PCBA for information & requested to mail the notice to M/s. APS Advertising Pvt. Ltd. for publishing in tomorrows newspaper.
9. The Regional Executive Engineer (i/c) Regional Office, Dibrugarh, PCBA for information & necessary action.
10. M/s. APS Advertising Pvt. Ltd., Guwahati-1 for information. They are requested to publish the **'POSTPONEMENT NOTICE'** in the "The Assam Tribune" & "Axomia Pratidin", in all editions immediately (in minimum font size) on 24.12.2019 and submit the bill for necessary payment.

Member-Secretary (i/c)

The Assam Tribune

PUBLISHED SIMULTANEOUSLY FROM GUWAHATI & DIBRUGARH

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POLLUTION CONTROL BOARD, ASSAM

BAMUNIMAIDAM, GUWAHATI - 781021

No. WB/T-204/19-20/59 Dated Guwahati, the 23rd Dec, 2019

POSTPONEMENT NOTICE

The proposed Public Hearing on "Drilling, production & Laying of Pipelines in Tinsukia district (Khagorijan, Jorajan area, Naharkotia-Deohal-Bogapani-Nagajan, North Hapjan Tinsukia Dhola Doomdooma Pengree area, ERD, Baghjan) by M/s Oil India Ltd., Duliajan" scheduled to be held on 24-12-2019 and 27-12-2019 respectively, has been postponed due to prevailing situation in the State.

Fresh date for the same will be notified later on.

Sd/-
Member-Secretary (i/c)

24/12/2019

Pollution Control Board:: Assam
Regional Office- Dibrugarh, P.O & Dist- Dibrugarh, Phone No-0373-2325577
E-mail-apcbdibrugarh@gmail.com,ro_dibrugarh@pcbassam.org
Website: www.pcbassam.org

No.RO/DBR/T-4474/19-20/07

Dated Dibrugarh, the 07th Feb'2020

To,

The Member Secretary,
Pollution Control Board Assam,
Bamunimaidam,Guwahati-21.

Sub: Public Hearing of M/s OIL

Ref: This office letter No RO/DBR/T-4474/19-20/06 dtd 20.12.2019

Sir,

With reference to the above, I have the honour to inform that, the Public hearing of M/s OIL, Duliajan for proposed drilling/production, Production Installations & pipeline facilities at Khagorijan, North Hapjan,Tinsukia, Dhola, Doomdooma-Pengeri, ERD Baghjan, Jorajan, Naharkotia-Deohall-Bogapani & Nagajan have been re-fixed on 12th & 13th March'2020 in discussion with Tinsukia district Administration. The venue & time of the public hearing will remain the same.

Forwarded for favour of kind necessary action.

VENUE	Public/Community Hall,Baghjan T.E., Baghjan, Tinsukia, Assam	Sambhawana Khetra,Dibgoi,under Digboi Forest Division(JFMC),Assam
DATE	12-03-2020	13-03-2020
TIME	11:00 A.M.	11:00 A.M

EE (PKD) 7.2.2020

Yours faithfully

7/2/20

(H.Pegu)
Regional Executive Engineer(I/C)
R.O. Dibrugarh

Pollution Control Board, Assam
Receipt No. 7997
Date 10.02.2020
Signature

নির্ভীক সাংবাদিকতার প্রতীক

দৈনিক জনমভূমি

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বামুনীমৈদাম, গুৱাহাটী-২১

লোক শুনানির জাননী

ভাৰত চৰকাৰৰ দ্বাৰা ২০০৬ চনৰ ১৪ চেপ্তেম্বৰত জাৰি কৰা পৰিবেশ প্ৰভাৱ মূল্যাংকন অধিসূচনা অনুসৰি, "মেচাৰ্চ অইল ইণ্ডিয়া লিমিটেড, দুলীয়াজানৰ দ্বাৰা তিনিচুকীয়া জিলাত (খাগৰিজান, জোৱাৰান এলেকা, নাহৰকটিয়া-দেওহাল-বগাপানী-নগাজান, উত্তৰ হাপজান, তিনিচুকীয়া, ধলা, ডুমডুমা, পেটেৰি এলেকা, ইআৰডি, বাঘজান) পাইপলাইনৰ স্থাপন, ড্ৰিলিং আৰু উৎপাদন"ৰ ওপৰত প্ৰস্তাৱিত শুনানিৰ পুনঃনিৰ্দ্ধাৰণ কৰা হৈছে। পূৰ্বৰ জাননীবলৰ দৰেই সামৰি লোৱা এই লোক শুনানিৰ স্থান, সময় আৰু এলেকা একেই থাকিবঃ

তাৰিখ আৰু সময়	স্থান	যাগৰিজান, উত্তৰ হাপজান, তিনিচুকীয়া, ধলা, ডুমডুমা আৰু ইআৰডি, বাঘজান এলেকাৰ বাবে
১২ মাৰ্চ, ২০২০ চন পুৱা ১১.০০ বজাত	বাজহৰা/সামুহিক হল, বাঘজান চাহ বাগিছা, বাঘজান, তিনিচুকীয়া, অসম	
১৩ মাৰ্চ, ২০২০ চন পুৱা ১১.০০ বজাত	সম্ভাৱনা ক্ষেত্ৰ, বালিজান, ডিগবৈ [ডিগবৈ বন সমণ্ডল (জেএকএমচি) অসমৰ অধীনস্থ]	জোৱাৰান, নাহৰকটিয়া-দেওহাল-বগাপানী-নগাজান আৰু পেটেৰি এলেকাৰ বাবে

এই লোক শুনানিৰ জাননীৰ জৰিয়তে আঞ্চলিক আবাসী, পৰিবেশ সংৰক্ষণৰ কৰ্মীদল, প্ৰস্তাৱিত আঁচনিৰ অন্তৰ্ভুক্ত গুচৰ চুবুৰীয়া, হেৰুকাবী স্বেচ্ছাসেৱী সংস্থা, ইচ্ছুক স্থানীয় ব্যক্তিসকলক ইয়াৰদ্বাৰা ওপৰোক্ত তাৰিখ, সময় আৰু স্থানত পৰিবেশৰ ওপৰত পৰিব পৰা সাম্ভাব্য অশুভ প্ৰভাৱ আৰু এইসমূহৰ প্ৰশমনৰ বিষোনো স্বকৃষ্টিলীৰ বাবে আয়োজিত লোক শুনানীৰ হেতু স্বয়ং উপস্থিত থাকি বিবৃতি, পৰামৰ্শ, মতামত, মন্তব্য দাঙি ধৰিবলৈ অনুৰোধ জনোৱা হ'ল। তেওঁলোকে ভেনে মতামত আৰু পৰামৰ্শ এই জাননী প্ৰচাৰৰ এমাহৰ ভিতৰত পৰিষদৰ গুৱাহাটীস্থিত মুখ্য কাৰ্য্যালয়লৈও আগতীয়াকৈ প্ৰেৰণ কৰিব পাৰিব।

যিকোন ব্যক্তি বা প্ৰতিষ্ঠানৰ প্ৰতিনিধিয়ে প্ৰস্তাৱিত প্ৰকল্পৰ বিষয়ে প্ৰস্তুত কৰা পৰিবেশ প্ৰভাৱ মূল্যাংকনৰ বিষয়ে বিতং ভাৱে জানিবলৈ আগ্ৰহ প্ৰকাশ কৰে তেওঁলোকে নিম্নলিখিত স্থানসমূহত উপলব্ধ থকা পৰিবেশ প্ৰভাৱ মূল্যাংকনৰ খচৰাৰ কাৰ্যবাহী সাৰাংশ (ইআইএ)ৰ বিপৰ্চ আৰু পৰিবেশ প্ৰভাৱ মূল্যাংকণ খচৰা (ইআইএ)ৰ বিপৰ্চৰ বিষয়ে বিস্তৃত তথ্য সংগ্ৰহ কৰিব পাৰিবঃ

(১) উপাযুক্তৰ কাৰ্য্যালয়, তিনিচুকীয়া জিলা, অসম।
(২) জিলা উদ্যোগিক কেন্দ্ৰ, তিনিচুকীয়া জিলা, অসম।
(৩) সংশ্লিষ্ট গাঁও সংস্থাসমূহৰ সভাপতি/সম্পাদক। যাৰ অধিক্ষেত্ৰৰ অধীনত প্ৰস্তাৱিত এলেকা পৰিব।
(৪) মুখ্য কাৰ্যবাহী বিষয়া, জিলা পৰিষদ, তিনিচুকীয়া জিলা, অসম।
(৫) পৰিবেশ আৰু বন মন্ত্ৰালয়, ভাৰত চৰকাৰৰ আঞ্চলিক কাৰ্য্যালয়, ল-ইউ-চিব, লুমবাতজেন, এম.টি.চি. ৰুক্ষিপৰ ওচৰত, টিলং-৭৯৩০২১।
(৬) ডিব্ৰুগড়, অসমস্থ হিতৰ্ভৰ আঞ্চলিক কাৰ্যালয়।
(৭) পৰিষদৰ মুখ্য কাৰ্য্যালয়, বামুনীমৈদাম, গুৱাহাটী-২১।

ইআইএ বিপৰ্চৰ কাৰ্যবাহী সাৰাংশ আৰু পৰিবেশ প্ৰভাৱ মূল্যাংকন খচৰা (ইআইএ) পৰিষদৰ বেবচাইট http://www.pcbassam.org তো উপলব্ধ হ'ব।

স্বাক্ষৰ
সদস্য সচিব

তাং-১০-০২-২০২০

11.02.2020

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PUBLISHED SIMULTANEOUSLY FROM GUWAHATI & DIBRUGARH

ePaper app for The Assam Tribune Pages 16 Price: ₹ 6.00 GUWAHATI, TUE

9/2018-2020, VOL. 82, NO. 39 www.assamtribune.com

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POLLUTION CONTROL BOARD, ASSAM

BAMUNIMAIDAM, GUWAHATI – 781021

PUBLIC HEARING NOTICE

As per provision of the Government of India's Notification on Environmental Impact Assessment dtd. 14.09.2006, the date for public hearing on Proposed "Drilling, production & laying of Pipeline in Tinsukia district (Khagorijan, Jorajan area, Naharkotia-Deohal-Bogapani-Nagajan, North Hapjan, Tinsukia, Dhola, Doomdooma, Pengree area, ERD, Baghjan) by M/s Oil India Ltd., Duliajan" has been re-fixed as follows. The venue, time & area covered under the Public Hearing remains the same as earlier notice.

Date & Time	Venue	For Khagorijan, North Hapjan, Tinsukia Dhola Doomdooma & ERD, Baghjan area
12th March, 2020 at 11.00 AM	Public/Community Hall, Baghjan T.E., Baghjan, Tinsukia, Assam	
13th March, 2020 at 11.00 AM	Sambhawana Khetra, Balijan, Digboi [under Digboi Forest division (JFMC) Assam]	For Jorajan, Naharkotia-Deohal-Bogapani-Nagajan & Pengree area

Interested persons of the locality including bonafide residents, environmental activist groups, NGOs within the neighbourhood of the proposed project are hereby requested to attend the aforesaid public hearing on the date, time and venue as stated above for getting their statements, suggestions, comments, views recorded regarding likely environmental impact and mitigation measures if any. Also, they may send their views and opinions within one month from the date of publication of this public hearing notice to the head office of the Board.

To know details of the proposed Project, Interested public, groups etc. may go through the Executive Summary of Draft Environmental Impact Assessment (EIA) report and Draft Environmental Impact Assessment (EIA) Report available at the following places.

i) The Deputy Commissioner's Office, Tinsukia district, Assam.
ii) District Industry Centre, Tinsukia district, Assam.
iii) President/Secretary of the concerned Gaon Panchayat under whose jurisdiction the proposed site falls.
iv) Chief Executive Officer, Zilla Parishad, Tinsukia district, Assam.
v) Ministry of Environment & Forests, Govt. of India, Regional Office, Law-U-Sib, Lumbatngen, Near MTC Workshop, Shillong-793021.
vi) Regional Office, of the Board at Dibrugarh, Assam.
vii) The Head Office of the Board, Bamunimaidam, Guwahati-21

The Executive Summary of EIA report and Draft Environmental Impact Assessment (EIA) will also be available in the Board's Website at http://www.pcbassam.org.

Sd/-
Member Secretary

Date: 10.02.2020

11.02.2020

Certified that, this register (containing 88 pages, marked on one side. This register is used for recording the proceedings of Public Hearing held at Public/Community Hall, Bagjan TE Bagjan, Tinsukia, Assam in connection with proposed drilling/ production, production Installation & pipeline facilities at Khagorijan, North Hapjan, Tinsukia, Khola, ERD Bagjan by M/s OIL, Duliajan.

(Proceedings are recorded in English in this register).

1/2/3/20
Executive Engineer
Pollution Control Board, Assam
Regional Office, Dibrugarh

2/3/2020
Deputy Commissioner
Tinsukia

Public Hearing is conducted for proposed drilling of production, Production Installations & pipeline facilities at Khagorijan, North Hajan, Tinsukia, Assam, ARD Baghjan by M/S OIL, Duliajan

Date of Public Hearing — 12/03/2020

Time — 11:00 AM

Venue — Public / Community Hall, Baghjan TE, Baghjan Tinsukia, Assam.

For Public Hearing, Panel Members consist of —

① Mr. Pabitra Kumar Das, ACS, ADC Tinsukia district, Assam

② Mr. Hiren Pegu, REE (I/c), Pollution Control Board Assam RO — Dibrugarh, Assam.

Mr. Pabitra Kumar Das, ACS, ADC Tinsukia District, Assam presided over the Public Hearing assisted by Sri Hiren Pegu REE (I/c) PCBA, RO - Dibrugarh as the representative of the Board.

Mr. Hiren Pegu, REE (I/c), PCBA, RO - Dibrugarh gave a brief introduction about the public Hearing held to-day. He welcomed the representative of the Oil India Limited and the representative of the various organisation and the public present in the hearing. He briefed about the Environmental impact Assessment done by M/S OIL, to the public. Also about the EC Environmental clearance M/S OIL has to achieve for which according to the MoEF guideline today's public Hearing is organised.

12/3/20

12/3/2020

Additional Deputy Commissioner
TINSUKIA

Mr. Sarma in his reply explained the [illegible] measures to reduce the pollution by the Forest and Forest while establishing their projects. He told the people that he is satisfied with various measures mentioned in the the power point presentation about the environment and also measure taken to prevent pollution both of Air and water, and also steps like plantations taken by M/s OIL in abondoned drilling sites.

VIEWS OF THE PUBLIC :

1. Mr. Bitapan Neog, a representative of Maguribeel paribesh Hurakesha Samiti, wanted to know, about the distance one should maintain while drilling a site from a National Park (Forest). He presented few pictures of drilling sites which he doubted to be within the boundary of the Dibru Saikhuwa Maguribeel. He questioned about the pipelines which remain exposed, which often burst and the OIL Authorities would give lame excuses of mere accident. He also has also observed that the piercing noise of drilling site has impact in the t emotion and brain development of the people around. He blamed M/s OIL for not taking developmental project which they often promise during Public Hearing. He Stressed that he and his organisation are not against development but it should not adversely impact the Environment.

2. Mr. Sanjay Tati, a resident of Baghjan Tea Estate, the president of Hapjan block mandal, too is upset about the advertisement and bannering made done by M/s OIL. He said that local people are unaware of the Public Hearing which is to be held today as he said that the bannering done by M/s OIL.

12/2/20
Executive Engineer
Pollution Control Board, Assam
Regional Office Dibrugarh

12/2/2020
Additional Deputy Commissioner
TINSUKIA

in writing but in manner and method will be made available in Pollution Control Board, Assam authorities. He also informed about the CER appeal from CSE, [illegible] for Environmental development. M/s OIL has tied up with ISRO for study in the matter of Bio diversity.

Mr. Tosarajyoti Hazarika wanted M/s OIL to grant the previous promises (to fulfil) and, only then the public will be more cooperative and happy.

Mr. Kabita Kr. Das, ADC, told the public that the Hearing is organised to note down the problems and Complaints of the public. He urged for the cooperation of all parties for the success of this Hearing.

4. Mr. Satyajeet Moran, a representative of Baghjan Milan Jyoti Jeuva Sangha is concerned about the Ecosystem of the Hazari Mora puraj Beel and Dibru Saikhuwa National park. He displayed few photographs of Hazari mora puraj beel's pipeline leaked and others of oilfield are close to Dibru Saikhuwa National forest.

5. Mr. Ajay Tinga, ex-president All Assam Adivasi Student Association is concerned about the destruction of the Tea Trees and other trees by M/s OIL which has not been re-planted and he worried about the serious damage caused by it to the ecosystem. He proposed that Pollution Control Board, Assam to take initiative to plant trees in 100's of hectors barren land around Dibru Saikhuwa national forest. He is concerned about the one-way road, where M/s OIL 10-12 wheeled vehicles, for which public has faced [illegible] of [illegible] harassment. He hoped for Ambulance Services from M/s OIL and also for Students Scholarships for higher education and also Skill development centre.

Executive Director
Pollution Control Board, Assam
Kahilipara, Guwahati-19

Deputy Commissioner

6. Mr. Nirod Ahmed, a local resident has [illegible] about the neglected pollution in the drilling [illegible] wanted M/s OIL to take enough measures to protect the Environment. He talked about the development plans of M/s OIL should undertake and also about a necessity of a Higher Secondary School in these area. He talked about the erosion of the Dangari river, he wanted M/s OIL to Contribute to the solve these problem. He told the Oil Authorities that one of the drilling site falls in Baghjan is one of the most backward region in these area. He wanted M/s OIL to establish one Lower Primary (L.P.) school there. He also felt the necessity of Street light in this area.

7. Tugiag Gowala, AAASA member, urged M/s OIL to Organise any public hearing in Tea Estates on Sundays or Holidays as people couldn't attend during working days. He talked about the roadways in the Tea Garden area, where large vehicles of M/s OIL moves. He wanted M/s OIL to take measure to widen the road. He demanded M/s OIL to replantation programmes to be taken to the damaged Tea plants while installation of pipelines in Tea Estates. He stress that the labours of Estate are the victims of these damages and he said that if the developmental works are not undertaken immediately then a strike would be initiated by Tea Tribe organizations.

8. Mr. Lokesh Nath, AAASA secretary, is concerned about the damaged/uprooted tea plants for installation of pipelines. He urged for a College be established in Baghjan area by M/s OIL. He talked about the air pollution in Gujan area.

9. Mr. Lupen Chutia, Baretuki anchalik Yuva Sangha, gave his gratitude to M/s OIL for their contribution in Baretuki by making roadway and other development. But he urged the Oil Authorities

to preserve the natural vegetation and environment. He stressed that the pipeline installed in Magurbeel should be relocated as he is concerned about the possible leakage of the pipeline and damage the ecosystem of the Magurbeel. He talked about the abandoned oil fields in Barekuri area to be fenced or made boundary walls. He demands for an employment in place of money for land acquisation process in Barekuri area.

10. Mr. Dambaru Chetia, a resident of Barekuri has proposed that M/S OIL should ~~no more extend~~ not take any more extension of oil field in and around Magaribeel Motapung beel as it is an income source for people surrounding it.

11. Mr. Kamal Baruah, a local resident, asked for the help of M/S OIL to get ~~naidi~~ maidi patta karan/registration of their land so that they could get proper compensation for land acquisition done by M/S OIL.

12. Mr. Rajendra Panik, vice president AAASU, complained that M/S OIL has not taken development project in Bizeltarang area. He asked for compensation for the tea plant damaged in the installation of pipelines.

Executive Engineer
Assistant Control Board, Assam
Regional Office, Dibrugarh

Mr. Pabitra Kr. Das, ADC told the public that entire proceedings were Video recorded and noted in writings will be presented to concern authorities from where it will be proceeded for ~~from~~ Environmental Clearance. He wanted the public to give in writings if any, left behind. He wanted M/S OIL to create an environment to co-operate and listen to grievances of the public. He urged M/S OIL to balance between the Environment and Industry (Oil & gas) and never to compromise on the importance of Ecosystem. He urged

13/12/20

M/s Oil to establishment of a Hospital and Fire station Services etc. as these are absolute necessity in these area. He informed about the Governmental project initiated to protect the erosion of Baragaon River. He thanked to the valuable opinion of the public and asked for their Co-operation in the days to come.

12/3/2020
Additional Deputy Commissioner
Nagaon

12/3/20
Executive Engineer
Assam Capital Regd. Assam
Nagaon Office Nagaon

(Type Copy)

Certified that, the register contains 58 pages, marked on one side. This register is used for recording the proceedings of Public Hearing held at Public / Community Hall, Baghjan TE, Baghjan, Tinsukia, Assam in connection with proposed drilling/production, production Installation & pipeline facilities at Khagorijan, North hapjan, Tinsukia, Dhola, ERD Baghjan by M/s OIL, Duliajan.

(proceedings are recorded in English in this register).

Sd/-
Executive Engineer
Pollution Control Board, Assam
Regional Office, Dibrugarh

Sd/-
Addl. Deputy Commissioner (Rev)
Tinsukia

Public Hearing is conducted for proposed drilling / production, production, installation & pipeline at Khagorijan, North Hapjan, Tinsukia, Dhola, ERD Baghjan by M/s OIL, Duliajan.

Date of Public Hearing – 12/03/2020

Time – 11.00 AM

Venue – Public / Community Hall, Baghjan TE, Baghjan, Tinsukia, Assam

For Public Hearing, panel Members consist of –

(1) Mr. Pabitra Kumar Das, ACS, ADC, Tinsukia district, Assam

(2) Mr. Hiren Pegu, REE (I/C), Pollution Control Board, Assam, RO, Dibrugarh, Assam

Mr. Pabitra Kumar Das, ACS, ADC, Tinsukia district, Assam presided over the Public Hearing assisted by Mr. Hiren Pegu, REE (I/C), Pollution Control Board, Assam, RO, Dibrugarh, Assam as the representative of the Board.

Mr. Hiren Pegu, REE (I/C), Pollution Control Board, Assam, RO, Dibrugarh gave a brief introduction about the public hearing held today. He welcomed the representative of the Oil India Limited and the representative of the various organization and the public present in the hearing. He briefed about the Environmental impact Assessment done by M/s OIL, to the public. Also about the Environmental Clearance M/s OIL has to achieve for which according to the MoEF guideline today's public hearing is organised.

Mr. Pabitra Kumar Das, ACS, ADC requested M/s OIL to take enough measures to balance the tranquillity of Environment and Forest while establishing these projects. He told the public that he is satisfied with various measures mentioned in the power point presentation about the environment and also measure taken to prevent pollution both of air and water and also steps like plantations taken by M/s OIL in abandoned drilling sites.

VIEWS OF THE PUBLIC:

1. Mr. Bitupan Neog, a representative of Maguribeel Poribesh Huraksha Samiti wanted to know about the distance one should maintain while drilling a site from a National Park (Forest). He presented few pictures of drilling sites which he doubted to be within the boundary of the Dibru Saikhuwa Maguribeel. He questioned about the pipelines which remain exposed, which after burst and the OIL Authorities would give lane excuses of there accident. He has also observed that the piercing noise at drilling site has impact in the emotion and grain development of

the people around. He blamed M/s OIL for not taking development project which they often promise during Public Hearing. He stressed that he and his organisation are not against development but it should not adversely impact the Environment.

2. Mr. Sanjay Tati, a resident of Baghjan Tea Estate, the president of Hapjan block Mandal is upset about the advertisement and bannering done by M/s OIL. He said that local; people are unaware of the Public Hearing which is to be held today as he said that the bannering done by M/s OIL.

To this M/s OIL representative replied explained about the standard guidelines given by MoEF in conducting a Public Hearing. He told about the exact locations where in Public Bannering are placed for publicity of today's Public Hearing. He also informed about newspaper publications.

Mr. Sanjay Tati has said even the existence of these Tea Estate are in questioned as on one side erosion by Dangori River and on one side by M/s OIL. He stressed that Tea Estate are their only livelihood. He wanted a reply from M/s OIL about development work undertaken by M/s OIL in earlier projects.

3. Mr. Tinrsanajyoti Hazarika, President of Baghjan gaon Milan Jyoti sangha wanted to know if a project permission / Environmental Clearance given for the particular drilling sites vide public hearing is extended even for other new drilling site (which is not mentioned in a Public Hearing).

To this M/s OIL representative informed that EC is received from MoEF for particular drilling sites only.

Mr. Tinrsanajyoti Hazarika questioned about the remaining drilling sites other than the 41 drilling sites which received Environmentral Clearance. He read out a memorandum previously presented to the DC, The CM and other Ministry. He even questioned the role played by Pollution Control Board, Assam, how could they provide Environmental Clearance other than these 41 drilling sites.

To this Mr. Hiren Pegu, REE (i/c), PCBA, RO-Dibrugarh replied to that before 2006 there was no requirement of Environmental Clearance for OIL fields. And if these were unaccounted oil field then there were not via Public Hearing.

M/s OIL representative replied to this that for few Drilling sites they took exemption from MoEF of Public Hearing for which they got the

permission. And he also briefed about the new guidelines which is to succeed will not require Environmental Clearance for exploratory Purpose but it is required for Development purpose.

Mr. Tinrsanajyoti Hazarika further stressed concerned about the preservation of the Maguri Beel. He informed about the damage caused by the pipelines which runs above the Maguri motapung beel, for which their organizations opposed during installation. He further said that previously abandonedsrill site has remained without a single tree plantation. He said they have been demanding a joint inspection to Deputy Commissioner, Tinsukia district by Pollution Control Board, Assam and their organization or local people in the drilling site nearby. He doubted the role of Pollution Control Board, Assam if they ever do inspection to these sites. He showed a picture taken a week ago, where black smoke emerged from Baghjan EPS. He doubted the promise made by M/s OIL about employment and development. He raised questioned if oil field site can be in Maguri beel if Pollution Control Board, Assam could give clearance oil field within 400 metres of Dibru Saikhowa Reserve.

M/s OIL representative informed the public that the grievances and the complaint placed by the public has been noted down in writings by Pollution Control Board, Assam and also video recording has been done so that point wise action plan will be undertaken. The proceedings in writing both in Assamese and English will be made available in Pollution Control Board, Assam websites. He also informed about the CER apart from CSR Environmental development. M/s OIL has tied up with ISRO for study in the matter of Biodiversity.

Mr. Tinrsanajyoti Hazarika wanted M/s OIL to grant the previous promises (to fulfil) and only then the public will be more co-operative and happy.

Mr. Pabitra Kr. Das, ADC told the public that the Hearing is organised to note down the problems and complaints of the Public. He urged for the cooperation of all parties for the success of this Hearing.

4. Mr. Satyajeet Moran, a representative of Baghjan Milan Jyoti Sangha is concerned about the Ecosystem of the Maguri Mota Pung Beel and Dibru saikhowa National park. He displayed few photographs of Maguri motapung beel's pipelie leaked and others of oil field close to Dibri saikhowa national forest.

5. Mr. Ajay Tinga, ex-president All Assam Adivasi Student Association is concerned about the destruction of the Tea Trees and other tress by

M/s OIL which has not been re-planted and he worried about the serious damage caused by it to the ecosystem. He proposed that Pollution Control Board, Assam to take initiative to plant trees in 100 's of hectors barren land around Dibru Saikhowa national forest. He is concerned about the one way road, where M/s OIL run 10-12 wheeled vehicle for which public has faced lot of harassment. He hoped for Ambulance services from M/s OIL and for students scholarships for higher education and also skill development centre.

6. MD. Narul Anwar , a local resident has said he is concerned about the expected pollution in the drilling sites. He wanted M/S OIL to take enough measures to protect the Environment. He talked about the development project M/S OIL should undertake and also about a necessity of a higher Secondary School in these area. He talked about the erosion of the Dangori river, he wanted M/S OIL to contribute to solve this problem. He told the OIL Authorities that one of the drilling site falls in Baghjan, is one of the most backward region in these area. He wanted M/S OIL to establish one Lower Primary (LP) school there. He also felt the necessity of Street Light in this Area.

7. Tuglag Guwala, AATSA member, Urged M/S OIL to organise any public hearing in the Tea Estate on Sundays or Holidays as people could not attend during working days. He talked about the roadways in the Tea Garden area, where large vehicles of M/S OIL moves. He wanted M/S OIL to take measure to wider the road. He demanded M/S OIL to replantation programmes to the taken to the measure to wider the road to damage tea plants while installation of pipelines in Tea Estates. He Stress that the labour of the Estate are the victims of the developmental works are not undertaken immediately then a strike would be initiated by Tea Tribe Organization.

8. Mr. Lorest Nath, AAASA, Secretary, is concerned about the damaged/ uprooted tea plants for installation of pipelines. He urged for a college be established in Baghjan area by M/S OIL . He talked about the air pollution in Guijan area.

9. Mr. Rupan Chutia, Barekuri anchalik, yuva sangha, gave his gratitude to m/s OIL for their contribution in BareKuri by making road ways and other development. But he urged the OIL Authorities to preserve the natural resources and environment. He stressed that the pipeline installed in Maguri Beel Bridge should be relocated as he is concerned about the possible leakage of pipelines and damage the ECO syatem of the Maguri beel. He talked about the abondoned oil field in Barekuri area to be fenced or made boundary walls. He demands for

employment in places of money for land acquisition process in Barekuri area.

10. Mr. Dambaru chetia, a resident of Barekuri has proposed that M/S OIL shoud not take any more extension of the oil field in and around MahuriBeel Motapung Beel as it is an income source for people surrounding it.

11. Mr. Kamal Baruah , a local resident, asked for the help of M/S OIL to get miadi patha karan/Registration of their land . so that they could get proper compensation for land acquisition done by M/S OIL.

12. Mr. Rajendra Panik, a local president AAASU, Complained that m/s OIL has not taken development project in Dighaltarang aera . he asked for compensation for the tea plant damaged in the installation of pipelines.

Mr. Pabitra Kr. Das, ADC told the public that the entire proceedings were video recorded and noted in writings will be presented to concern authorities from where it will be proceeded for environmental clearances. He wanted the public to give in writing if any left behind. He wanted M/S OIL to create an environment to co-operate and listen to grievances of the public. He urged m/S OIL to balance between the environment and industry development and never to compromise on the importance of the Ecosystems. He urged M/S Oil to establishment of a Hospital and ambulance services etc. as these are necessity in these area. He informed about the governmental project initiated to protect the erosion of Dangari River. He Thanked for the valuable opinion of the public and asked for their co-operation in days to come.

Sd/-
Executive Engineer
Pollution Control Board, Assam
Regional Office, Dibrugarh

Sd/-
Addl. Deputy Commissioner (Rev)
Tinsukia

Pollution Control Board, Assam
(Department of Environment & Forests : : Government of Assam)
অসম প্রদূষণ নিয়ন্ত্রণ পৰিষদ
(অসম চৰকাৰৰ বন আৰু পৰিবেশ বিভাগ)
(An ISO 9001:2008 & BS OHSAS 18001:2007 Certified Organisation)

No. WB/T-204/18-19/112 — Dated Guwahati, the 08th June, 2020

To 34

The Deputy Commissioner
Tinsukia District
Dist.: Tinsukia, Pin-786125 (Assam)

Sub: Display of Public Hearing documents.

Ref: Public Hearing held on 12.03.2020 at baghjan and on 13.03.2020 at Digboi in Tinsukia district respectively for proposed "Drilling, Production & Laying of Pipelines for Khagorijan, Jorajan area, Naharkotia-Deohal-Bogapani-Nagajan, North Hapjan Tinsukia Dhola Doomdooma Pengree area, ERD, Baghjan by M/s Oil India Ltd., Duliajan

Sir,

In enclosing herewith the photocopies of Minutes of the proceedings (both in English & Assamese) and the Attendance Registers of above referred public hearing, held on 12.03.2020 & 13.03.2020 respectively. It is requested to kindly make necessary arrangements for display of the minutes, at the Notice Board of your office for kind information to all concerned.

Yours faithfully,

Member-Secretary (i/c)

Enclo: As stated

Memo No. WB/T-204/18-19/112-A — Dated Guwahati, the 08th June, 2020

Copy to: 34

1. PA to the Chairman, PCBA for kind appraisal of the Chairman.
2. The General Manager (HSE), M/s. Oil India Ltd., Duliajan for favour of information.
3. The Zonal Officer, Ministry of Environment & Forests, Govt. of India, Regional Office, Law-U-Sib, Lumbatngen, Near MTC Workshop, Shillong-793021, Meghalaya for information & necessary action.
4. The Chief Executive Officer, Zilla Parishad, Tinsukia district, Assam for information.
5. The President/Secretary of the concerned Gaon Panchayat for information.
6. The General Manager, DI&CC, Tinsukia for information.
7. The Regional Exe. Engineer (i/c), Regional Office, Dibrugarh, for information & necessary action.

Member-Secretary (i/c)

Head Office : Bamunimaidam, Guwahati - 781021, Assam : India.
Phone : 2652774 & 2550258 ; Fax : 0361-2550259 ; Gram : POLUTIONCONTOL
E-mail : membersecretary@pcbassam.org; Website : www.pcbassam.org










EIA for Onshore Oil & Gas development drilling and production in Khagorijan Oil & Gas Field in Dibrugarh & Tinsukia District under Tinsukia PML, Tinsukia Extension PML and Chabua PML

Draft Report

September 2018

www.erm.com

The business of sustainability

DRAFT REPORT

Oil India Limited

EIA for Onshore Oil & Gas development drilling and production in Khagorijan Oil & Gas Field in Dibrugarh & Tinsukia District under Tinsukia PML, Tinsukia Extension PML and Chabua PML

September 2018

Reference#0426932

Project Manager:	**Abhishek Roy Goswami** *Senior Consultant*	Abhishek Roy Goswami
NABET Approved EIA Coordinator and Oil and Gas sector:	**Debanjan Bandyopadhyay** *Partner*	Banerjee

This report has been prepared by ERM India Private Limited a member of Environmental Resources Management Group of companies, with all reasonable skill, care and diligence within the terms of the Contract with the client, incorporating our General Terms and Conditions of Business and taking account of the resources devoted to it by agreement with the client.

We disclaim any responsibility to the client and others in respect of any matters outside the scope of the above.

This report is confidential to the client and we accept no responsibility of whatsoever nature to third parties to whom this report, or any part thereof, is made known. Any such party relies on the report at their own risk.

CONTENTS

ABBREVIATIONS		*I*
EXECUTIVE SUMMARY		*III*
1	*INTRODUCTION*	*1*
1.1	*BACKGROUND*	*1*
1.2	*OBJECTIVE OF THE EIA STUDY*	*1*
1.3	*SCOPE OF THE EIA STUDY*	*2*
1.4	*COMPLIANCE TO TOR*	*2*
1.5	*LIMITATIONS*	*5*
1.6	*LAYOUT OF THE REPORT*	*6*
2	*PROJECT DESCRIPTION*	*7*
2.1	*OVERVIEW OF THE PROJECT*	*7*
2.2	*OBJECTIVES OF PROPOSED DRILLING AND PRODUCTION ACTIVITY*	*7*
2.2.1	*Project Objectives*	*7*
2.3	*AREA LOCATION AND ACCESSIBILITY*	*8*
2.3.1	*Area Location*	*8*
2.3.2	*Accessibility*	*8*
2.4	*ENVIRONMENTAL SETTINGS*	*13*
2.4.1	*Khagorijan Oil and Gas Field*	*13*
2.4.2	*Well Sites and Production Facilities*	*13*
2.5	*EXISTING ACTIVITY IN OIL FIELD*	*14*
2.6	*WELL DRILLING*	*16*
2.6.1	*Pre-drilling Activity*	*16*
2.6.2	*Drilling Activity*	*18*
2.6.3	*Well Decommissioning*	*21*
2.7	*PRODUCTION INSTALLATIONS*	*22*
2.7.1	*Oil Collection Station (OCS)*	*22*
2.7.2	*Gas Compressor Station (GCS)*	*24*
2.7.3	*Field Gas Gathering System (FGGS)*	*24*
2.7.4	*Quick Production System (QPS)*	*25*
2.8	*INTERCONNECTED PIPELINES*	*25*
2.9	*UTILITIES AND RESOURCE REQUIREMENTS*	*25*
2.9.1	*Power requirement and generation*	*25*
2.9.2	*Fuel Consumption, Supply and Storage*	*25*
2.9.3	*Water Requirement*	*26*
2.9.4	*Manpower*	*27*
2.10	*POLLUTION SOURCES AND CHARACTERIZATION*	*28*
2.10.1	*Noise*	*28*
2.10.2	*Air Emissions*	*29*
2.10.3	*Liquid wastes*	*30*
2.10.4	*Solid and Hazardous Waste Streams*	*31*
2.10.5	*Drilling Hazards*	*32*
2.11	*PROJECT TIMELINE*	*32*
2.12	*PROJECT COST*	*32*

3	*DESCRIPTION OF THE ENVIRONMENT*	*33*
3.1	*STUDY AREA*	*33*
3.2	*STUDY PERIOD*	*33*
3.3	*PHYSICAL ENVIRONMENT*	*33*
3.3.1	*Topography*	*33*
3.3.2	*Land use and Land Cover*	*35*
3.3.3	*Soil Quality*	*37*
3.3.4	*Climate and Meteorology*	*42*
3.3.5	*Ambient Air Quality*	*46*
3.3.6	*Ambient Noise Quality*	*55*
3.3.7	*Hydrogeology*	*56*
3.3.8	*Groundwater Quality*	*58*
3.3.9	*Drainage*	*65*
3.3.10	*Surface Water Quality*	*68*
3.3.11	*Traffic Analysis*	*72*
3.3.12	*Natural Disaster*	*73*
3.4	*BIOLOGICAL ENVIRONMENT*	*73*
3.4.1	*Introduction*	*73*
3.4.2	*Objectives*	*74*
3.4.3	*Methodology*	*74*
3.4.4	*Terrestrial Ecosystem*	*76*
3.4.5	*Aquatic Ecosystem*	*94*
3.2	*SOCIOECONOMIC ENVIRONMENT*	*96*
3.2.1	*Area of Influence*	*97*
3.2.2	*Methodology*	*97*
3.2.3	*General Socioeconomic Profile*	*98*
3.2.4	*Basic Amenities and Infrastructure*	*99*
4	*IMPACT ASSESSMENT AND MITIGATION MEASURES*	*103*
4.1	*IMPACT ASSESSMENT METHODOLOGY AND APPROACH*	*103*
4.1.1	*Identification of Potential Impact*	*103*
4.1.2	*Impact Assessment Methodology*	*103*
4.2	*ASSESSMENT OF IMPACT*	*109*
4.2.1	*Potential Impact Aesthetic and Visual*	*109*
4.2.2	*Potential Impact on Land Use*	*112*
4.2.3	*Potential Impact on Soil Quality*	*112*
4.2.4	*Potential Impact on Topography & Drainage*	*115*
4.2.5	*Potential Impact on Air Quality*	*116*
4.2.6	*Potential Impact on Noise Quality*	*128*
4.2.7	*Potential Impact on Road & Traffic*	*131*
4.2.8	*Potential Impact on Surface Water Quality*	*132*
4.2.9	*Potential Impact on Ground Water Resources*	*135*
4.2.10	*Potential Impact on Ground Water Quality*	*136*
4.2.11	*Potential Impact Terrestrial Ecology*	*137*
4.2.12	*Impact on Aquatic Ecology*	*142*
4.2.13	*Potential Impact on Socio-economic Environment*	*144*
4.2.14	*Potential Impact on Occupational Health & Safety*	*147*
4.2.15	*Potential Impact on Community Health and Safety*	*149*

5	*ANALYSIS OF ALTERNATIVES*	*154*
5.1	*NO PROJECT SCENARIO*	*154*
6	*ENVIRONMENTAL MONITORING PROGRAMME*	*155*
7	*ADDITIONAL STUDIES*	*162*
7.1	*QUANTITATIVE RISK ASSESSMENT*	*162*
7.2	*OBJECTIVE OF THE QRA STUDY*	*162*
7.3	*RISK ASSESSMENT METHODOLOGY*	*163*
7.3.1	*Hazard Identification*	*164*
7.3.2	*Frequency Analysis*	*165*
7.3.3	*Consequence Analysis*	*166*
7.3.4	*Risk Evaluation*	*167*
7.4	*RISK ASSESSMENT OF IDENTIFIED PROJECT HAZARDS*	*168*
7.4.1	*Blow Outs/Loss of Well Control*	*169*
7.4.2	*Hydrocarbons Leaks Due to Loss of Containment While Drilling & Testing*	*180*
7.4.3	*Interconnecting Hydrocarbon Pipeline Network*	*184*
7.4.4	*OCS Tank Failure*	*195*
7.4.5	*Hazardous Material Releases or Mishaps*	*202*
7.4.6	*External Hazards*	*202*
7.5	*DISASTER MANAGEMENT PLAN*	*203*
7.5.1	*Emergency Identified*	*203*
7.5.2	*Emergency Classification*	*204*
7.5.3	*Preventive and Mitigation Measures for Blow Outs*	*205*
7.5.4	*Preventive Measures for Handling of Natural Gas*	*206*
7.5.5	*Preventive Measures for Interconnecting Pipeline Risk Management*	*206*
7.5.6	*Preventing Fire and Explosion Hazards*	*207*
7.5.7	*General Health and Safety*	*207*
7.5.8	*Personal Protective Equipment*	*208*
7.5.9	*First Aid*	*209*
8	*PROJECT BENEFITS*	*210*
9	*ENVIRONMENTAL MANAGEMENT PLAN*	*211*
9.1	*SPECIFIC MANAGEMENT PLANS*	*223*
9.1.1	*Air Quality Management Plan*	*223*
9.1.2	*Noise Management Plan*	*225*
9.1.3	*Soil Quality Management Plan*	*226*
9.1.4	*Site Closure Plan*	*227*
9.1.5	*Surface Water Quality Management Plan*	*228*
9.1.6	*Ground Water Quality Management Plan*	*230*
9.1.7	*Waste Management Plan*	*231*
9.1.8	*Spill Management Plan*	*233*
9.1.9	*Wildlife Management Plan*	*234*
9.1.10	*Road Safety & Traffic Management Plan*	*236*
9.1.11	*Occupational Health & Safety Management Plan*	*237*
9.1.12	*Management of Social Issues and Concerns*	*238*
9.2	*OIL ENVIRONMENT MANAGEMENT POLICY AND SYSTEM*	*239*

9.2.1	*Environmental Management Organisation*	*239*
9.2.2	*Training and Awareness*	*240*
9.2.3	*Inspection & Monitoring*	*241*
9.2.4	*Compliance Auditing*	*241*
9.2.5	*Corrective Action*	*241*
9.3	*EMP BUDGET*	*242*
10	*SUMMARY AND CONCLUSION*	*245*
11	*DISCLOSURE OF CONSULTANTS*	*247*
11.1	*ERM'S ACCREDITATION AS EIA CONSULTANT*	*247*
11.2	*EIA TEAM*	*247*

LIST OF TABLES

Table 1.1 Compliance of TOR 2
Table 1.2 Content of the Report 6
Table 2.1 Details of Coordinates of Khagorijan Oil & Gas Field 8
Table 2.2 Summary of Environmental Setting of Wells and Production Installations in Khagorijan Oil and Gas Field 14
Table 2.3 Salient features of a typical well 21
Table 2.4 Water Requirement per Well 26
Table 2.5 Construction Equipment Noise Level 28
Table 2.6 Drilling Rig and Equipment Noise Level 28
Table 2.7 Wastewater generated and it's management 30
Table 2.8 Waste streams generated during drilling and their disposal 31
Table 3.1 Distribution of Land use and Land Cover in Study Area 35
Table 3.2 Soil Monitoring Locations in Study Area 38
Table 3.3 Results of Soil Monitoring Results 39
Table 3.4 Rating chart for the soil test data for few selected soil parameters 41
Table 3.5 Rainfall Recorded in Dibrugarh and Tinsukia Districts 43
Table 3.6 Summary of Micro-Meteorological Data 45
Table 3.7 Air Monitoring Locations 47
Table 3.8 Summary of Ambient Air Monitoring 53
Table 3.9 Ambient Noise Monitoring Locations 55
Table 3.10 Groundwater Monitoring Locations in the Study Area 58
Table 3.11 Result of Ground Water Sampling 60
Table 3.12 Surface water-monitoring locations 68
Table 3.13 Surface-water Monitoring Results 68
Table 3.14 Traffic Values observed in the Project study area 72
Table 3.15 Details of the Sample Plot 75
Table 3.16 Phytosociology of Tree species within the Study Area 81
Table 3.17 Phytosociology of Shrub species 82
Table 3.18 Phytosociology of Herbs and ferns 83
Table 3.19 Species Richness and diversity within Study Area 84
Table 3.20 Facilities within the Ecosensitive Zone of Bherjan-Borajan-Padumoni Wildlife Sanctuary and Dibru-Saikhowa National park 85
Table 3.21 IBA's Located within Khagorijan Field 90
Table 3.22 Amphibians observed/reported from the Khagorijan Field 91
Table 3.23 Reptiles observed/reported from the Khagorijan Field 91
Table 3.24 Avifaunal Species observed in the Study Area during Primary Survey 92
Table 3.25 Mammalian species recorded/reported in the study area 94
Table 3.26 Plankton Recorded from the Study Area 95
Table 4.1 Impact Identification Matrix 105
Table 4.2 Input Parameters Considered for Modelling 118
Table 4.3 Predicted GLC for Air Pollutants 119
Table 4.4 Projected Ambient Air Quality Concentrations from Drill Site/production facilities at ambient air quality monitoring location 126
Table 4.5 Critical Levels for NO_2 138
Table 4.6 Impact Significance Matrix without Mitigation Measures 152
Table 4.7 Impact Significance Matrix with Mitigation Measures 153

Table 6.1 Proposed Monitoring Program for Drilling of Well, Production facilities and Pipelines 156
Table 7.1 Frequency Categories and Criteria 166
Table 7.2 Severity Categories and Criteria 167
Table 7.3 Risk Matrix 168
Table 7.4 Risk Criteria and Action Requirements 168
Table 7.5 Blow Out Cause Distribution for Failures during Drilling Operations 170
Table 7.6 Blow Out Frequencies Recommended per Drilled Well 171
Table 7.7 Pool Fire Modelling Scenario 173
Table 7.8 Pool Fire Diameter & Steady State Burning Scenario 173
Table 7.9 Thermal Radiation Intensity Threshold Values Impact Criterion 174
Table 7.10 Distance to Thermal Radiation Threshold Levels 174
Table 7.11 Natural Gas Release Modelling Scenario 175
Table 7.12 Zone of Flammable Vapour Cloud-Natural Gas Release Scenarion 179
Table 7.13 Thermal Radiation Zone -Natural Gas Release Scenario during Well Testing 183
Table 7.14 Primary Gas Pipeline Failure Frequency 185
Table 7.15 Primary Failure Frequency based on Diameter Class (1970-2013) 186
Table 7.16 Interconnecting Pipeline - Failure Frequency 187
Table 7.17 Interconnecting Pipeline – Ignition & Jet Fire Probability 188
Table 7.18 Interconnecting Pipeline Risk Modelling Scenarios 189
Table 7.19 Tank Failure Frequency 196
Table 7.20 OCS Storage Tank – Risk Modelling Scenarios 198
Table 9.1 Environment Management Matrix 213
Table 9.2 Environmental Management Organisation Roles and Responsibilities 239
Table 9.3 Tentative Budget for EMP Implementation for Each Well 242
Table 9.4 Tentative Budget for EMP Implementation for Each Production Installation per year 243
Table 10.1 Summary of Impact Significance without and with Mitigation Measures 245
Table 11.1 Professionals Engaged for the EIA Study 248

LIST OF FIGURES

Figure 2.1	Regional Setting Map of Khagorijan Oil and Gas Field	9
Figure 2.2	Khagorijan Oil and Gas Field on Toposheet	10
Figure 2.3	Khagorijan Oil and Gas Field on Satellite Imagery	11
Figure 2.4	Accessibility Map of Khagorijan Oil and Gas Field	12
Figure 2.5	Environmental Setting Map	15
Figure 2.6	Drilling Waste Management	20
Figure 2.7	Process Description of OCS	23
Figure 2.8	Line Diagram of GCS	24
Figure 2.9	Water Balance Diagram- Drilling for 50 KLD	27
Figure 3.1	Topography Map	34
Figure 3.2	Distribution of land use and land cover of Khagorijan Block	36
Figure 3.3	Annual Wind Rose at Dibrugarh, Assam	44
Figure 3.4	Wind rose of Study Area during Study Period	46
Figure 3.5	Air, Noise and Traffic Monitoring Locations	48
Figure 3.6	Concentration of Particulate Matter 10 (PM_{10}) in the Study Area	49
Figure 3.7	Concentration of Particulate Matter 2.5 (PM2.5) in the Study Area	50
Figure 3.8	Concentration of Sulfur Dioxide (SO_2) within Study Area	50
Figure 3.9	Concentration of Nitrogen Dioxide (NO_2) in the Study Area	51
Figure 3.10	Concentration of Carbon Monoxide (CO) in Study Area	51
Figure 3.11	Ambient Noise Monitoring Results	56
Figure 3.12	Soil, Groundwater and Surface water Monitoring Locations	59
Figure 3.13	Drainage Map	67
Figure 3.14	Primary Environmental Monitoring Photographs	71
Figure 3.15	Contribution of Different Type of Vehicle at NH 37 and Panitola Dibrugarh Road	73
Figure 3.16	Description of Sample Plot	76
Figure 3.17	Photographs of Different Type of Habitats in Khagorijan Field	80
Figure 3.18	Ecological sensitivity Map of Khagorijan Field	86
Figure 3.19	Hoolock Gibbon Habitat in Tinsukia and Dibrugarh Districts	89
Figure 3.20	Photographs of Community Consultation in the Khagorijan Field	102
Figure 4.1	Impact Assessment Process	104
Figure 4.2	Predicted Incremental Concentration of NO_x - operation of DG sets	120
Figure 4.3	Predicted Incremental Concentration of PM -operation of DG sets	121
Figure 4.4	Predicted Incremental Concentration of HC -operation of DG sets	122
Figure 4.5	Predicted Incremental Concentration of NO_x -Flaring from well testing	123
Figure 4.6	Predicted Incremental Concentration of NO_x Flaring from OCS	124
Figure 4.7	Predicted Incremental Concentration of NO_x-Operation of GG sets	125
Figure 4.8	Predicted Incremental Concentration of HC-Operation of GG sets	126
Figure 4.9	Predicted Noise Pressure Levels at Receptor Points (with and without barrier)	131
Figure 7.1	Risk Assessment Methodology	164
Figure 7.2	Ignition Probability Vs Release Rate	172
Figure 7.3	Scenario I: Risk Contour Map	177
Figure 7.4	Scenario II: Risk Contour Map	178
Figure 7.5	Scenario III: Risk Contour Map	179
Figure 7.6	Scenario III (Worst Case) – Overpressure Risk Modelling	180
Figure 7.7	Overpressure Risk Modelling – Well Releases during drilling	181
Figure 7.8	Thermal Radiation Distances of Jet Flame due to Leak of 25 mm size	182

Figure 7.9	Thermal Radiation Distances of Jet Flame due to Leak of 50 mm size	183
Figure 7.10	Gas Pipeline Failure – Distribution of Incident & Causes	186
Figure 7.11	Natural Gas Release – Potential Consequences	189
Figure 7.12	Threat Zone Plot – 50mm dia pipeline complete rupture	190
Figure 7.13	Threat Zone Plot – 300mm dia pipeline leak (75mm dia)	191
Figure 7.14	Threat Zone Plot – 300mm dia pipeline rupture	192
Figure 7.15	Threat Zone Plot –200mm dia pipeline leak (50mm dia)	193
Figure 7.16	Threat Zone Plot –200mm dia pipeline rupture	194
Figure 7.17	Event Tree Analysis - Tank Failure	197
Figure 7.18	Threat Zone Plot – OCS Storage Tank Leak (50mm dia)	199
Figure 7.19	Threat Zone Plot – Diesel Storage Tank Leak (100mm dia)	200
Figure 7.20	Threat Zone Plot – OCS Storage Tank Leak (300mm dia)	201
Figure 7.21	Emergency Classification "Decision Tree"	204
Figure 11.1	ERM's Accreditation from NABET	250

ABBREVIATIONS

ALARP	As Low as Reasonably Possible
BBPWLS	Bherjan Borajan Padumoni Wildlife Sanctuary
BOD	Biochemical Oxygen Demand
CGWB	Central Ground Water Board
COD	Chemical Oxygen Demand
CPCB	Central Pollution Control Board
DG	Diesel Generator
DNV	Det Norske Veritas
DO	Dissolved Oxygen
DSNP	Dibru Saikhowa National Park
EC	Environmental Clearance
EGIG	European Gas Pipeline Incident Data Group
EIA	Environmental Impact Assessment
EMP	Environment Management Plan
IMD	Indian Meteorological Department
ITOPF	International Tanker Owners Pollution Federation Limited
IUCN	International Union for Conservation of Nature
KLD	Kilo Liter per Day
LEL	Lower Explosive Limit
MoEFCC	Ministry of Environment, Forest and Climate Change
MoPNG	Ministry of Petroleum and Natural Gas
MWP	Minimum Work Programme
NAAQS	National Ambient Air Quality Standards
NABET	National Accreditation Board for Education and Training
NABL	National Accreditation Board for Testing and Calibration Laboratories
NELP	New Exploration Licencing Policy
NH	National Highway
NOx	Oxides of Nitrogen
OGP	International Association of Oil & Gas Producers
OIL	Oil India Limited
OISD	Oil Industry Safety Directorate
PEL	Petroleum Exploration License
PM	Particulate Matter
PPE	Personnel Protective Equipment
PSC	Production Sharing Contract
QCI	Quality Council of India
QPS	Quick Production System

QRA	Quantitative Risk Assessment
RCC	Reinforced Cement Concrete
RF	Reserved Forest
SO_2	Sulphur Dioxide
TDS	Total Dissolved Solids
TSS	Total Suspended Solids
UEL	Upper Explosive Limit

INTRODUCTION

Oil India Ltd. (OIL) is currently planning for drilling of 54 onshore exploratory and developmental wells, 2 nos. of production installations and laying of approximately 201 km of pipelines in Khagorijan Field located in Tinsukia and Dibrugarh District of Assam. The pipelines include 200 mm 21 km long crude oil pipeline from East Khagorijan GGS to Dikom OCS, 300 mm 20 km long natural gas pipeline from East Khagorijan GGS to Chabua FGGS, 200 mm 10 km long natural gas pipeline from Nadua OCS to Dikom OCS and 50 mm to 300 mm approx. 150 km long assorted oil & gas flowlines/ delivery lines in Khagorijan Oil & Gas Field under Dibrugarh and Tinsukia district of Assam.

The exploration of oil and gas is included under activities has been categorized as "A" level project in EIA Notification, 2006 that requires an Environmental Clearance (EC) from the Ministry of Environment, Forests and Climate Change (MoEFCC). MoEFCC has issued an approved Terms of Reference ToR vide J-11011/35/2018-IA II (I) dated 11th March 2018 to OIL for conducting the EIA study.

The scope of the EIA study will be to establish the likely effect of drilling and production activities in Khagorijan Field on the physical, social and biological environment of the surrounding areas. The scope of the EIA is delineated in line with the approved Terms of Reference (ToR) received from MoEFCC.

PROJECT DESCRIPTION

Location and Accessibility

The Khagorijan Oil and Gas Field is located in Dibrugarh and Tinsukia districts of Assam. Total area of Khagorijan Oil and gas Field is 405 sq. km. NH 37, being the most prominent road in the region, runs through the southern side of Khagorijan Field, in an east to west orientation. This road connect Tinsukia town located in the south eastern corner of the Field, with Dibrugarh town located on the south western side, outside the Field. Tinsukia Junction and New Tinsukia Junction are the major railway stations within the Field.

Environmental Settings of Khagorijan Field

Khagorijan Field is located in the drainage basin of Brahmaputra River. Apart from Brahmaputra (flowing through North). The branch of the Brahmaputra River, Dangori River flows within Field from north-eastern to the northwestern part. Dinjan river that flows more or less through the southern part of the Field. North eastern part of the Khagorijan Field falls within the buffer of Dibru-Saikhowa National Park. Apart from Padumoni section (1.7

sq. Km) of the Bherjan-Borajan-Padumoni Wild Life Sanctuary falls in the eastern part of the Field. The field mostly comprises with large tea estate, rural area with agricultural lands, settlements and homestead plantation. Major tea estate within the field area are Oakland T.G, Hazelbank T.G, Nadua T.G, North Balijan T.G, Dinjoy T.G, Kharjan T.G, Panitola T.G, Dinjan T.G, Rangagora T.G, Nalani T.G, Nokhroy T.G, Limbugudi T.G. etc.

Environment setting of the Well sites and Production Facilities

Among the 54 wells, 9 wells are located in agricultural land, 8 wells located in homestead plantation area, 26 wells located in tea garden, 1 wells located in brick field and 26 wells located in existing well sites of OIL. One production facility is located in agricultural land and the other is located in tea garden.

Project Activities

Land Procurement

The land required for the well sites and production facilities will be procured from the local villagers through direct purchase. Generally, OIL will procure the required land through private negotiation. In few cases, OIL may apply the provision of Rule-189/190 of AL&RR, 1886, if private negotiation is not successful. Land procurement will be done including crop compensation. No physical displacement will not occur; hence, resettlement and rehabilitation will not be applicable for this project.

Site Preparation & Construction Drill site

Site preparation will involve levelling, filling and consolidation of the site for staging equipment and machinery. Individual sites will be duly fenced to a height of about 2 m using jingle wired fencing or Xpm fencing.

Preparation and construction of drill sites and production facilities will involve top soil scraping and storage for future use, elevating the site by excavated material from the site and material brought from authorized quarry area. Reinforced Cement Concrete (RCC) will be used for the construction of foundation system at drill sites. For making foundations of the main rig structure, cast in-situ bored under- reamed piles of specified lengths will also be used.

Drilling & Testing

The exploitation of hydrocarbons requires the construction of a conduit between the surface and the reservoir. This is achieved by the drilling process. The exploration wells will be drilled using a standard land rig or a "Mobile Land Rig" with standard water based drilling fluid treatment system. This rig will be suitable for deep drilling up to the desired depth of 3900 metres as planned for the project.

During drilling operations, a fluid known as drilling fluid (or 'mud') is pumped through the drill string down to the drilling bit and returns between the drill pipe –casing annulus up to surface back into the circulation system after separation of drill cuttings /solids through solids control equipment. Drilling fluid is essential to the operation and helps in controlling down hole pressure, lift soil/rock cuttings to the mud pit, prevent cuttings from settling in the drill pipe, lubricate, cool and clean the drill bit.

Drill cuttings generated will be collected and separated using a solid control system and temporarily stored on-site in HDPE lined pits. Drilling and wash wastewater generated will also be stored at an onsite HDPE lined pit. The water will be adequately treated in a mobile ETP to ensure conformance to the S No. 72 A (ii) Schedule I - Standards for Emission or Discharge of Environmental Pollutants from Oil Drilling and Gas Extraction Industry of CPCB and discharged into a nearby natural drainage channel.

There will be other ancillary facilities like Drilling mud system, Effluent Treatment System (ETP), Cuttings disposal, Drill Cementing, equipment etc. and utilities to supply Power (DG sets), water, fuel (HSD) to the drilling process and will be set up as a part of the project.

Between drilling operations for different zones, logging operations will be undertaken to provide information on the potential type and quantities of hydrocarbons present in the target formations.

Well Site decommissioning

On completion of activities, the wells will be either plugged and connected with flow lines or suspended. In the event of a decision to suspend the well, it will be filled with a brine solution containing very small quantities of inhibitors to protect the well. After the activities, the well will be sealed with a series of cement plugs, all the wellhead equipment will be removed leaving the surface clear of any debris and site will be restored.

Production Installations

Two Production installations planned within the Khagorijan Field. The production installation may include Oil Collection System (OCS), Gas Compressor Station (GCS), Field Group Gathering Station (FGGS) or Quick Production System (QPS).

Utilities and Resource Requirements

Power: The power requirement for each drill site construction will be met through the 100 KW DG Sets. During drilling, DG sets of 1000 KW capacities, will be used to meet the power requirement for drilling. Lighting and other

power requirements at drill sites will met through 200KW DG sets. It is estimated that 3.5 KLD of diesel will be required during drilling phase. Power requirement for the production installations will be met through Gas Generator (GG) sets of 216 KW capacity.

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Water: During the drilling operations, water requirement at a drill site is expected to be 60 m^3 per day. The water requirement at the drilling sites during construction and drilling phase will be met groundwater after obtaining necessary permission. Potable water requirement at site will be met through packaged drinking water. In addition, a water storage pit of around 1000 m^3 is proposed to store water for fire water supply the likely source being surface water. For production facility approximately, 5 m^3 per day water will be required for construction and 3 m^3 per day for workers during construction phase. Approximately 20 m^3 per day water is required during the operation of the production installations. The water requirement will be met groundwater after obtaining necessary permission.

Manpower: The drilling rig will be operated by approximately 50 persons on the rig at any particular time. The manpower will operate in two shifts with continuous operations on the rig. This will include technical experts, who will be responsible for various drilling related activities and some local workers who will be hired from nearby villages for the entire duration of the Project. Production facilities are operated in three shifts with approximately 10 persons operating per shift.

Pollution Sources

- *Air emissions*: Point source air emissions will be generated from DG/GG sets. Fugitive emissions will occur from vehicles involved in the drilling operations and from windblown dust from storage and staging areas within the drill sites and production facilities.
- *Noise & Vibrations*: Noise and vibration will be generated due to operation of drilling rig, DG/GG sets and vehicles.
- *Liquid wastes:* During the drilling phase, wastewater will be generated as a result of rig wash and dewatering of spent mud and washing of drill cuttings The wastewater will be treated in an Effluent Treatment System (ETP) at site. The treated water would be reused. Domestic wastewater will be generated from the drill sites would be treated in septic tanks and soak pits. In production facilities, produced formation water will be disposed to the shallow wells after necessary treatment; surface Runoff after treatment through Oil Water Separator (OWS) and sedimentation tank will be discharge to natural drains.
- *Drill cuttings & spent mud:* Approximately 350-400 m^3 of drill cuttings and 900-1200 m^3 of spent mud will be generated per site. Drill cuttings and spent mud will be disposed off in a well-designed pit lined with impervious liner located on site.

BASELINE ENVIRONMENTAL STATUS

Land use and land cover: The land-use and land-cover of the Khagorijan Field has been interpreted from the satellite data, toposheet of the area, and subsequently by ground truthing during field surveys. Out of 405 sq. km of the study area, about 80.67 sq. km of land i.e. 19.91% of Block area is used for agricultural purposes. Rivers and riverbed areas including the courses of Brahmaputra River, Dinjan River and Dangori river etc. cover 106.65 sq. km i.e. 26.32% of the study area. Tea garden covers the area of 105.81 sq. km, which is 26.11% of the study area. Homestead plantations located around human settlement covers about 79.51 sq. km i.e. 19.62%. Forest areas cover only 2.28% of the total Khagorijan Field, among this Dibru Saikhowa National Park and Padumoni RF are the major forest patch.

Soil Quality: Soil samples were collected from five locations spread across different types of land cover. Soil samples were found to be clayey, sandy clay and clay loam in nature with acidic pH. The macronutrient contents *viz*. NPK values of the soil samples were found to be better to very less. Metal contamination was been observed.

Climate and Meteorology: The study area experiences a humid sub-tropical climate zone with warm seasons, except for a moderately cold winter from December to February. Hourly micro-meteorological data collected during the winter season (October 2017-December 2017) reveal that the pre-dominant wind direction is from the north-east with an average speed of 0.16 m/s.

Air Quality: Ambient air quality was monitored at eight locations within the Block. Average PM_{10} values varied from 20.86 and 89.25 µg/m^3; $PM_{2.5}$ varies from 12.28 and 47.92 µg/m^3. Other gaseous parameters like SO_2, NOx, CO were observed to be well within the levels specified in the National Ambient Air Quality Standards (NAAQS) for industrial, residential and other areas. The average total hydrocarbon concentration in the study area ranged between 0.90 and 1.60 ppm. All the values for non-methane hydrocarbons were recorded to be below detection limits (<0.5 ppm). Almost all the values for VOCs were recorded to be below detection limits (<2.08 µg/m^3) for all the samples.

Noise Quality: The ambient noise was monitored at 13 locations within the Block. The equivalent noise level as measured at the residential areas range between 52.9 -54.9 dB(A) at day time and between 40.0-44.6 dB(A) at night time. The equivalent night time noise values in all the locations were in compliance to the night time standard of 45 dB(A) for residential areas.

*Groundwater Quality: G*roundwater monitored at four locations was found to be slightly acidic (pH-6.54 to 6.84). Few samples reveal values for parameters such as Nitrate to be in exceedance to the respected acceptable limits. Otherwise the concentration of majority of the parameters analysed were within the acceptable limit of IS:10500, 2012 standard.

Surface Water Quality: Surface water samples were analyzed from Brahmaputra River, Dinjan river and Dangori river. The analyzed values reveal that all the samples were in compliance to the CPCB Class D i.e. *Propagation of Wild life and Fisheries*.

Biological Environment: Podumoni and Bherjan segments of Bherjan-Borajan-Padumoni Wild Life Sanctuary located within the Khagorijan Field. Dibru Saikhowa National Park is located at the north of the field. No wells or production facilities will be located within forest areas. Four mammal species categorized as schedule 1 species have been reported in the study area. No birds, amphibian or reptile species, categorized as schedule 1 has not found in the study area.

Socioeconomic Environment: Twenty nine villages lie within 1 km of proposed well locations and production facilities. Major population in the study area villages either are workers in nearby Tea Estates or involved in agricultural crop cultivation as a source of their livelihood. Water requirement is catered through household bore well/tube well facility in the village areas. Almost every village has a primary school; however, percentage of students pursuing higher education is comparatively less. Three primary health centers are present in the influenced area villages.

IMPACT ASSESSMENT

The potential impacts arising due to the construction and operation of the drilling activities are given below:

Air Quality: The operation of DG/GG sets, movement of vehicles and machineries during construction and drilling at drill sites and production operations will result in the generation of air pollutants *viz*. PM, NOx and SOx that may affect the ambient air quality temporarily.

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

Soil Quality: Stripping of top soil will affect the soil fertility of the well sites temporarily. Potential adverse impacts on soil quality may also result from improper storage and handling of fuel, lubricants, drilling mud and drill cuttings.

Water Quality and Hydrogeology: All wastewater discharged from the drilling and production operations will be treated in the ETP and discharges will conform to CPCB standards. As the volume of water to be discharged is small, it is anticipated to cause minor increase in pollution load for specific

parameters in receiving water bodies. Uncontrolled surface runoff from the drill sites and production facilities may compose of waste fluids or storm water mixed with oil and grease and may pollute the surface water quality. However, the surface runoff will be treated with sedimentation tank and oil water separator at site.

Biological Environment:
The existing vegetation at the proposed drill sites, production installations, approach roads and RoU of the pipeline will be felled for site development. Noise generated from drilling operations and vehicular movement within the drill sites, production facilities and approach roads may affect the reptiles, birds and mammals adversely and may result in their moving away from the project area for a temporary period. Surface runoff from the drill sites and production facilities contaminated with sediment, may reach surface water channels and increase the suspended solids load of the channel water. Increase of suspended solid will increase the turbidity of river water that ultimately will adversely affect the DO level in the water. The turbid water and lower DO may affect the primary productivity of the impacted areas of the streams and rivers. The process effluent will be adequately treated in the ETP to meet the industrial effluent discharge standards. The discharge of treated effluent is not expected to cause perceptible changes in the water quality of the receiving stream.

Socio-Economic Environment: Approximately 3 ha. land would be required for each well and 4-7 ha. land would be required for each production facility. Land will be purchased from local communities however; no physical displacement during land procurement is anticipated. Additionally, land will also be procured for construction of 100-200 m approach road to the drill sites and production facilities from existing roads. Anticipated number of families directly impacted would be limited to 2-5 nos. for each of the drill sites. The dependency of the landowner in case of generation of livelihood is limited as the land is classified as monocropped agricultural land.

OIL/its contractors would endeavour to provide maximum employment to the local people; however, certain percentage of semi-skilled and highly skilled migrant labour would be used by contractors for manning technical activities. It is anticipated that occasional conflicts would arise with the local community over the recruitment of migrant workers. Discomfort due to dust and noise to adjoining communities, influx of people are likely to occur.

The construction phase of the project is likely to generate both direct and indirect opportunities for employment. The estimated direct employment would be approximately 50 un-skilled workers during the peak construction phase that will primarily sourced from nearby areas. Indirect employment would be primarily in the supply chain as vendors, which are anticipated to be set up to support the construction.

Impact on Community Health & Safety: Community health and safety of inhabitants residing close to the proposed well sites and production facilities

stand to get affected from frequent heavy vehicular movements along village access roads and due to noise from drilling rig operations, movement of heavy vehicles during construction etc.

ENVIRONMENT MONIROING PROGRAM

Environmental monitoring Program for each well will include the following

- Ambient Air Quality Monitoring – at 3 monitoring location; once during construction, twice during drilling and once during site decommissioning phase
- Stack emission monitoring at 3DG sets during drilling
- Ambient Noise Monitoring – 3 locations, once during construction, twice during drilling and once during site decommissioning phase
- Workplace noise monitoring -5 locations, twice during drilling
- Surface Water Quality Monitoring- 2 locations, once during construction, once during drilling and once during site decommissioning phase
- Treated water -2 from ETP and 1 from oil/water separator- once each during drilling phase
- Ground Water Quality Monitoring, three location, once during drilling phase
- Soil Quality Monitoring - three locations, once each during pre-construction, drilling and post drilling phase

At the production facilities ambient air, stack emission monitoring from GG sets, ambient and workplace noise monitoring, surface and groundwater quality monitoring, treated wastewater monitoring and soil quality monitoring would be conducted twice a year.

RISK ASSESSMENT AND MITIGATION

Quantitative Risk Assessment (QRA) aims to provide a systematic analysis of the major risks that may arise as a result of drilling and production activities in Khagorijan Field. The QRA process outlines rational evaluations of the identified risks based on their significance and provides the outline for appropriate preventive and risk mitigation measures.

Three major categories of hazards that can be associated with proposed Project which includes:

- Blowouts leading to uncontrolled well flow, jet fires, pool fires;
- Hydrocarbon leaks due to loss of containment while drilling;
- Non-process fires / explosions, the release of a dangerous substance or any other event resulting from a work activity which could result in death or serious injury to people within the site; and
- Any event which may result in major damage to the structure of the rig.

Risk Reduction Measures

Blow Out Risk reducing measures include:

- Kick simulation training for personnel;
- Presence of well-trained engineers;
- Appropriate well design;
- Good well control procedures;
- Appropriate mud weight formulations;
- Installation of primary and secondary blow out preventors; and
- Trained and skilled operation staff.

Accidents related to leaks from equipment can be minimised by:

- Ensuring that equipment is designed, installed and maintained as per international standards;
- Implementing a robust preventive maintenance system of all safety critical equipment; and
- Efficient test separator;

Risk from storage areas can be minimized by;

- Proper preventive maintenance and robust safety management and security systems.
- For the storage tank, secondary containment to be provided.

Other risk management can be achieved by;

- A hydrocarbon gas detection system with suitable alarm system will be provided at the drilling sites and production facilities.
- Management of Oil Spills/Leaks and Soil contamination

PROJECT BENEFITS

- Provision of more royalty to Assam Government and more cess to Govt. of India;
- Provision of more employment opportunity to local people;
- Development of infrastructure (roads, culverts, bridges, schools etc.) in the area;
- Increase in business opportunity for the local people;
- Energy security for the country;
- Programs related to livelihood generation, health improvement as per OIL's Corporate Social Responsibility (CSR) programmes.

ENVIRONMENTAL MANAGEMENT PLAN

Air Quality Management Plan

- Vehicles delivering raw materials like fine aggregates will be covered to prevent fugitive emissions.
- Sprinkling of water on earthworks, material haulage and transportation routes on a regular basis during construction and decommissioning phase of the wells.
- Flare stacks of adequate height would be provided.
- DG/GG set stacks would have adequate height, as per statutory requirements, to be able to adequately disperse exhaust gases
- Periodic monitoring of DG/GG set stack emission will be carried out in accordance with the Environmental Monitoring Plan to assess compliance with CPCB DG set exhaust standards.

Noise Management Plan

- Selection and use of low noise generating equipment with in-built engineering controls viz. mufflers, silencers, etc.
- All DG/GG sets would be provided with acoustic enclosures.
- Appropriate PPEs (e.g. ear plugs) will be used for by workers while working near high noise generating equipment.

- All vehicles utilized in transportation of raw materials and personnel will have valid Pollution under Control Certificates (PUC).
- All high noise generating equipment will be identified and subjected to periodic preventive maintenance.
- No night time operation of vehicles and construction activities will be undertaken.

Soil Quality Management Plan

- Drip trays to be used during vehicular/equipment maintenance and during re-fuelling operations.
- Spill kits will be made available at all fuel and lubricant storage areas. All spills/leaks contained, reported and cleaned up immediately.
- Dedicated paved storage area will be identified for the chemicals, fuel, lubricants and oils within the drill sites and production facilities.
- 1.5 mm HDPE lined pits will be considered for the disposal of unusable drilling mud cuttings and drilling wastewater etc.

Surface Water Quality Management Plan

- Levelling and grading operations will be undertaken with minimal disturbance to the existing site contours thereby maintaining the general slope and topographical profile of the site.
- During site preparation and construction, surface water run-off will be channelized through appropriately designed drainage system.
- Sediment filters and oil-water separators will be installed to intercept run-off and remove sediment before it enters water courses.

- Domestic wastewater generated from drill sites and production facilities will be treated through septic tank and soak pit system and then discharged.
- Process wastewater would be treated in Effluent Treatment Plant (ETP) at drill sites and production facilities.

Ground Water Quality Management Plan

- Water based mud would be used as a drilling fluid for the proposed project.
- Eco-friendly synthetic based mud if required for deeper sections, will be used after providing intimation to the Pollution Control Board;
- The drill cutting along with spent mud will be stored in HDPE lined pit.

Waste Management Plan

- Use of low toxicity chemicals for the preparation of drilling fluid.
- Management of drill cuttings, waste drilling mud, waste oil and domestic waste, wastewater in accordance with Standards for Emission or Discharge of Environmental Pollutants from Oil Drilling and Gas Extraction Industry of CPCB as modified in 2005.
- The hazardous waste (waste and used oil) will be managed in accordance with Hazardous Waste (Management, Handling & Transboundary Movement) Rules, 2016.
- The kitchen waste will be disposed in nearest municipal/village dumping site on a daily basis through approved waste handling contractors.
- The sewage generated will be treated through septic tank and soak pit system.
- Used batteries will be recycled through the vendors supplying lead acid batteries as required under the Batteries (Management & Handling) Rules, 2001.
- The drill cuttings pit will be bunded and kept covered using tarpaulin sheets during monsoon.

Wildlife Management Plan

- Movement of heavy vehicles will be restricted at night time as most of the mammals movement occurs during night;
- Noise levels at the drill sites and production facilities will be controlled through selection of low noise generating equipment and installation of sufficient engineering controls viz. mufflers, silencers etc.
- No temporary electric supply connection line from the grid will be laid for the proposed project activity. All electric requirements will be supplied from the internal DG sets.

Road Safety & Traffic Management Plan

- The condition of roads and bridges identified for movement of vehicles and drilling rig will be assessed and if required strengthened by OIL to ensure their safe movement.
- Precautions will be taken by the contractor to avoid damage to the public access routes including highways during vehicular movement.
- Traffic flows will be scheduled wherever practicable during period of increased commuter movement.

Occupation Health & Safety Management Plan

- All machines to be used in the construction will conform to the relevant Indian Standards (IS) codes, will be kept in good working order, will be regularly inspected and properly maintained as per IS provisions and to the satisfaction of the site Engineer.
- Hazardous and risky areas, installations, materials, safety measures, emergency exits, etc. shall be appropriately marked.

Management of Social issues and concerns

- People from adjoining areas especially given job preference through local contractors according to the skill sets possessed.
- Prior to the commencement of the proposed activity, a consultation program will be conducted by OIL with the target groups and local authorities. The primary objective of such consultation will be to share with the concerned villagers/stakeholders the objective of the proposed project associated impacts and their mitigation.
- OIL will give more emphasis and priority on periphery development, development of health facilities and provision for drinking water facility as per Corporate Social Responsibility (CSR) Plan.
- The drill sites and production facilities would be fenced and gates would be constructed so that the children are refrained from straying into the site.

Emergency Response Plan

- Drilling rig and related equipment to be used for drilling will be conformed to international standards specified for such equipment.
- Blow-out preventers and related well control equipment shall be installed, operated, maintained and tested generally in accordance with internationally recognized standards.
- Appropriate gas and leak detection system will be made available at each of the drill sites and production facility.
- Adequate fire-fighting equipment shall be provided at each site.

PROJECT COST

Total cost of the project would be approximately INR 1988.62 crore. EMP implementation cost per well will be approximately 11.22 lakhs per well. EMP implementation cost of each production facility would be approximately 6.27 lakhs per year.

1 INTRODUCTION

1.1 BACKGROUND

Oil India Limited (OIL), a Government of India Navaratna Enterprise, is currently engaged in carrying out exploration activities for hydrocarbon in its operational areas of Upper Assam, Arunachal Pradesh and Mizoram in the North Eastern part of India. OIL has significant presence in pan-India and overseas. Government of Assam has awarded Petroleum Mining Lease (PML) in Dibrugarh and Tinsukia districts and adjoining areas for exploration and development of oil and gas to OIL covering Tinsukia PML, Tinsukia Extension PML and Chabua PML.

OIL is currently planning for drilling of 54 onshore exploratory and developmental wells, 2 nos. of production installations and laying of approximately 201 km of pipelines including 200 mm 21 km long crude oil pipeline from East Khagorijan GGS to Dikom OCS, 300 mm 20 km long natural gas pipeline from East Khagorijan GGS to Chabua FGGS, 200 mm 10 km long natural gas pipeline from Nadua OCS to Dikom OCS and 50 mm to 300 mm approx. 150 km long assorted oil & gas flow lines/ delivery lines in Khagorijan Oil & Gas Field under Dibrugarh and Tinsukia district of Assam.

Development and production activities in Khagorijan Oil & Gas Field is part of OIL's larger plan of development of hydrocarbons in 10 hydrocarbon Blocks in Dibrugarh, Tinsukia, Sibsagar and Charaideo districts of Assam Upper Assam region.

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 categorized as "A" level project that requires an Environmental Clearance (EC) from the Ministry of Environment, Forests and Climate Change (MoEFCC).

OIL had submitted Form-1 of the EIA Notification, along with a draft Terms of Reference (ToR) for scoping to MoEFCC. MoEFCC has issued an approved ToR vide J-11011/35/2018-IA II (I) dated 11th March 2018. The approved ToR is attached as ***Annexure 1.1***.

ERM India Pvt Ltd., a NABET-QCI accredited firm has been entrusted with the task of conducting an EIA study and technically assisting OIL in obtaining environmental clearance from the MoEFCC.

1.3 SCOPE OF THE EIA STUDY

The scope of the EIA study considers the impact due to drilling of 54 onshore exploratory & developmental wells, 2 nos. of production installations and laying of approximately 201 km of pipelines in Khagorijan Oil & Gas Field on physical, biological and socioeconomic environment of the surrounding areas as per the approved ToR provided by the 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 expansion 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.

1.4 COMPLIANCE TO TOR

The compliance against ToR points have been provided in ***Table 1.1.***

Table 1.1 Compliance of TOR

Sl No.	ToR Point	Comments
Standard ToR		
1.	Executive summary of a project.	Incorporated at the beginning of the report
2.	Project description, project objectives and project benefits.	Project description and Project objectives are presented in Chapter 2 while Project benefits are described in Chapter 8.
3.	Cost of project and period of completion.	The cost of Project is provided in Section 2.11. The tentative schedule for this drilling project is 5 years. The drilling of each well is expected to take 3-4 months.
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 Tope sheet of 1:40000 scale, superimposing the well locations and other structures of the projects. Topography of the project site.	Site details within 1 km for the development well locations have been provided in Section 2.4. Land use and land cover of the Khagorijan Field is presented in Section 3.3.2. The Toposheet and Satellite Imagery showing development well locations and production facilities are presented in Figure 2.2 and Figure 2.3 respectively. Floral/Faunal species recorded/reported in proximity to the proposed locations and production facilities are presented in Section 3.4. The proposed development wells and production facilities are located in flat land.

Sl No.	ToR Point	Comments
		The topography of the Khagorijan Oil & Gas Field is presented in Section 3.3.1.
5.	Details of sensitive areas such as National Park, Wildlife sanctuary and any other eco-sensitive area along with map indicating distance.	Details of sensitive areas such as National Park, Wildlife sanctuary and any other eco-sensitive areas indicating distance from proposed drill locations has been provided in Figure 3.15
6.	Approval for the forest land from the State/Central Govt. under Forest (Conservation) Act, 1980 as project involves forest land.	No well/production facility is located in forest land (refer Section 2.4)
7.	Recommendation of SCZMA/CRZ Clearance as per CRZ Notification, dated 6th January 2011 (if applicable)	Not Applicable
8.	Distance from nearby critically/severely polluted area as per Notification, if applicable. Status of moratorium imposed on the area.	There is no critically/severely polluted area within 10 km of the Khagorijan Oil and Gas Field.
9.	Does proposal involve rehabilitation and resettlement? If yes, details thereof.	The proposal does not involve any rehabilitation and resettlement (refer Section 2.6.2)
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.	Section 5 contains environmental and socioeconomic consideration for selection of proposed wells.
11.	Baseline data collection for air, water and soil for one season leaving the monsoon season in an area of 10 km radius with center of Oil Field as its center covering the area of all proposed drilling wells.	Baseline data has been collected for ambient air-8 locations for one season, noise at 13 locations, surface water at 3 locations, groundwater at 4 locations and soil at 5 locations. The data has been collected from October 2017 to December 2017. The data has been provided in Section 3.3.
12.	Climatology and Meteorology including wind speed, wind direction, temperature, rainfall relative humidity etc.	Climatology and meteorology data comprising of wind speed, wind direction, temperature, rainfall, relative humidity has been collected at Dibrugarh during the study period (refer Section 3.3.4).
13.	Details of Ambient Air Quality monitoring at 8 locations for $PM_{2.5}$, PM_{10}, SO_2, NO_x, CO, VOCs, total and non-methane HC.	Details of ambient air quality at 8 monitoring locations for $PM_{2.5}$, PM_{10}, SO_2, NOx, CO, VOCs, total and Non-Methane HC have been provided in Section 3.3.5.
14.	Soil sample analysis (physical and chemical properties) at the areas located at 5 locations.	Soil samples were collected at 5 locations. The monitoring locations and the results have been provided in Section 3.3.3.
15.	Ground and surface water quality in the vicinity of the proposed wells site.	Ground and surface water quality in the vicinity of the proposed well locations has been provided in Sections 3.3.8 &. 3.3.10 respectively.
16.	Measurement of Noise levels within 1 km radius of the proposed wells.	Noise levels have been measured at 13 locations within 1 km of the proposed wells. The details are provided in Section 3.3.6.
17.	Vegetation and land use; flora/fauna in the block area with details of endangered species, if any.	Information on flora and fauna has been provided in Section 3.4. Land use and land cover has been provided in Section 3.3.2.

Sl No.	ToR Point	Comments
18.	Incremental GLC as a result of DG set operation, flaring etc.	Incremental GLC has been provided in Section 4.2.5
19.	Potential environmental impact envisaged during various stages of project activities such as site activation, development, operation/ maintenance and decommissioning.	Potential environmental impacts envisaged during various stages of project activities are provided in Section 4.2.
20.	Actual source of water and 'Permission' for the drawal of water from the Competent Authority. Detailed water balance, wastewater generation and discharge.	Section 2.9.3 covers source and quantity of water required for each drill site. Water is planned to be withdrawal from groundwater Water balance have been provided in Figure 2.9. The volume of wastewater generation and discharge options are provided in Section 2.10.3.
21.	Noise abatement measures and measures to minimize disturbance due to light and visual intrusions.	Measures to mitigate light and noise related disturbances is given in Section 4.2.1 and 4.2.6 respectively.
22.	Details on wastewater generation, treatment and utilization /discharge for produced water/ formation water, cooling waters, other wastewaters, etc. during all project phases.	The volume of wastewater generation and discharge options are provided in Section 2.10.3. Water balance has been provided in Figure 2.9.
23.	Details on solid waste management for drill cuttings, drilling mud and oily sludge, produced sand, radioactive materials, other hazardous materials, etc. including its disposal options during all project phases.	Details on solid waste management for drill cuttings, drilling mud and oily sludge, produced sand, radioactive materials, other hazardous materials, including its disposal options during all project phases has been provided in Section 9.1.7 Waste Management Plan.
24.	Disposal of spent oil and lube.	Disposal option for used and spent oil has been provided in Section 9.1.7 Waste Management Plan.
25.	Storage of chemicals and diesel at site. Hazardous material usage, storage and accounting.	Some chemicals and diesel will also be stored at paved and bunded areas within the drill site (refer section 2.6). Hazardous material usage, storage and accounting is presented in Section 9.1.7 Waste Management Plan.
26.	Commitment for the use of water based mud (WBM) only	Water based mud will only be used as discussed in Section 2.6. However, eco-friendly polymer based mud will also be used if required for deeper sections after providing intimation to the Pollution Control Board.
27.	Oil spill emergency plans for recovery/ reclamation.	Spill Management Plan has been provided under Section 9.1.8
28.	H_2S emissions control.	Earlier explorations show the absence of H_2S in the study area. However, H_2S detector and self-containing breathing apparatus is available with OIL.
29.	Produced oil/gas handling, processing and storage/transportation.	Information on Production Installations have been presented in Section 2.7 while information on Interconnected Pipelines is presented in Section 2.8
30.	Details of control of air, water and noise pollution during production phase.	Details of control of air, water and noise pollution during drilling and testing phases have been provided in

Sl No.	ToR Point	Comments
		Section 9.1.1 Air Quality Management Plan Section 9.1.2 Noise Quality Management Plan Section 9.1.5 Surface water Quality Management Plan Section 9.1.6 Groundwater Quality Management Plan
31.	Measures to protect ground water and shallow aquifers from contamination.	Measures to protect groundwater and shallow aquifers from contamination has been provided in Section 9.1.6 Groundwater Quality Management Plan
32.	Whether any burn pits being utilised for well test operations.	Burn pits will not be utilized 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.	Risk assessment has been discussed in detail with a focus on blowout in Chapter 7.
34.	Environmental management plan.	Environmental Management Plan is provided in Chapter 9.
35.	Total capital and recurring cost for environmental control measures.	The capital and recurring costs are presented in Section 9.3
36.	Emergency preparedness plan.	Emergency plan of OIL in case of emergency is provided in Section 7.5.
37.	Decommissioning and restoration plans.	Decommissioning Plan is presented in Section 9.1.4.
38.	Documentary proof of membership of common disposal facilities, if any.	Common disposal facility does not exist in Assam.
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.	OIL maintains relevant information/ documents in their internal system.
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.	A copy of Health, Safety and Environmental Policy of OIL has been provided as a part of the Environmental Management Plan in Box. 9.1.
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.	None

1.5 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 OIL with the assumption that the information gathered is representative for the proposed drilling of 54 onshore exploratory and

developmental wells, 2 nos. of production installations and laying of approximately 201 km of pipelines in Khagorijan Oil and Gas Field. If information to the contrary is discovered, the findings in this EIA may need to be modified accordingly. The impact assessment for the Project is based on the project configuration as described in ***Section 2*** on Project Description.

ERM is not engaged in the impact assessment and reporting for the purposes of advertising, sales promotion, or endorsement of any client's interests, or other publicity purposes. The client acknowledges that any report prepared by ERM are for the exclusive use of the client and agrees that ERM's reports or correspondence will not be used or reproduced in full or in part for such promotional purposes, and may not be used or relied upon in any prospectus or offering circular for commercial purposes.

1.6 LAYOUT OF THE REPORT

The report has been structured as per guidelines stated in EIA Notification, 2006 and its amendments thereof. The following sections form part of the report:

Table 1.2 Content of the Report

Sl. No.	Section	Brief Description
	Executive Summary	Executive Summary of EIA report.
1.	Introduction	This section covers project background; regulatory requirement and overview of the project.
2.	Project Description	Presents a Description of the Existing and proposed project.
3.	Environmental Baseline Study	Includes a description of existing environmental and social baseline conditions covering both existing plant area and surrounding area.
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 to be scheduled during construction and operation phase is provided
7.	Additional studies	Risk assessment and Emergency Response Plan of the plant. Stakeholder assessment as per primary consultation and Public hearing related issues.
8.	Project Benefits	Benefits arising due to proposed project.
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 ERM and professionals who were engaged for completion of this study.
	Annexure	Annexure to EIA study

2 PROJECT DESCRIPTION

2.1 OVERVIEW OF THE PROJECT

The project include OIL's proposed onshore Oil & Gas exploration and development drilling, installation of production facility and laying of 201 km assorted pipeline in Khagorijan Oil and Gas Field area in Dibrugarh and Tinsukia Districts under Tinsukia PML, Tinsukia Extension PML and Chabua PML.

The area includes Tinsukia, Chabua, Panitola, Guijan, Dinjan areas. OIL is presently producing crude oil and gas from the Khagorijan Oil and Gas Field which is spread over the administrative districts of Dibrugarh and Tinsukia in Assam. In order to further enhance production activities in the area OIL is proposing to drill 54 (Fifty Four) exploratory & developmental wells along with construction of production facilities covering Tinsukia PML, Tinsukia Extension PML and Chabua PML covering a project area of 405 sq. km. In the event of successful completion of drilling of the additional wells, it is expected to further augment the production of the crude oil from the said block by around 5 million metric ton (MMT) with 250 MMSCM gas per year.

2.2 OBJECTIVES OF PROPOSED DRILLING AND PRODUCTION ACTIVITY

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

- Provision of more royalty to Assam Government and more cess to Govt. of India
- Provision of more employment opportunity to local people
- Development of infrastructure (roads, culverts, bridges etc.) in the area
- Increase in business opportunity for the local people
- Energy security for the country
- Programs related to livelihood generation, health improvement as per OIL's Corporate Social Responsibility (CSR) programmes

2.2.1 *Project Objectives*

Specific objectives of the proposed drilling activities are summarized below:

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

2.3 AREA LOCATION AND ACCESSIBILITY

2.3.1 Area Location

The Khagorijan Oil and Gas Field is located in Dibrugarh and Tinsukia districts of Assam. Total area of Khagorijan Oil and gas Field is 405 sq. km. The coordinates of the four corners of the Khagorijan Oil and Gas Field is presented below. The regional setting of Khagorijan Oil and Gas Field is presented in ***Figure 2.1*** and the location of the Khagorijan Oil and Gas Field on toposheet and satellite imagery is shown in ***Figure 2.2*** and ***Figure 2.3.***

Table 2.1 ***Details of Coordinates of Khagorijan Oil & Gas Field***

Point	Latitude	Longitude
A	27°33'56.18"N	94°58'00.01"E
B	27°35'18.88"N	95°21'00.05"E
C	27°28'50.00"N	95°20'60.00"E
D	27°28'50.00"N	94°58'00.00"E

2.3.2 Accessibility

NH 37(AT road) is the most prominent road in the region. The road runs through the southern side of Khagorijan Field, in an east to west orientation. This road connect Tinsukia town located in the south eastern corner of the Field, with Dibrugarh town located on the south western side, outside the Field. PWD roads arising from the AT road leads northward up to Brahmaputra River/Dibru River making the interior of the Field accessible. Notable among the small roads are Bilu road, which leads to Dibrugarh Airport, another such road is Dinjan-Balijan road which leads to Balijan (located more or less centrally in the block) and Rangagora Road that arises from Tinsukia town and leads to Guijan. The extreme northern side of the block is not easily accessible as it is mainly Brahmaputra River on the west and Dibru-Saikhowa National park in the east.

Tinsukia Junction and New Tinsukia Junction are the major railway stations within the Field and are located at the Guwahati-Dibrugarh line of North East Frontier railway. The Guwahati Dibrugarh line traverses through the south of the Khagorijan Field. Other railways stations located within or close to the Field are Lahoal, Dikom, Chabua, Panitola etc.

Mohanbari Airport is located within the Khagorijan Field which is primarily used for commercial flights. There are also two Air Force bases within the Field located at Chabua and Dinjan.

The accessibility to the different Study area is shown in ***Figure 2.4.***

Figure 2.1 Regional Setting Map of Khagorijan Oil and Gas Field

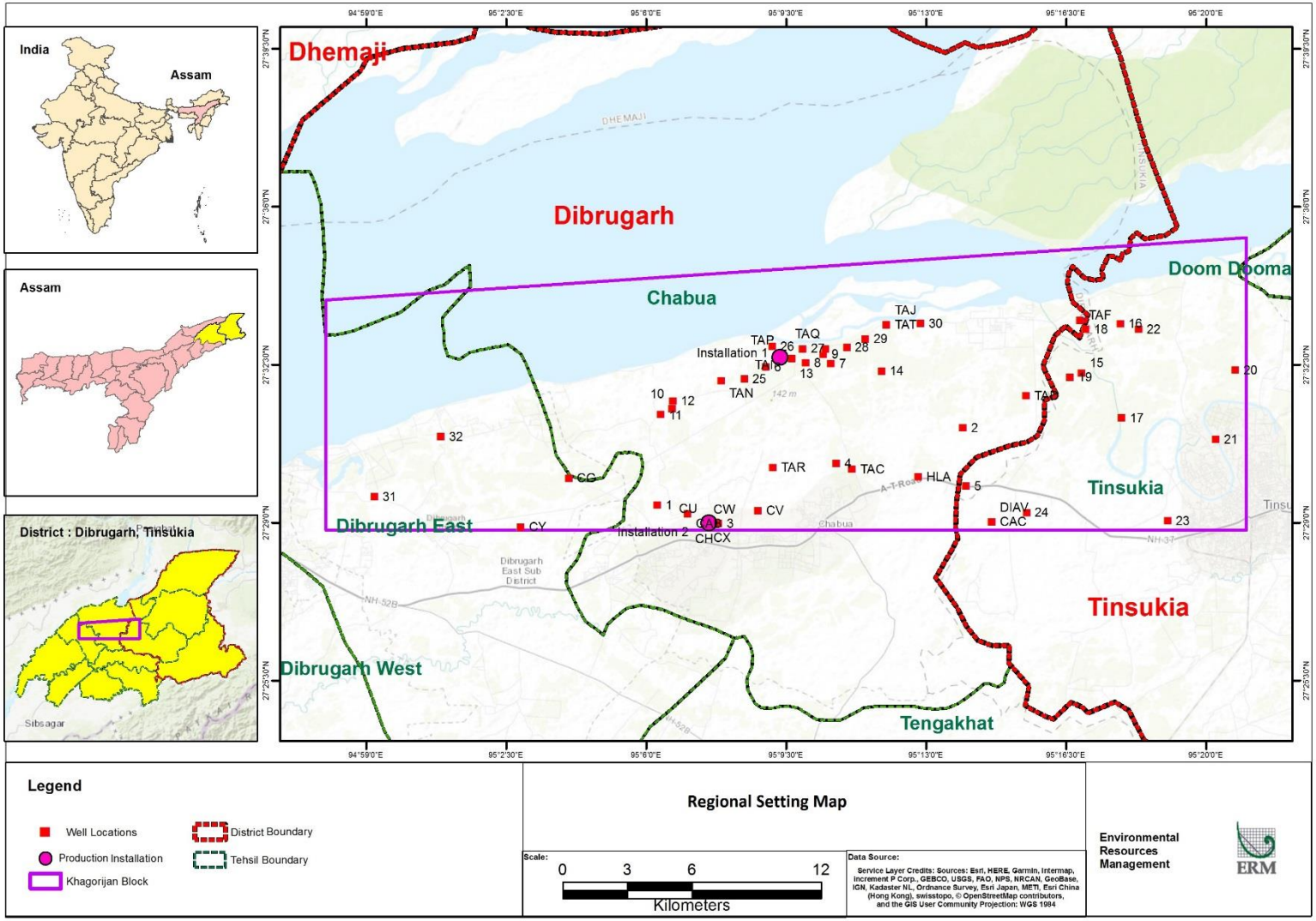


Figure 2.2 Khagorijan Oil and Gas Field on Toposheet

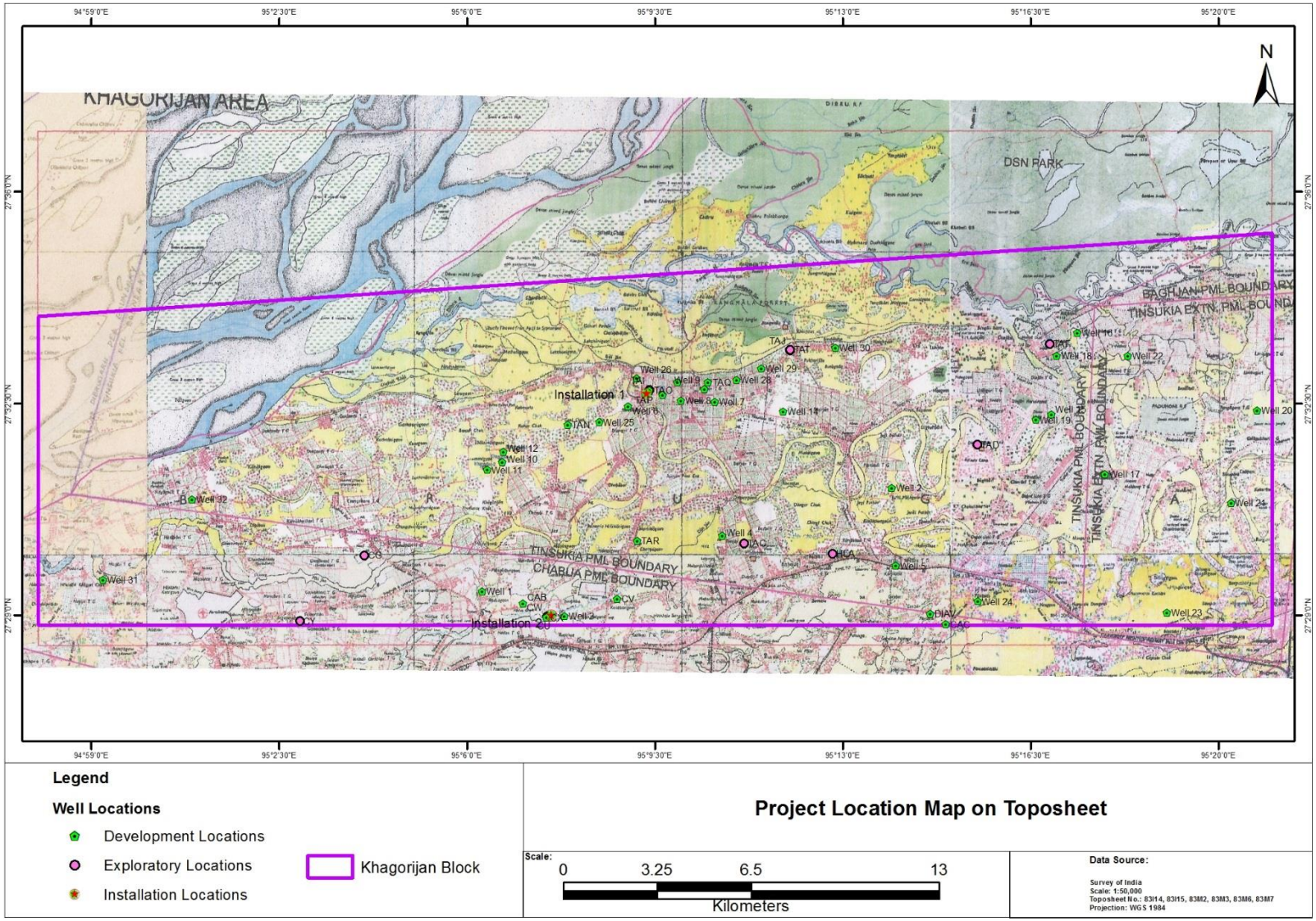


Figure 2.3 Khagorijan Oil and Gas Field on Satellite Imagery

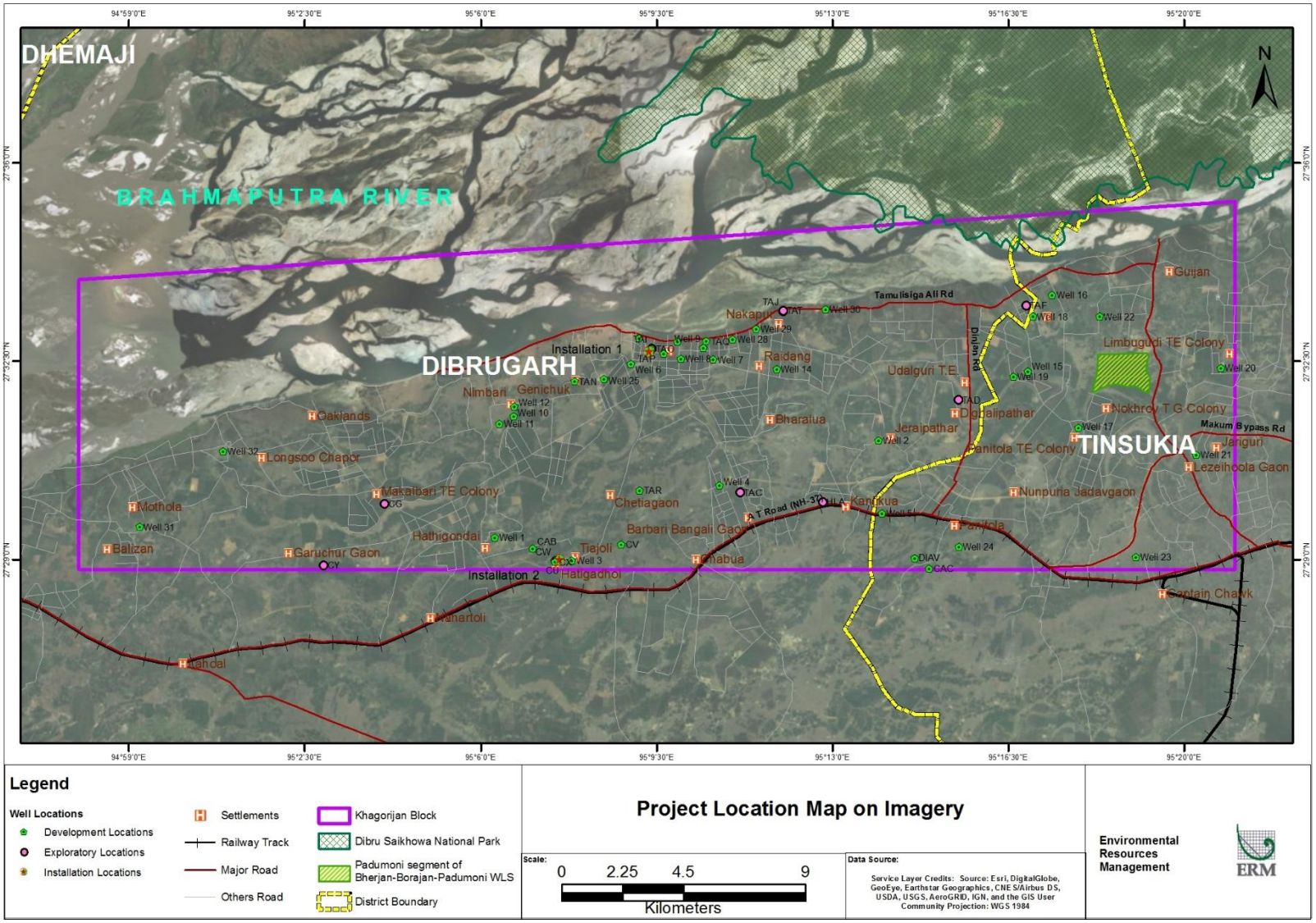
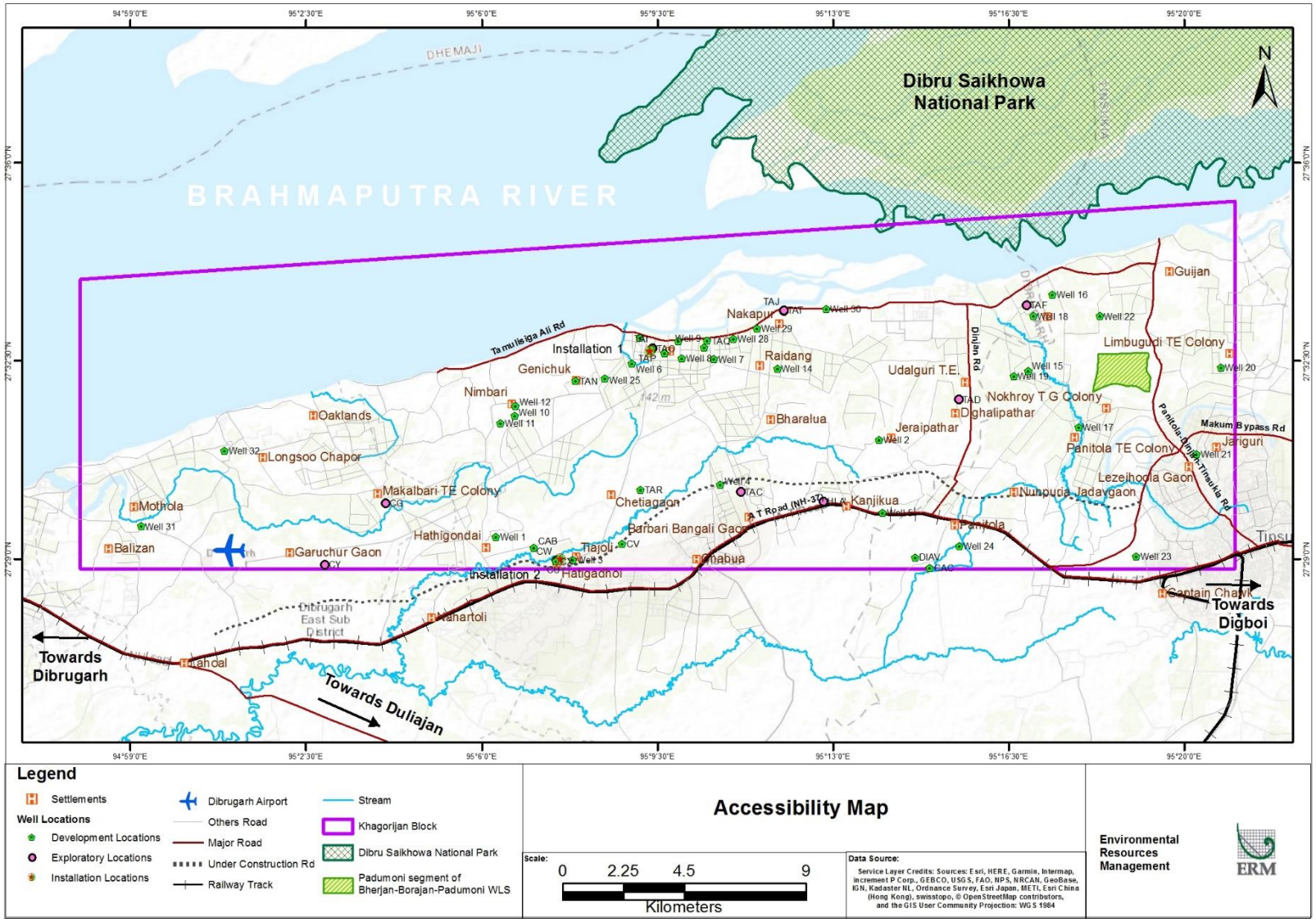


Figure 2.4 Accessibility Map of Khagorijan Oil and Gas Field



2.4 ENVIRONMENTAL SETTINGS

2.4.1 Khagorijan Oil and Gas Field

Environmental settings of the Khagorijan Oil and Gas Field is presented below;

- The Field is rectangular in shape having a dimension of approximately 38 km in length and 12 km in breadth. The northern half of the Field is mainly covered under the course of the Brahmaputra River (at the north-west) and Dibru-Saikhowa National Park (at the north-east). The southern boundary of the Field is more or less aligned with the NH 37 with towns like Tinsukia and Dibrugarh located near the south-eastern and south-western boundary respectively.
- The Khagorijan Field is located in the drainage basin of Brahmaputra River. The branch of the Brahmaputra River, Dangori River flows within Field from north-eastern to the northwestern part. Dangori River branches off from the Lohit River and connects the Brahmaputra River near Rahmoria. Apart from Brahmaputra (flowing through North), other major river in the block is the Dinjan river that flows more or less through the southern part of the Field. Dinjan flows east to west.
- Two protected areas are located within the Field area. The north eastern part of the Khagorijan Field falls within the buffer of Dibru-Saikhowa National Park. Apart from that the Padumoni section (1.7 sq Km) of the Bherjan-Borajan-Padumoni Wild Life Sanctuary falls in the eastern part of the Field.
- A large number of tea gardens are located within the Field area. Majority of the tea garden are located centrally in the Field, mostly along the southern bank of the Brahmaputra River. Major tea estate within the field area are Oakland T.G, Hazelbank T.G, Nadua T.G, North Balijan T.G, Dinjoy T.G, Kharjan T.G, Panitola T.G, Dinjan T.G, Rangagora T.G, Nalani T.G, Nokhroy T.G, Limbugudi T.G. etc.
- The field mostly comprises of large tea estates, rural area with agricultural lands, settlements and homestead plantation. Tinsukia is the major town in the area, located in the south eastern corner of the field. Apart from that, Panitola and Chabua are two other urban areas located more or less in the southern part of the field. Though not located within the field, Dibrugarh town is located within 2km of the block in the south western direction. Mohanbari Airport is located in the south western part of the Field.
- Due to the geostrategic location of the area a large number of defence installations are located within and around the Block.

2.4.2 Well Sites and Production Facilities

The proposed well sites and production facilities were selected based on environmental considerations *viz*. by avoiding locations that are sensitive, i.e.

ecological habitats, settlements, schools/ hospitals, water bodies etc. Environmental settings of wells and production installations in Khagorijan Field is presented below.
Summary of environmental settings of the within 1 km of the wells and productions installations are presented in ***Table 2.2.***

Table 2.2 ***Summary of Environmental Setting of Wells and Production Installations in Khagorijan Oil and Gas Field***

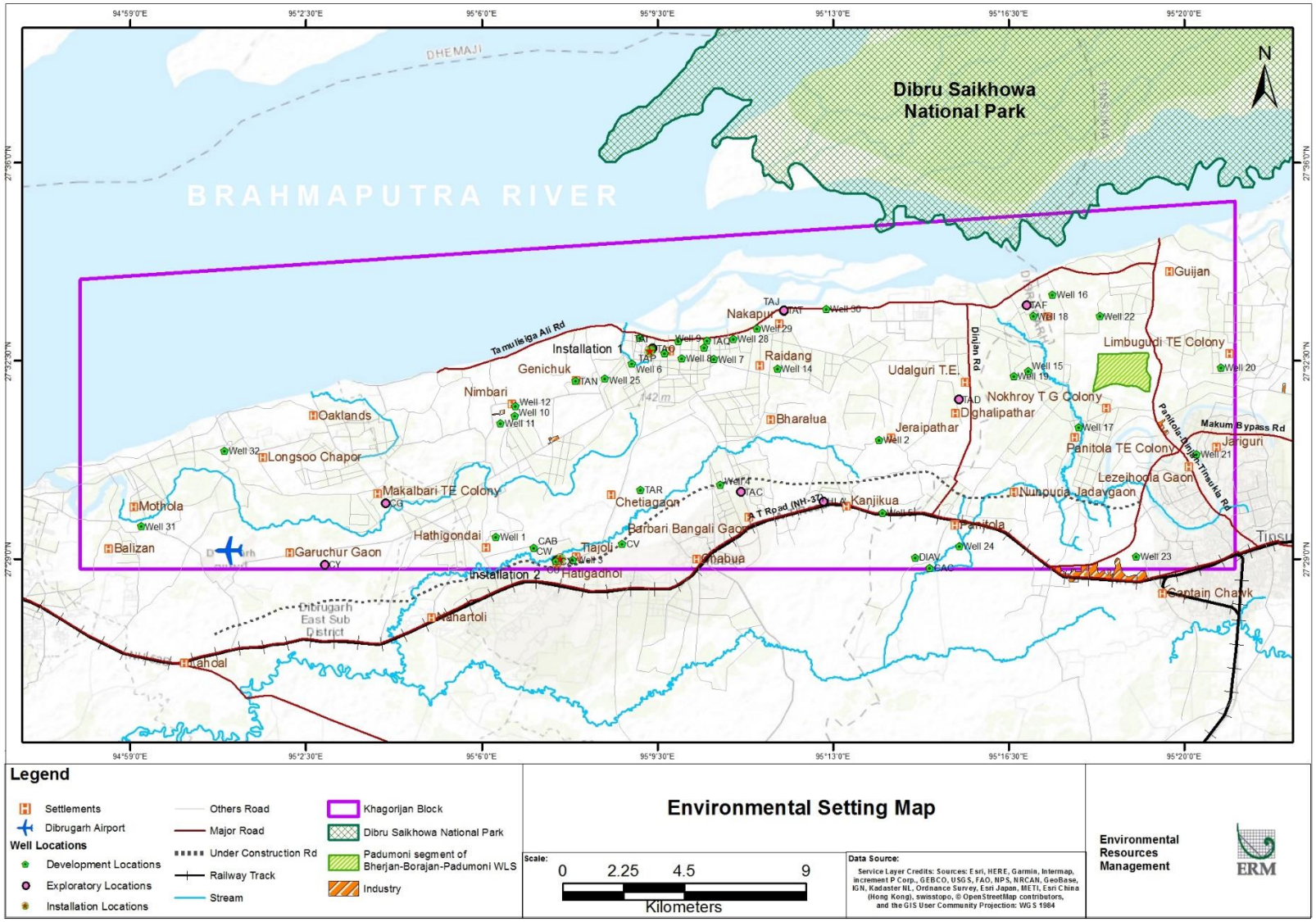
Land Use/Land Cover Class	No	Area (ha.)	Wells/Production facilities
Land Use/Land Cover - Wells			
Agricultural Land	9	27 (approx 3 ha. per well)	Well 21, Well 23, Well 17, Well 18, Well 24, Well 11, Well 32, TAR
Homestead Plantation	8	24 (approx 3 ha. per well)	Well 2, CAC, DIAV, HLA, Well 30, TAN, CV, Well 31
Tea garden	26	78 (approx 3 ha. per well)	Well 20, Well 22, Well 16, TAF, Well 15, Well 19, Well 14, Well 5, Well 4, TAQ, Well 9, Well 7, Well 8, Well 13, Well 6, Well 26, Well 27, Well 28, Well 29, Well 3, CAB, Well 12, Well 10, Well 1, CY
Brick Field	1	3 (approx 3 ha. per well)	Well 25
Existing Site	12		TAD, TAJ, TAT, TAC, TAP, TAI, TAO, CH, CU, CW, CX, CG
Land Use/Land Cover - Production Installation			
Agricultural Land	1	4-7	Installation 1. E Khag
Tea Garden	1	4-7	Installation 2. Nadua

Detailed environmental settings of the wells and production facilities are presented in ***Annexure 2.1***.

2.5 EXISTING ACTIVITY IN OIL FIELD

Khagorijan-1 was the first well in this EC block and drilled in 1998. Oil was established in this well in Lakadong+Therria Formation and presently under production. Later on East Khagorijan, Jeraipathar and Matimekhana structures were drilled.

Figure 2.5 Environmental Setting Map



2.6 *WELL DRILLING*

The lifecycle of project drilling activities for the proposed project has been divided into distinct steps and each is described in detail in the subsequent sections and will take approximately three to four months to complete drilling and testing activity at each well site.

The drilling phase lifecycle has been classified into three phases:

- Pre-drilling activity;
- Drilling activity and
- Decommissioning.

2.6.1 *Pre-drilling Activity*

The pre-drilling phase will involve the following activities:

Site Selection

The sub-surface locations were selected by OIL on the basis of available geological data. The environmental considerations for selection of surface locations of the drill sites are as follows:

- Outside the boundary of Wildlife Sanctuary;
- Non-forest area and area with low vegetation.
- Away from organized human habitats.
- Easy access to area of interest

Land Procurement

As mentioned in ***Table 2.2*** land would be procured from agricultural lands, homestead plantation areas and tea garden areas for the development of the proposed wells and production facilities. Approximately 3 ha. land would be required for each well and 4-7 ha. land would be required for each production facility. 9 wells are located in agriculture land, 8 wells in homestead plantation areas, 26 wells located in tea garden areas, 1 well located in brick field and 12 wells in existing well site. Apart from that 1 production facility located in agriculture land and 1 production facility in tea garden. As 12 well is located in existing well site it is to be anticipated that no additional land will be procured for this facility.

However, no physical displacement during land procurement is anticipated, hence the project will not involve any rehabilitation and resettlement.

Generally, OIL will procure the required land through private negotiation. In few cases, OIL may request district authority to acquired land under LARR act 2013, if private negotiation is not successful. Land procurement will be done including crop compensation. Land from the tea garden would be taken on long-term lease from the tea garden authority.

Access Road and Site Construction

Construction of Access Road

The distance of the proposed well locations and production facilities would be in proximity to the existing roads; however, 100-200 m approach road need to be constructed from the existing roads to reach the proposed locations. In some cases the existing roads would also need to be widened or strengthened for the movement of heavy vehicles for drilling and other production facilities.

Construction of site access road will not require any forestland or involve displacement of any household. As far as possible, existing roads will be used. Cutting of trees will be avoided as far as possible. If necessary, existing road will be developed by widening, etc. Culverts and drainage channel will be maintained during site preparation. The approach road will be constructed by a contractors appointed by OIL.

Drill Site Construction

After clearance of vegetation, top soil from non-paved areas of the drill sites site will be scraped and stored in the top soil storage area for future use. Once the top soil removal process is completed, levelling and compaction will be done with help of graders and mechanical rollers. Quantity of fill material required for each drill sites depends upon the site elevation and HFL. Fill material will be met from excavated material for pit required for drill site and balance amount will be sourced from authorized quarry area.

Reinforced Cement Concrete (RCC) will 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 will also be used. For the construction of a drill site, a total of about 2500 kg of cement, 5000 kg of sand, 500m^3 of earth/fill material, 200 kg steel and 1000m^3 of aggregate will be required. A backhoe will be used for all excavation and cutting activities (for construction of pits) on site. Subsequently, the proposed well site & campsite will be duly fenced to a height of about 2 m using jingle wired fencing or XPM fencing.

Drill site construction will also involve the following:

- Construction of cellar pit 1.85m X 2.15m X 1.5 m for installation of well head and BOP
- Construction of HDPE lined pit of ~800m^3 for each well site for temporary storage and disposal of drill cutting
- Construction of HDPE lined pit of 3000 m^3 for temporary storage and disposal of drilling wash water & waste mud (800 m^3)
- Septic tanks and soak pits to dispose the domestic wastewater at the drill site.

Spares, chemicals and other materials will be received from OIL's warehouse located at Duliajan (at an average distance of 50 km from the proposed facilities) Materials will be intermittently supplied from the warehouse to the drilling site, during operations; a provision will be kept for temporary storage of materials at the drilling site itself.

Rig Mobilization and Rigging up

A rig building process will follow the site preparation activities. This process involves transport of rig including auxiliary equipment and camp facilities, assembling of various rig parts and equipment to drill a well. The rig including auxiliary equipment and camp facilities will comprise of around 100 truck/trailer loads. Once the drilling rig is assembled, thorough rig inspection will be carried out to check equipment working capability and quality standards. The rig will have various allied equipment like mud tanks, mud pumps, compressors, fuel tank and DG sets etc.

Initial Well Construction

Spudding-in well is the start of drilling activity. Top-hole section will be drilled to a desired depth based on well design. After drilling top-hole section, it will be cased with a pipe called "Casing". Casing provides support to hole wall and secures hole section. This process of drilling and casing the hole section continues until the final well depth (target) is achieved.

Lengths and diameters of each section of the well are determined prior to drilling and are dependent on the geological conditions through which the well is to be drilled. 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.

2.6.2 Drilling Activity

The development of hydrocarbons requires the construction of a conduit between the surface and the reservoir. This is achieved by the drilling process. The development wells will be drilled using a standard land rig or a "Mobile Land Rig" with standard water based drilling fluid treatment system. This rig will be suitable for deep drilling up to the desired depth of 3900 metres as planned for the project.

Additionally, there will be other ancillary facilities like Drilling mud system, Effluent Treatment System (ETP), Cuttings disposal, Drill Cementing, equipment etc. and utilities to supply Power (DG sets), water, fuel (HSD) to the drilling process and will be set up as a part of the project.

Mud System and Cuttings

During drilling operations, a fluid known as drilling fluid (or 'mud') is pumped through the drill string down to the drilling bit and returns between

the drill pipe –casing annulus up to surface back into the circulation system after separation of drill cuttings /solids through solids control equipment. Drilling fluid is essential to the operation and helps in controlling downhole pressure, lift soil/rock cuttings to the mud pit, prevent cuttings from settling in the drill pipe, lubricate, cool and clean the drill bit amongst other functions. OIL will use primarily water based mud for drilling activities. Eco-friendly polymer mud system may also be used if required for deeper sections after providing intimation to the Pollution Control Board. Unlike an oil-based mud system, usage of water-based mud will not pose higher risk of contamination to subsurface formations, but disposal of the fluid and cuttings will be less problematic. Because of the anticipated borehole instability problems, it may be necessary to introduce a base salt, such as Sodium Formate (HCOONa) into the system.

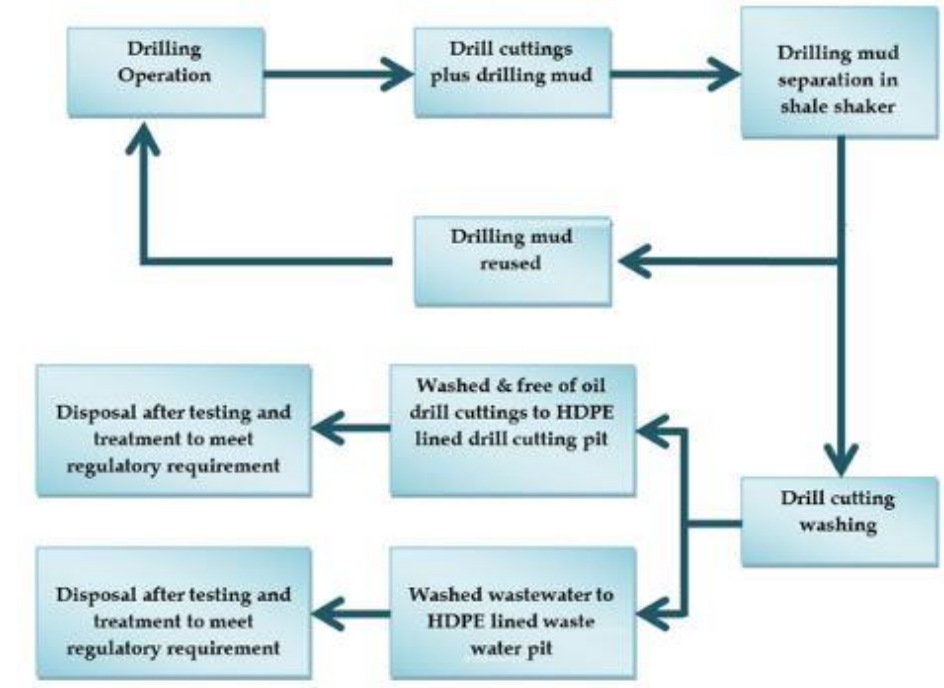
Mud used during the operation will flush out formation cuttings from the well hole. These cuttings will be separated from the drilling mud using a solids-control and waste management package. Cuttings will then be stored in the HDPE lined pits (of approximately 800 m^3 capacity) and after completion of the drilling activities, cuttings will be tested for hazardous nature and based on nature of the drill cuttings, final disposal pathway will be finalized by OIL. The total amount of cuttings produced during the entire drilling period is projected to be about 350-400 m^3 per well.

Once the cuttings have been separated, the drilling fluid will be reused or processed after further treatment in a Chemically Enhanced Dewatering (CED) system designed to remove suspended solids that are too fine for mechanical separation in solids control package producing inlet particles called 'flocs'. The flocs will be removed in the decanting centrifuges and the resultant sludge disposed off in High Density Polyethylene (HDPE) lined pits (of approximately 800 m^3 area) for each well. The cleaned wastewater will also be stored in HDPE lined pits and disposed of, after testing and any necessary treatment, to meet the regulatory requirements.

The whole process by which the drilling fluid will be reused during the drilling operation is commonly known as a "closed loop system." This system is ideal for drilling operations in sensitive environments as it cuts down immensely on the total water consumption for the formulation of drilling mud and saves on the consumption of chemicals. ***Figure 2.6*** shows the schematic layout of the drilling waste management. Various components of the drilling mud will be selected carefully to be able to provide desired properties to the mud. Mud chemicals will be added to the uniform mud system to adjust the mud properties and ensure fluid loss control/circulation, lubricity, shale inhibition, pH control and pressure control in the well during drilling.

Chemicals required for the preparation of drilling fluid will be centrally stored in Duliajan. Additionally, some chemicals will also be stored in the drill site. The storage area will be paved and bunded and will be provided with a shed.

Figure 2.6 Drilling Waste Management



Cementing Programme

Cementing is a necessary aspect of drilling oil and gas wells. Cement is used to

- Secure/support casing strings
- Isolate zones for production purposes
- Solve various hole problems

Cementing generally utilizes Portland cement (API Class G Oil Well Cement) with various additives in small quantities as accelerators/retarders, density adjusters, dispersants, fluid loss additives, anti-gas migration additives, etc.

Well Testing

Between the drilling operations for different zones, logging operations are undertaken to provide information on the potential type and quantities of hydrocarbons present in the target formations. Technicians employed by a specialist Logging Service will be entrusted with the job of undertaking well logging. Logging instruments (sensors) will be attached to the bottom of a wire line and lowered to the bottom of the well. They are then slowly brought back, the devices reading different data as they pass each formation and recording it on graphs, which can be interpreted by the geologist, geophysicist and drilling engineer. There are no emissions to the environment associated with wire line logging operations. The radioactive source required for well logging operations will be kept in specially designed container. The excess hydrocarbon will be flared.

Salient Features of Wells

The water consumption, generation of drill cuttings and drilling fluid is determined by depth and type of well as presented in ***Table 2.3***.

Table 2.3 Salient features of a typical well

Type of Well	Depth of Well	Water Consumption	Drill Cutting	Drilling Fluid
Development	3900 m	3600-4800m^3	350-400m^3	900-1200m^3

Use and Storage of Chemicals and Diesel: Chemicals required for the preparation of drilling fluid will be centrally stored in Duliajan. Additionally, some chemicals will also be stored in the drill site. The storage area will be paved and bunded and will be provided with a shed. Diesel will also be stored in tankers at site within paved and bunded areas.

2.6.3 Well Decommissioning

On completion of activities, if the production of the well is commercially viable, the development wells will be either plugged or connected with flow lines or suspended. In the event of a decision to suspend the well, it will be filled with a brine solution containing very small quantities of inhibitors to protect the well. The well will then be sealed with cement plugs and few wellhead equipment (Blind Flange) left on the surface (Cellar). All the wellhead equipment will be removed leaving the surface clear of any debris and site will be restored. It is expected that demobilization phase will last about 10-15 days and will involve the transportation of materials, equipment and other materials from site to bring it back to original condition. It is estimated that about 60 truckloads will be transported out of site during this period. Subsequently, following steps will be typically involved to restore and rehabilitate the area:

- The wellhead and all casing string will be cut off to a minimum depth of 3 m (10 ft.) below ground level;
- Drill cuttings and drill mud will be treated as per G.S.R 546 (E) dated 30th August 2005 to render them harmless;
- Drilling wastewater including drill cuttings wash water shall be collected in HDPE lined disposal pit, evaporated, treated, and shall comply with the S No. 72, Schedule I-Standards for Emission or Discharge of Environmental Pollutants from various industries;
- All fencing and access gates will be removed;
- All pits whose contents will show regulatory compliance for on-site disposal, at the time of site closure, will be backfilled and closed out as per Hazardous and other Waste (Management and Transboundary Movement) Rules, 2016; and
- Restoration of unusable portion of the access track, removal of pilings.

2.7 *PRODUCTION INSTALLATIONS*

Two Production installations planned within the Khagorijan Field. Among the production facilities, one facility in agricultural land and one facility in tea garden areas. The production installation may include the following facilities.

2.7.1 *Oil Collection Station (OCS)*

Considering the size of the oil field and the number of oil / gas wells in the area, it is necessary to have certain facilities at various central locations to collect and handle oil / gas coming from the wells before pumping them to the Central Tank Farm (CTF) / Central Processing Facility (CPF) for storage and processing of hydrocarbons. OCS's are built to serve the above purpose. An OCS also facilitates to monitor the flow of oil / gas from wells and the conditions of wells and the flow-lines. An OCS has a number of oil / gas wells connected to it depending upon the oil / gas handling capacity of the OCS and techno-economics of laying flow-lines from the well to the OCS. Producing fluids from the neighbouring wells are collected in an OCS through well flow lines.

Process Description

An OCS has a number of oil / gas wells connected to it depending upon the oil / gas handling capacity of the OCS and techno-economics of laying flow-lines from the well to the OCS. Producing fluids from the neighboring wells are collected in an OCS through well flow lines. Fluid from the wells enters the LP manifold and passes through the steam jacket to the Three Phase Separator (TPS). Gas, oil and free water (if any) are separated here. Then the wet crude is taken to the Emulsion Treater (ET). In the Emulsion Treater, the wet crude is heated up to 600^0C and a chemical called 'Oil Soluble Demulsifier is added to it continuously. In this process oil and water are separated from each other. Oil from the Emulsion Treater is then taken to the Stabilizer and from the stabilizer it goes to the crude oil storage tanks. The stored crude oil is dispatched to CTF from time to time with the help of reciprocating pump. Water is collected in formation water storage tanks. There after it is disposed in water disposal wells with the help of centrifugal pumps.

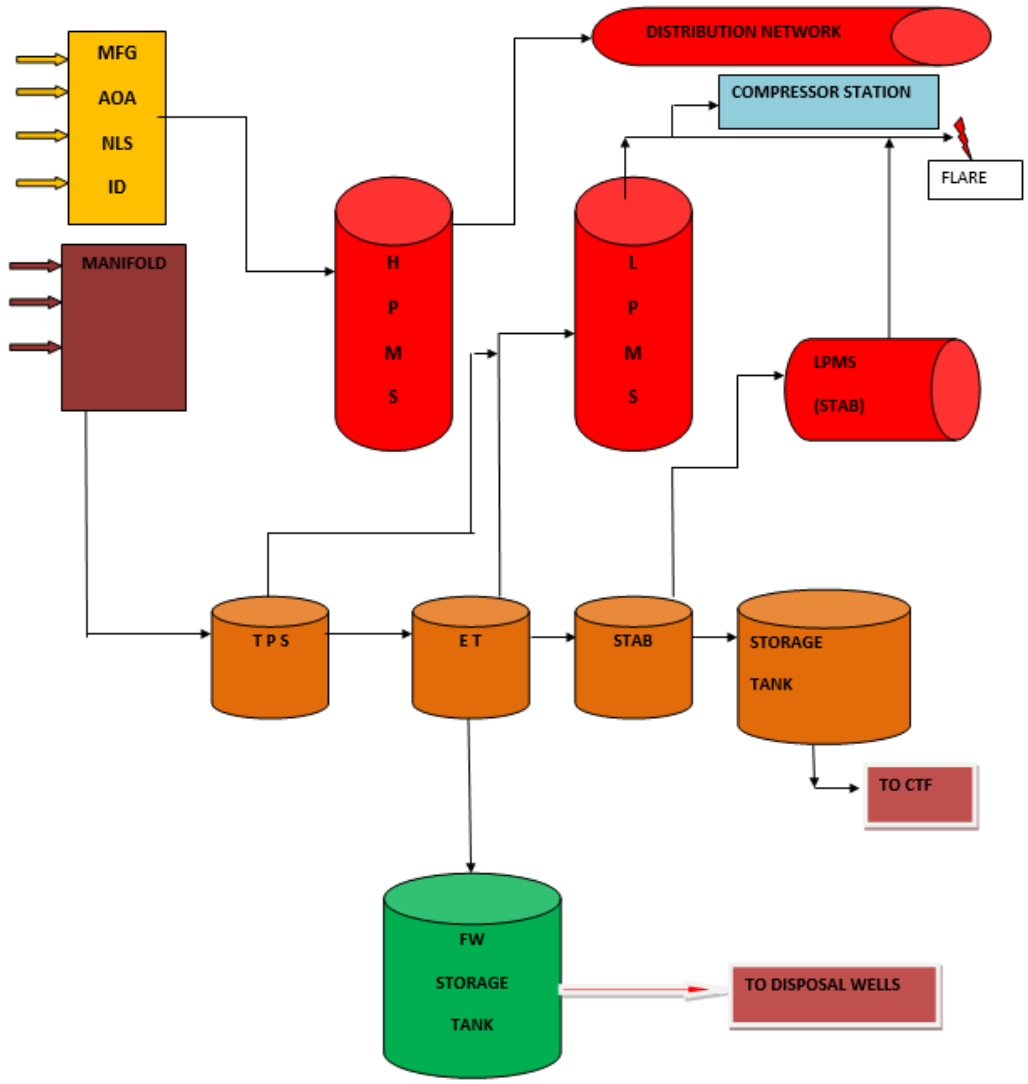
Gas separated in TPS and ET goes to the 30 psi Low Pressure Master Separator (LPMS) and then to Booster suction at GCS. The excess gas is flared in the flare pit. Gas separated in the Stabilizer goes to the 10 psi Low Pressure Master Separator (LPMS) from where it is flared in the flare pit. Process description of an OCS is presented in the figure below.

Storage Facilities

In general following storage facilities are provided at the OCS[1]

- Two production tanks (795 KL capacity) for storage of crude oil. Height of the tanks are approximately 10 m with safe storage height of 5.7 m. Crude is generally stored at 1 atmospheric pressure and at 60^{0}C.
- One test tank (160 KL capacity) for storage of hydrocarbons at the time of testing
- Two formation water tanks (160 KL and 40 KL) for storage of formation water
- One skimming tank (40 KL capacity)

Figure 2.7 Process Description of OCS



ET- Emulsion Treater; LPMS- Low Pressure Master Separator; HPMS- High Pressure Master Separator; CTF- Central Tank Farm; Fw- Formation Water;

[1] The details provided here are obtained from operating Jorajan OCS of OIL. These are standard figures for OCS of OIL. However, the storage facilities may vary on the basis of specific requirement of OCS and its receiving wells.

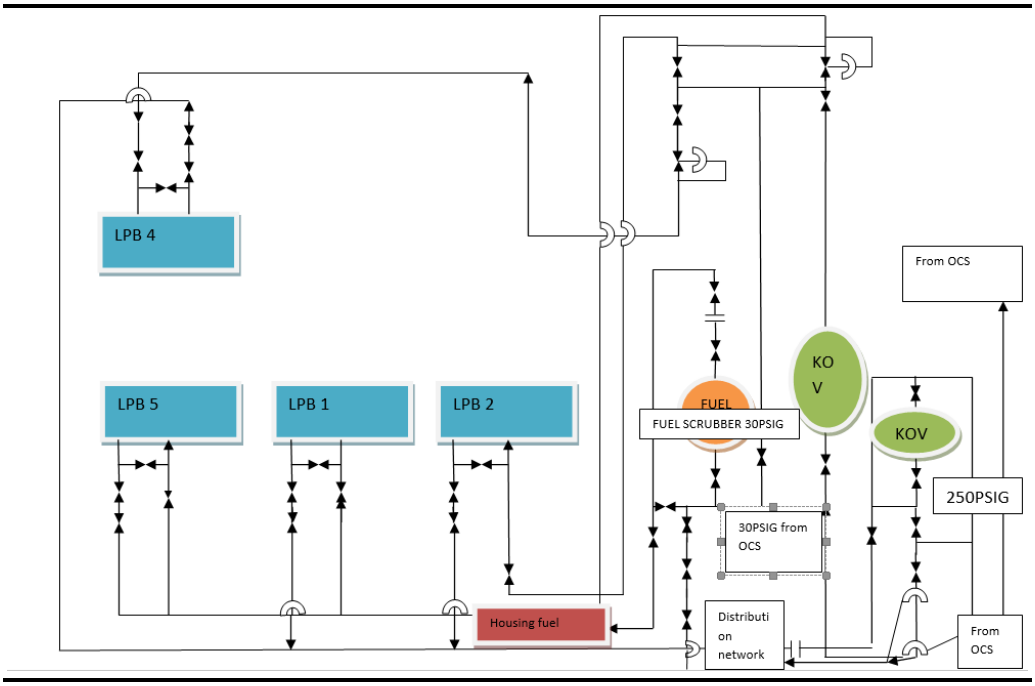
2.7.2 *Gas Compressor Station (GCS)*

Associated / non-associated gas is collected from the fields through OCSs / Gas Production installations in two pressure streams LP & HP. In order to transport it to consumers, the gas needs to be further compressed to a certain high pressure, depending upon the distance, type of use like LPG extraction etc. Gas Compressor Stations, GCS houses a number of compressors along with allied facilities & pipelines. The compressed gas from GCS is sent to

- LPG Plant for extraction of Propane & Butane, main content of LPG.
- To downstream consumers through Assam Gas Corporation Ltd. (AGCL), Gas Authority of India Ltd. (GAIL).

A fraction of the gas is dehydrated and compressed to higher pressure for use in Gas Lift system. The GCS constructed in the field is also used to pump compressed are to the sick wells to augment their production. Schematic diagram of a GCS is presented at the figure below.

Figure 2.8 Line Diagram of GCS



LPB- Low Pressure Booster Pumps

2.7.3 *Field Gas Gathering System (FGGS)*

In a particular field a FGGS is set up which accommodates multiple OCS and GCS in a single facility. FGGS generally require the maximum area i.e. approximately 7 ha.

2.7.4 Quick Production System (QPS)

In a particular field a Quick Production System (QPS) is set up which is small version of full-fledged OCS. QPS generally require the maximum area i.e. approximately 7 ha.

2.8 INTERCONNECTED PIPELINES

Oil/ gas pipeline various 6″ to 30″ diameter of total length of 180 km including the some portion of 200 mm gas pipeline and assorted oil & gas flow lines/delivery lines various from 50 mm to 300mm will be laid from the proposed well location to different neighbouring production facility. These pipelines will be laid approximately 1.5 m below the ground and land will not be acquired for them. A Right of Use (RoU) of 10m will be maintained by OIL and adequate compensation will be paid to the landowners for the Right to Use.

2.9 UTILITIES AND RESOURCE REQUIREMENTS

The proposed well drilling and hydrocarbon processing facilities will require the following resources:

2.9.1 Power requirement and generation

Drilling

The drilling process requires movement of drill bit through the draw works. The power requirements at the site preparation and construction phase for the drill site will be met by 100 KW DG Sets. Although drilling operations will be continuous, power requirement will vary depending on activities being carried out. It is anticipated that two DG sets with a power rating of 1000 KW each will be required for drilling purposes of which one will be kept standby. Lighting and other power requirements at drill sites will be met through 200 KW DG sets.

Production Installations

Power requirement of production installations will be met through Gas Generator (GG) sets. Natural gas for the GG sets are supplied from the field itself. In general, 216 KW GG sets are used for power supply of the production facilities.

2.9.2 Fuel Consumption, Supply and Storage

Drilling

Fuel consumed during the drilling phase will mainly be diesel used for various equipment and vehicles operating to transport goods and supplies to

site. It is estimated that about 1 KLD diesel will be required to power the off-road construction equipment and vehicles during site preparation phase. During the drilling phase, consumption about 3.5 KLD of High Speed Diesel (HSD) will be required. Fuel will be supplied onsite by local supplier through mobile tankers. Oil will store a contingency of 3 days (approximately 10 KL) in a tank at the drill site. Out of this, a major part comprising about 85% will be consumed by the rig (also include the DG sets) and about 15% will be required for the campsite.

Production Installations

Gas for the GG sets are supplied through pipelines from the production field of OIL. Natural gas consumption for the GG sets would be 1500 Standard Cubic Meter (SCUM) per day.

2.9.3 Water Requirement

Drilling

Approximately, 5 m^3 per day water will be required for construction and 3 m^3 per day for domestic use during construction phase. Water consumption during drilling and testing of wells will be 60 m^3 per day. Total 40 m^3 per day fresh water and 10 m^3 per day recycled water will be required for drilling activities and 10 m^3 per day freshwater will be used for domestic purposes including drinking, washings and domestic use.

Production Installations

Approximately, 5 m^3 per day water will be required for construction and 3 m^3 per day for workers during construction phase. Approximately 20 m^3 per day water is required for the operation of production installations.

Water Source and Permission

Water for drilling and production facilities will be sourced from groundwater after obtaining necessary permission. In case of availability of surface water nearby, sourcing of water usage will be done accordingly. The water requirement per well is shown in ***Table 2.4.***

Table 2.4 Water Requirement per Well

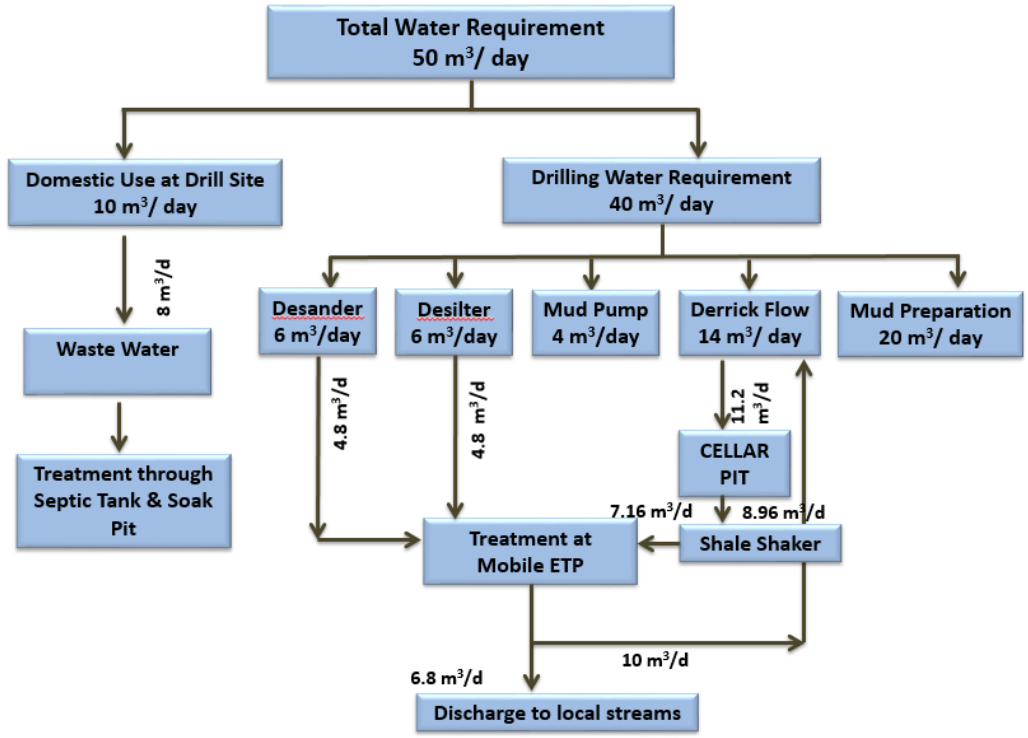
Description	Quantity
Total Water Requirement for Drilling Phase (m^3)	4500
No. of Days on well	90
Average drilling water consumption per day (m^3 per day)	50

A provision for storage of about 250 m^3 per day of water (5 days water requirement during peak period) will be made at the drilling site. Potable water requirement at site will be met through packaged drinking water. In

addition, a water storage pit of around 1000 m³ is proposed to store water for fire water supply the likely source being surface water.

The water balance diagram is provided at ***Figure 2.9***.

Figure 2.9 Water Balance Diagram- Drilling for 50 KLD



Freshwater requirement 50m³/day; Recycled Water Requirement 10 m³/day

2.9.4 *Manpower*

Drilling

The estimated employment would be approximately 50 un-skilled workers during the peak construction phase that will be primarily sourced from nearby villages. The drilling rig will be operated by approximately 50 persons on the rig at any particular time. The manpower will operate in two shifts with continuous operations on the rig. This will include technical experts (including expats), who will be responsible for various drilling related activities and some local workers who will be hired from nearby villages for the entire duration of the Project. Technical staff will be housed in the Drilling Camp Site that will be adequately supported by facilities like kitchen, washrooms, laundry etc. This camp will be preferably located at the outskirts of the closest towns.

Production facilities

The estimated employment would be approximately 50 un-skilled workers during the peak construction phase that will be primarily sourced from

nearby villages. Production facilities are operated in three shifts with approximately 10 persons operating per shift. Personnel involved in a production facility include the Installation Manager, supervisors and other technical staffs.

2.10 POLLUTION SOURCES AND CHARACTERIZATION

2.10.1 Noise

Drilling

Noise will be generated from drill site during site preparation, drilling and decommissioning phases. The major noise generating operations from the proposed activity during drilling, testing are operation of rotary drilling equipment as part of rig, diesel engines for power generation, mud pumps and operation of vehicles. Noise during the site preparatory phase will primarily be contributed by heavy construction machinery operating on site and vehicular sources for constructing the facilities for wells. Average noise emission ranges for different types of construction machinery are provided in ***Table 2.5***.

Table 2.5 Construction Equipment Noise Level

Equipment	Sound Level At Operator (in dB(A))
Earth Moving Equipment	
Front End Loader	85-91
Back Hoe	79-89
Bull Dozer	89-103
Roller	79-93
Truck	89-103
Material Handling Equipment	
Concrete Mixer	<85.0
Crane/Hydra	<85.0

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

Noise during the drilling phase would be generated from operation of the rig, mud pumps, diesel generators and shale shakers. Average noise emission ranges from drilling equipment are provided in ***Table 2.6.***

Table 2.6 Drilling Rig and Equipment Noise Level

Equipment	Equivalent noise levels 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	-
Derrick	99.5	97-102
Air Compressors	77.5	65-90

Production Installation

Noise and vibrations during the construction phase of production facilities would be from the movement of heavy vehicles, equipments and machineries. Noise emitted from the machineries are expected in the range as mentioned in ***Table 2.5.***

During operation of production installations along with gensets noise will be generated due to running of crude oil despatch pump sets, gas compressors, formation water pumps, boilers, etc. Acoustic gensets will be used in the installations. Sound generated from the GG sets and pumps would be in the range as mentioned in ***Table 2.6.***

2.10.2 Air Emissions

Drilling

Point sources emissions are expected from the proposed drilling mainly from sources such as combustion of diesel in the diesel engines of power generators that will be operated to meet power requirement of the drilling rig and the campsite. The principal pollutants will comprise of Particulate Matter (PM), Oxides of Nitrogen (NO_x) and other Hydrocarbons (HC). As diesel is mostly sulphur free emission of Sulphur Dioxide (SO_2) from the DG sets would be insignificant. The quantity of diesel consumption during drilling will be approximately 3.5 KL /day/drilling site. Additionally, the flaring and burning of gas during the testing of well will 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 will also happen during the Project lifecycle, mostly during the construction and decommissioning activities. Additionally, there will be re-entrainment of dust from the approach road leading to the site mainly during the dry season.

Hydrogen sulfide is generally not encountered during the previous drilling activities in the area. However, if hydrogen sulfide is found then appropriate measures will be taken as outlined in the safety protocol and in accordance to Industrial Best Practice.

Production Installation

During construction phase re-entrained dust may be generated due to construction activities and movement of vehicles on unpaved surfaces. Emission during operation phase would be from the operation of the GG sets and flaring of hydrocarbons. Combustion of natural gas for operation of GG sets and during flaring will generate NOx, unburnt hydrocarbons etc.

2.10.3 Liquid wastes

Drilling

During drilling, drilling wastewater generation will be approximately 6.8 m^3 per day as a result of rig wash and dewatering of spent mud and washing of drill cuttings will be treated, reused, and recycled. Effluents from, floor washings, pump, seal leakages, spillages will comprise of chemical ingredients of drilling fluid thereby rendering effluent to be polluted. The characteristics of drilling and wash wastewater will be primarily dependent on type and composition of drilling fluid used for drilling. As OIL is proposing the use of water-based drilling mud, the potential for contamination of such wastewater is significantly lower. The drilling wastewater will contain spent drilling fluid generated as a result of washings. The rig wash water and drilling wastewater generation is proposed to be collected in a wastewater pit (constructed at the drilling site). Domestic wastewater generation of about 8.0 m^3 per day for the drilling camp will be treated through a septic pit/soak tank arrangement. The quantities of the liquid wastes, their characteristics and anticipated disposal methods are given in ***Table 2.7.***

Table 2.7 Wastewater generated and it's management

Waste Type	Quantity	Disposal Method
Drilling and Wash wastewater discharge from wells	6.8 m^3 per day well	The wastewater will be adequately treated in a mobile ETP to ensure conformance to the CPCB oil drilling and gas extraction industry effluent standards and then discharged in the nearest stream.
Domestic wastewater discharge from labour camp	8 m^3 per day	Septic tank followed by soak pit
Formation Water	Unquantified	Will be stored temporarily and treated in ETP and then injected into abandoned wells.
Wastewater generated from testing of pipeline	Unquantified	The wastewater will be treated in modular ETP and discharged as per the oil drilling and gas extraction industry effluent standards and then discharged in the nearest stream.

Source –OIL

The drilling wastewater (around 270-360 m^3) will be generated during the entire drilling period from rig wash and dewatering of spent drilling mud. To ensure that effluent from the project comply with the waste water discharge standards as mentioned in 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, a mobile Effluent Treatment Plant will be installed. The plant would be capable of handling 125m^3/day of drilling effluents. Domestic wastewater generated (about 8.0 m^3/ day for the drilling camp) will be treated through a septic pit/soak tank arrangement. Formation water generated during drilling activities will be disposed at underground structures at depth below 1000-1500 m

Production Installation

- Produced formation water is stored in formation water tanks will be disposed to the shallow wells after necessary treatment.
- Surface Runoff is chanellized to natural drains after treatment through Oil Water Separator (OWS) and sedimentation tank
- Separated water from phase separation system will be treated in an ETP before disposal to natural drains.

2.10.4 Solid and Hazardous Waste Streams

The different solid and hazardous waste streams generated during drilling and their disposal methodology has been presented in ***Table 2.8***.

Table 2.8 Waste streams generated during drilling and their disposal

Waste Type	Quantity	Characteristics	Disposal
Kitchen Waste	10 – 20 kg per day	Organic waste (Non HW)	Will be disposed in compost pits on daily basis that will be buried during site closure.
Drill Cuttings	350-400 m^3/ well	Mainly Inert material Consisting of shales, Sands and clay; about 1% of drilling mud. (Non HW)	Drill cuttings will be disposed off in a well-designed pit lined with impervious liner located on site as per S No. 72 C.1.a Schedule I Standards for Emission or Discharge of Environmental Pollutants from Oil Drilling and Gas Extraction Industry of CPCB as modified in 2005.
Waste Drilling Mud (Fluid)	900-1200 m^3	Barite, Bentonite and Traces of Heavy metals (Non-HW)*	The mud will be tested for hazardous contaminants and will be disposed as per S No. 72 C.1.a Schedule I Standards for Emission or Discharge of Environmental Pollutants from Oil Drilling and Gas Extraction Industry of CPCB as modified in 2005
Acid – Lead Batteries	2 – 3 Batteries per drilling of well	Lead – Acid (HW)	Will be recycled through the vendors supplying acid – lead batteries as required under the Batteries (Management & Handling) Rules, 2001.
Oily waste- used oil & spent Oil	0.5 m^3 5-10 Kg	Used & Waste oil	Will be collected in metal drums kept in secured dyked area & disposed through approved used oil recycling facility
Recyclables *viz.* packaging wastes, paper, plastic, packaging wastes	Dependin g on usage	-	Proper segregation and storage of recyclable waste in designated bins onsite. Recyclables will be periodically sold to local waste recyclers.

**As accorded in 2016 Notification*

Production Installation

Waste generated from production facilities would include the following;

- Domestic Waste: 4.5-5 kg domestic generated will be disposed in compost pits on site on daily basis, collected through a vendor and disposed to common municipal disposal facilities.
- Recyclable Wastes- Packaging wastes, paper, plastic, packaging wastes etc. will be stored at waste storage area at each facility and send to recyclers
- Hazardous wastes *viz*. oily waste, used oil and spent oil will be stored temporarily at site. From site, the hazardous wastes are transferred to the central waste storage area of OIL. From the central waste storage area the hazardous wastes are sent to Assam State Pollution Control Board (ASPCB) registered authorized hazardous waste recyclers.
- Tank Cleaning Sludge: Tank cleaning sludge from storage tanks would be disposed at lined pits at OIL facilities.

2.10.5 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 will be developed by OIL and communicated to the project teams. A risk assessment has been carried out as part of this EIA that includes identification of hazards, risks and formulating management plans for emergency response, blowout, oil spills.

2.11 PROJECT TIMELINE

Drilling of each well location is expected to take three to four months. After development phase the wells if converted to production wells will continue till the life of the well. The production facilities are permanent facilities. The developmental drilling, construction of production facilities and pipelines would be conducted within 5 years.

2.12 PROJECT COST

Total cost of the project would be 1988.62 crore rupees.

3 DESCRIPTION OF THE ENVIRONMENT

The baseline data is collected through primary survey or from secondary sources with reference to the project specific approved ToR provided by Ministry of Environment Forest and Climate Change (MoEFCC). This data has been collected through the following:

- Reconnaissance Survey and Field Visits;
- Primary monitoring of key environmental parameters like air, water, soil, noise and meteorology;
- Survey of flora and fauna;
- Stakeholder consultations with local people, government departments such as Forest, Panchayats, etc.; and
- Review of secondary literatures available on public domain

3.1 STUDY AREA

Khagorijan Field within which the facilities (wells and production facilities) are proposed is spread across 405 sq. km and is a large geographical expanse. Hence, rather than considering 10 km radius around each facility the whole Khagorijan Field was considered to be the Study Area.

3.2 STUDY PERIOD

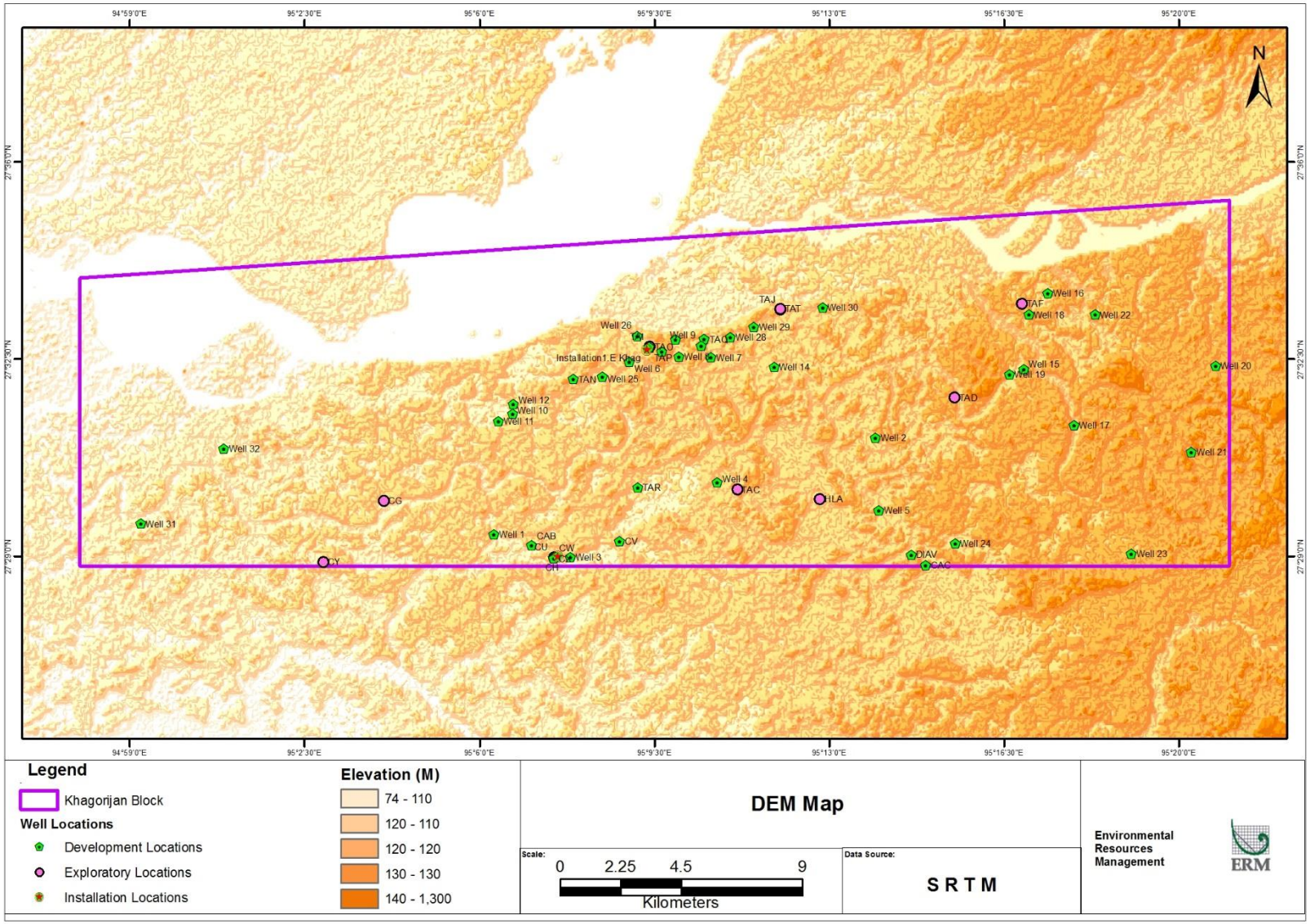
The baseline study was conducted between October 2017-December 2017 for collecting information on physical environment, biological environment and socio-economic environment. Mitra SK Pvt. Ltd., a NABL certified laboratory was engaged for conducting primary monitoring for the EIA study. The NABL certificate is attached as ***Annexure 3.1***. The primary monitoring data was collected under the supervision of different Functional Area Experts of ERM.

3.3 PHYSICAL ENVIRONMENT

3.3.1 Topography

The Khagorijan Field has almost a flat topography and in general the slope of the Field is towards the Brahmaputra River. The Brahmaputra River and Dibru River covers the entire northern part of the Field and flows from north-east to south west. In general the elevation of the Field ranges between 90-110 m from mean sea level. The topography map of the area is presented in figure below.

Figure 3.1 Topography Map



3.3.2 Land use and Land Cover

The land use of the study area has been interpreted utilising multispectral satellite imagery (LANDSAT 8) and World Imagery dated 16th September, 2016 along with ground truthing surveys undertaken during site reconnaissance. The land use distribution of the Khagorijan Field is presented in ***Table 3.1***, while the land use map is presented in ***Figure 3.2***

Table 3.1 Distribution of Land use and Land Cover in Khagorijan Field

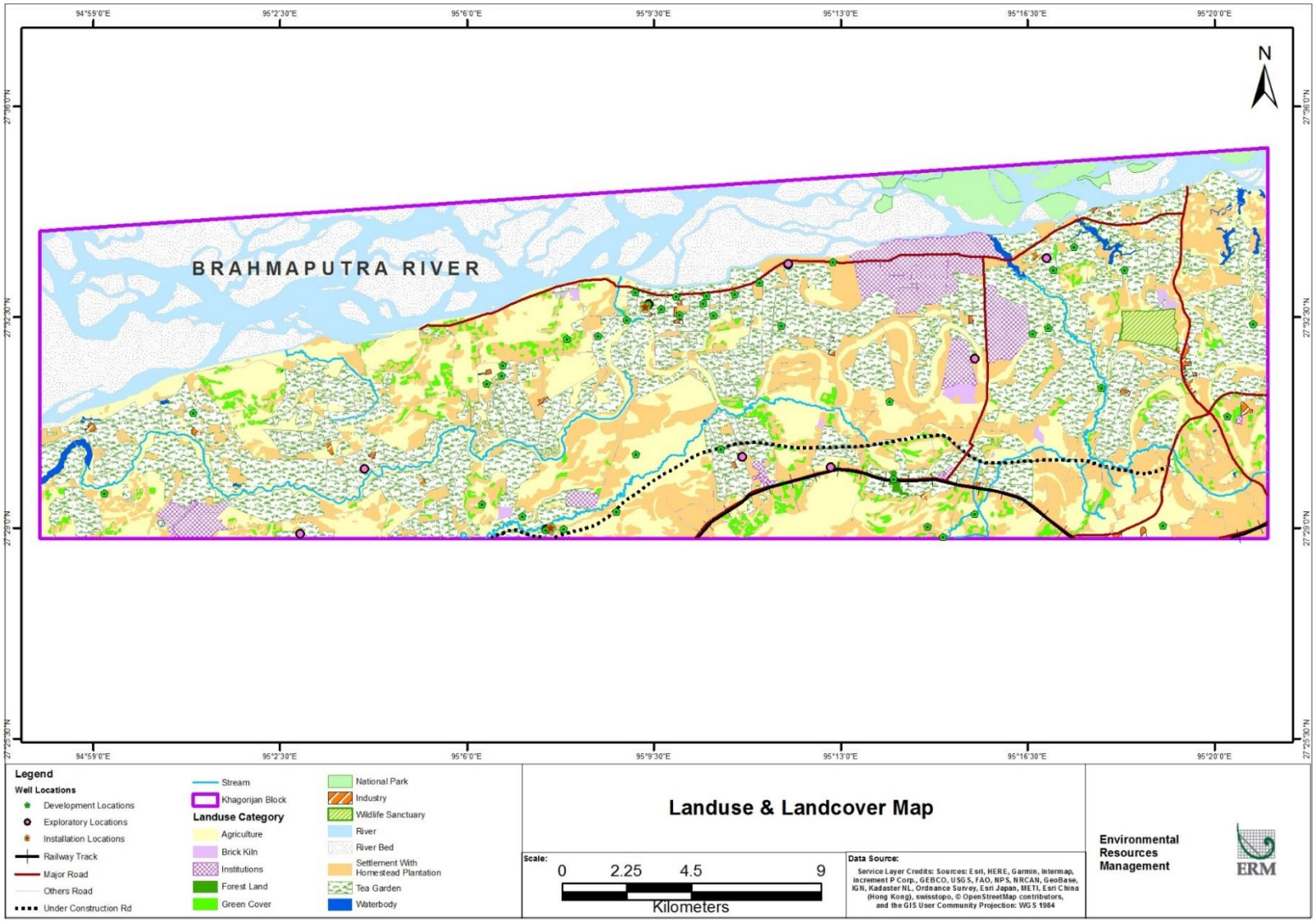
Sl No.	Land Use Category	Area (in sq.km)	Percentage (%)
1.	Agriculture	80.67	19.91
2.	Brick Kiln	1.19	0.29
3.	Defence Installations	13.08	3.23
4.	Forest Land	9.23	2.28
5.	Industry	1.23	0.30
6.	Railway Track	0.28	0.07
7.	River	106.65	26.32
8.	Road Network	5.72	1.41
9.	Settlement With Homestead Plantation	79.51	19.62
10.	Tea Garden	105.81	26.11
11.	Waterbody	1.85	0.46
12.	**Total**	405	100.00

River (26.32%) is major land use category present with in Khagorijan Field followed by tea garden (26.11%) and settlement with homestead plantation (19.62%). Forest areas cover only 2.28%% of the total Khagorijan Field among this Dibru Saikhowa National Park and Padumoni RF are the major forest patch. Rivers and streams including the stretch of Bramhaputra river within the Khagorijan field comprise of 2.28% of the Khagorijan Field. Road networks and railway tracks cover 1.41% and 0.07% of the study area respectively.

Well coordinates provided by OIL revealed 26 wells within tea garden, 9 wells are located in agricultural land, 8 wells located in homestead plantation areas, 1 well in brick field and 12 wells in existing well site. Apart from that 1 production facility located in agriculture land and 1 production facility located in tea garden.

Land use land cover map of Khagorijan Field is presented in ***Figure 3.2.***

Figure 3.2 Distribution of land use and land cover of Khagorijan Field



3.3.3 Soil Quality

Soil character of cultivable land in Tinsukia district is mainly alluvial and composed of mixture of sand (coarse to fine) and clay in varying proportions. The general geochemical characteristic of the soil of the region is moderate to slightly acidic. The alluvial soils of the Brahmaputra valley are highly fertile and are suitable for raising of varieties of crops (such as cereals, pulses, oilseeds, plantation crops etc.) round the year. The well drained, deep, acidic alluvial soils of upper Assam with good proportion of phosphoric content are mostly suitable for the paddy plantation. The new alluvial soils formed due to inundation of land by river at intervals contain high percentage of fine sand, fine silt and are less acidic. Such soils are often neutral and even alkaline. Large expanses of low-lying land are characterized by heavy clayish soil with a high percentage of nitrogen and organic matter which is appropriate for rice cultivation.

Soils of the Dibrugarh district are basically the products of fluvial processes of the Brahmaputra and its tributaries. The plains are composed of alluvium which may be classified as new and old. The new alluvium varies mostly from clayey to sandy loam in texture and is slightly acidic in reaction. It is found in the vast plain of the district along the river valleys, especially in their lower courses. The old alluvium on the other hand, occurs in upper and middle parts of the valley. It occurs mainly in Joypur, Tipling, Kheremia and Tengakhat mouzas in the form of terrace deposits. These deposits contain alternating beds of pebbles, gravel or boulder with loose sand and clays. (Source: DPR of IWMP for Dibrugarh-2 Watershed (Kalakhowa)

As discussed above, since soils of the Brahmaputra Valley, of which the Khagorijan Field is a part is characterized by fertile alluvium the implementation of the proposed project may lead to the temporary change/loss of soil fertility at the drilling site. The understanding of soil quality therefore assumes significance considering the block soil fertility characteristics and also given the responsibility of the proponent to restore the site back to its original condition following decommissioning. An effort has been therefore been made to establish the soil quality of the block through primary monitoring study as discussed in the section below.

Primary Soil Monitoring

Soil was monitored from four different locations in the Khagorijan Field. An effort was made to represent the major land uses present in the study area such as agricultural field, homestead plantation and tea garden soils and assess the quality. The details of the soil monitoring locations are provided in ***Table 3.2***. The soil locations have been shown in ***Table 3.2.***

Table 3.2 Soil Monitoring Locations in Study Area

S. No.	Monitoring Location	Station Number	Land Use	Latitude	Longitude
1.	Balijan	S1	Agriculture Land	27° 28' 57.370" N	94° 58' 34.135" E
2.	Kosowoni Pathar	S2	Agriculture Land	27° 31' 50.382" N	95° 4' 14.121" E
3.	Bharalua	S3	Tea Garden	27° 31' 34.057" N	95° 10' 53.725" E
4.	Nunpuria Bengali Gaon	S4	Tea Garden	27° 30' 19.963" N	95° 18' 1.012" E
5.	Guijan	S5	Agriculture	27° 34' 11.028" N	95° 20' 32.252" E

Source: ERM Primary Monitoring

Table 3.3 Results of Soil Monitoring Results

PARAMETER	Location	Balijan	Kosowoni Pathar	Bharalua	Nunpuria Bengali Gaon	Guijan
	Station Code	S1	S2	S3	S4	S5
Texture	None	Clay	Clay	Sandy Clay	Clay Loam	Clay Loam
Particle Size Distribution	%	sand:18.7silt:13.0clay:68.3	sand:18.4 silt:8.5clay:73.1	sand:46.7 silt:4.9clay:48.4	Sand:31.2Silt:29.2Clay:39.6	Sand:35.2Silt:26.9Clay:37.9
pH (1:2.5) at 25°C	None	6.27	5.14	4.68	4.02	4.82
Electrical conductivity (EC) at 25 Deg C	µS/cm	85	49	61	266	113
Specific gravity	None	2.32	2.1	2.3	2.14	2.41
Bulk Density	gm/cc	1.05	1.03	1.18	1.05	1.05
Porosity	%	54.4	52.0	47.8	50.9	56.4
Moisture	%	19.2	37.1	17.7	23.1	24.8
Permeability	Cm/hr	0.013	0.022	0.87	0.17	0.21
Infiltration rate	mm/Hr	3.7	1.1	4.9	3.0	3.2
Cation Exchange Capacity	meq/100 gm	28	15	16	8.7	6.1
Sodium (as Na)	mg/kg	29	30	10	21	10
Calcium (as Ca)	mg/kg	1078	490	490	588	490
Potassium (as K)	mg/kg	115	22	75	156	38
Sodium Adsorption Ration (as SAR)	None	0.09	0.15	0.05	0.096	0.046
Chloride (as Cl)	mg/kg	29	49	59	88	39
Sulphate (as SO4)	mg/kg	<15	<15	<15	<15	<15
Carbonate ion as (Co3)-2	mg/kg	nil	nil	nil	nil	Nil
Nitrogen (as N)	mg/kg	230	347	437	370	302
Phosphorus (as P)	mg/kg	<3.0	<3.0	29	<3	35
Hexavalent Chromium (as Cr+6)	mg/kg	<2.0	<2.0	<2.0	<2.0	<2
Boron (as B)	mg/kg	33	20	15	25	17
Copper (as Cu)	mg/kg	44	13	<2.0	19	7.2
Iron (as Fe)	mg/kg	617	67	13	82	33
Lead (as Pb)	mg/kg	13	11	<5.0	13	8.2
Mercury (as Hg)	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1

PARAMETER	Location	Balijan	Kosowoni Pathar	Bharalua	Nunpuria Bengali Gaon	Guijan
	Station Code	S1	S2	S3	S4	S5
Arsenic(as As)	mg/kg	<0.25	<0.25	<0.25	<0.25	<0.25
Zinc (as Zn)	mg/kg	58	38	<2.0	60	40
Acidity	mg/kg	Nil	Nil	Nil	Nil	Nil
Alkalinity (as CaCO3)	mg/kg	59	65	43	48	96
Cadmium (as Cd)	mg/kg	<2.0	<2.0	<2.0	<2.0	<2
Magnesium (as Mg)	mg/kg	118	176	118	176	235

Soil Monitoring Results

The results of the primary soil monitoring are discussed below:

pH

Soil acidity has a correlation with the availability of nutrients in terms of their deficiency and toxicity. A soil having pH less than 6.5 is considered as acidic. The soil in the study area was found to be extremely acidic to slightly acidic as the pH ranges from 4.02 and 6.27.

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 were found to be clayey, sandy clay and clay loam.

The EC values for the soils monitored at the study area range between 49 and 266 µs/cm. For a productive soil, the electrical conductance (EC) should be < 1000µs/cm.

Macronutrients

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 3.4.*** Nitrogen contents in the soil samples ranged between 222-437 mg/kg (99.11-195.09 kg/ha), phosphorus content in the soil samples ranged between <3-29 mg/kg (<1.3-12.95 kg/ha) and potassium contents ranges between 22-156 mg/kg (9.82-69.64 kg/ha). With comparison to the rating chart nitrogen status is less to better, phosphorus status and potassium status is very less.

Table 3.4 Rating chart for the soil test data for few selected soil parameters

S.N.	Soil Test Parameters	Classification
1	pH	<4.5 Extremely acidic 4.51-5.00 Very strongly acidic 5.00-5.50 slightly 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 mhos/cm)	Upto 1.00 Average 1.01-2.00 harmful to germination 2.01-3.00 harmful to crops (sensitive to salts)
3	Nitrogen (kg/ha)	Upto 50 very less 51-100 less 101-150 good

S.N.	Soil Test Parameters	Classification
		151-300 Better >300 sufficient
4	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
5	Potash (kg/ha)	0-120 very less 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, 2015

Metals

Heavy metals such as Copper (<2.0-44 mg/kg), Lead (<5.0-13 mg/kg) and Zinc (<2-60 mg/kg) were detectable in the soil of the study area. Cadmium (<2.0 mg/kg) and Mercury (<0.1mg/kg) concentrations were found to be below detectable. The concentration of copper, lead and Zinc in the soil sample was much below the soil remediation intervention values specified in Dutch Soil Remediation Circular (Refer ***Annexure 3.2***).

Sodium Absorption Ratio (SAR) - Sodium absorption ratio for the soil samples varied between 0.05-0.15.

Conclusion

The soil samples were found to be clayey, sandy clay and clay loam in nature with acidic pH. The macronutrient contents *viz*. NPK values of the soil samples were found to be better to very less. Metal contamination has not been observed.

3.3.4 Climate and Meteorology

The study area falls under the humid sub-tropical climate zone with warm seasons.

Seasons

There are four well defined seasons as shown below:
Pre-monsoon : March-May
Monsoon : June- September
Post-monsoon : October- November
Winter : December- February

The meteorological data of IMD station at Dibrugarh has been used for interpretation of longer-term temperature profile, rainfall pattern, relative humidity, wind speed and wind direction in the study area.
Interpretation of IMD Dibrugarh Data

Temperature

The mean monthly maximum and mean monthly minimum recorded over a period of 1961 to 1990 shows that mean monthly maximum temperature is experienced in April (33.5°C) and the mean monthly minimum temperature is experienced in January (9.9°C). The diurnal variation temperature is observed to be maximum in January (a difference of 15°C).

Rainfall

Rainfall begins from late April and continues up to early October, with the months of June, July and August and September receiving maximum rainfall (***Table 3.5***). Total rainfall varied between 1661.5-2167.5 mm for Dibrugarh district mm and 1903.9-2663.6 mm for Tinsukia district as per five-year district rainfall data of IMD. Analysis of the rainfall pattern is therefore considered important in context of the present study for effective scheduling of both drilling and testing operations.

Table 3.5 ***Rainfall Recorded in Dibrugarh and Tinsukia Districts***

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Dibrugarh												
2012	22.7	4.1	37.8	347.6	176.3	208.2	324.3	285.3	205.4	45.3	0.1	4.4
2013	1.5	7.7	91.9	110.7	326.8	175.7	416.8	390.8	112.6	103.9	0	7.1
2014	4.5	21.5	32.3	57.3	134.7	330.7	451.4	240.8	155.2	57.6	1.6	0
2015	16.7	14	32.1	234.7	293	273.6	328.4	297.2	212.8	115.1	6.4	39.5
2016	22.7	27.4	137.7	457.5	334.3	218.7	329.7	228.8	304.7	76.1	19.7	10.2
Tinsukia												
2012	23.1	6.8	29.9	304.7	216.5	417.3	488	329.7	636.5	187.1	6.2	17.8
2013	8.9	4.5	141.5	246	335	289	424	298.4	199.3	176.6	0.4	2.2
2014	3.3	37.6	40.4	56.2	361.1	240.2	214.7	546.8	367.4	33.7	2.5	0
2015	17.1	44.9	72.1	334.3	247.1	493.2	301.5	627.8	233.7	84.4	20.6	30.6
2016	13.2	70	150.6	551.7	306.1	221.5	484.6	244	354.7	135.1	13.1	7.1

Source: Customized Rainfall Information System (CRIS), IMD.
http://hydro.imd.gov.in/hydrometweb/(S(z0ghqpza5odnsd55rcebbirf))/DistrictRaifall.aspx

Relative Humidity

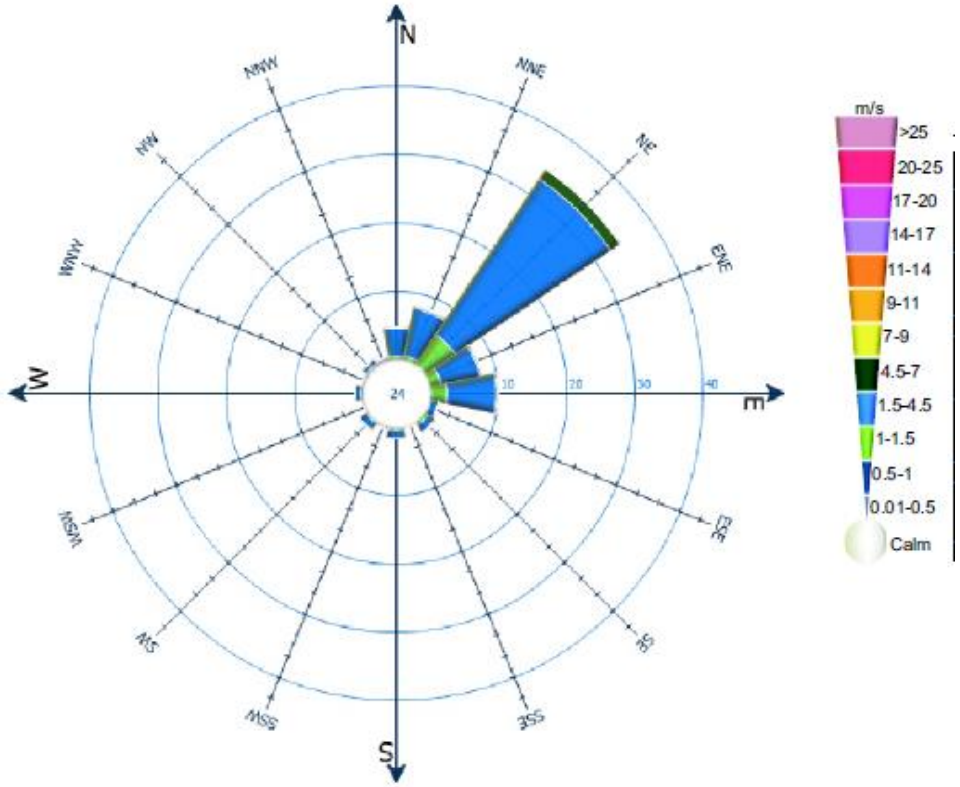
Relative humidity values measured twice daily at 0830 hrs and 1730 hrs at the Dibrugarh IMD station for 2009 revealed high average monthly relative humidity values ranging from 54.68%-87.65%. Maximum monthly average relative humidity values were observed in monsoon months of June to August. The average humidity values recorded for these months during both 0830 hrs and 1730 hours generally varied between 85.97% – 87.65% and 72.67% – 78.71% respectively.

Wind Speed and Wind Direction

The wind speed and wind direction of an area influences the dispersal of pollutants from a point and non-point sources. As the proposed drilling and testing activities involve the operation of both point (DG sets) and non-point pollutant emissions sources, analysis of wind speed and direction data is considered important for predicting the air quality impacts based on pollutant dispersion.

The annual wind rose (***Figure 3.3***) for Dibrugarh prepared from daily surface wind data recorded at 3:00am from 1971- 2000 indicates that 65% of the year, the wind blows from northeast.

Figure 3.3 ***Annual Wind Rose at Dibrugarh, Assam***



Source: IMD

Primary Micrometeorology

An automatic micro-meteorological station was installed at Rupai during the study period. The parameters monitored included wind speed, wind direction, ambient temperature, relative humidity, rainfall, solar radiation and cloud cover. The result of primary meteorological monitoring is presented in the subsequent section.

Temperature: The maximum and minimum temperature reported during the study period was 36.70°C and 7.30°C. The average temperature was in the range of 20.79°C during the study period.

Relative humidity: The average relative humidity was 73.13% during the study period. The humidity ranged between 25.50% and 99.60% during the study period.

Rainfall: Rainfall occurred on few days of the study period. Total rainfall recorded during the study period was 87.50 mm. Total 4 rainy days (rainfall>2.5 mm/day) were recorded during the study period.

Summary of meteorological data is presented in ***Table 3.6***. The detail monitoring results is presented in ***Annexure 3.3***.

Table 3.6 Summary of Micro-Meteorological Data

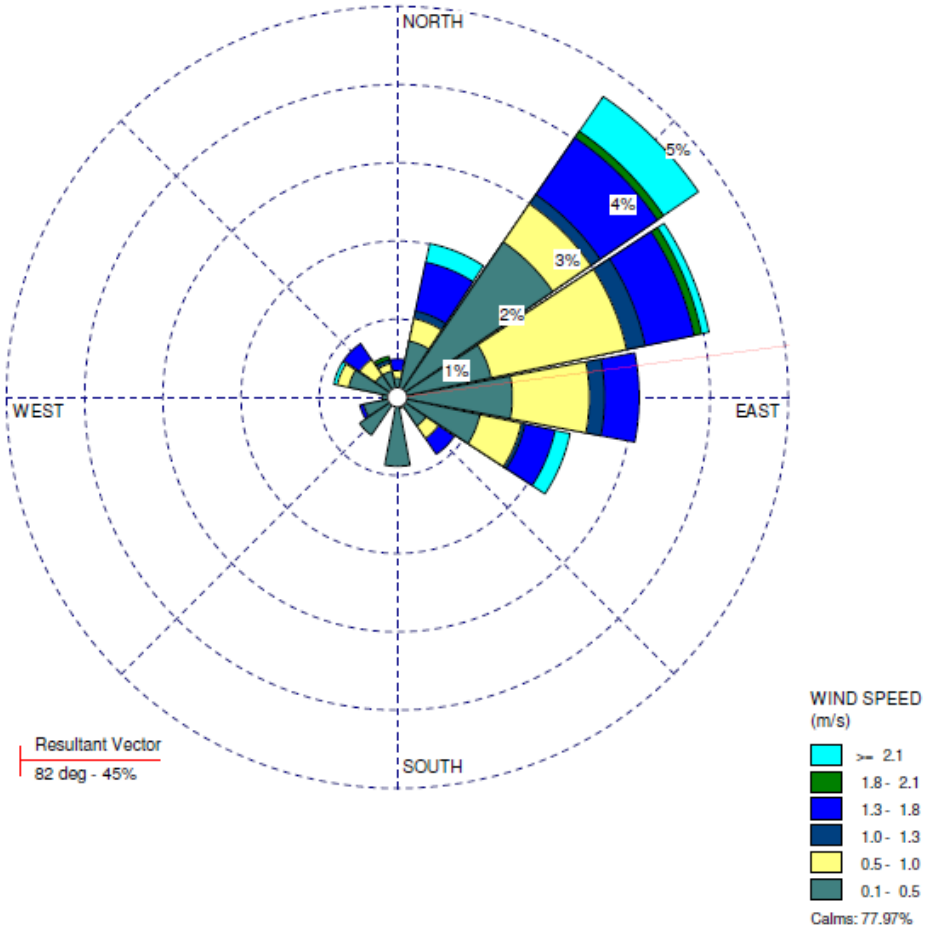
Particulars	Temperature (°C)	Relative Humidity (%)	Wind Speed (m/s)	Rainfall (mm)
Maximum	36.70	99.60	3.36	-
Minimum	7.30	25.50	0.00	-
Average	20.79	73.13	0.16	-
Total	-	--	-	87.50

Source: Primary Monitoring 2017

Wind Speed and Direction

The average wind speed in the study period was 0.16 m/s. The maximum wind speed was 3.36m/s. On average 77% of the study period, wind speed was at calm. The predominant wind direction during the study period was from East North East. The wind rose for the study period is shown in ***Figure 3.4***.

Figure 3.4 Wind rose of Study Area during Study Period



Source: Primary Monitoring Data

3.3.5 *Ambient Air Quality*

The study area resembles a pre-dominantly rural landscape with villages interspersed between plantations, agricultural lands and tea gardens. The major emission sources within the Khagorijan Field are vehicular emission, emission from cooking etc. The major industrial sources of air emission at the Field are from hydrocarbon exploration and production of OIL and gas, transportation of vehicles, emission from tea garden factories etc.

The major sources of air emissions due to the proposed drilling and producing activities would be exhaust gases generated from operation of DG sets, GG sets project related vehicular movements and flaring from production facilities etc.

Primary Air Quality Monitoring

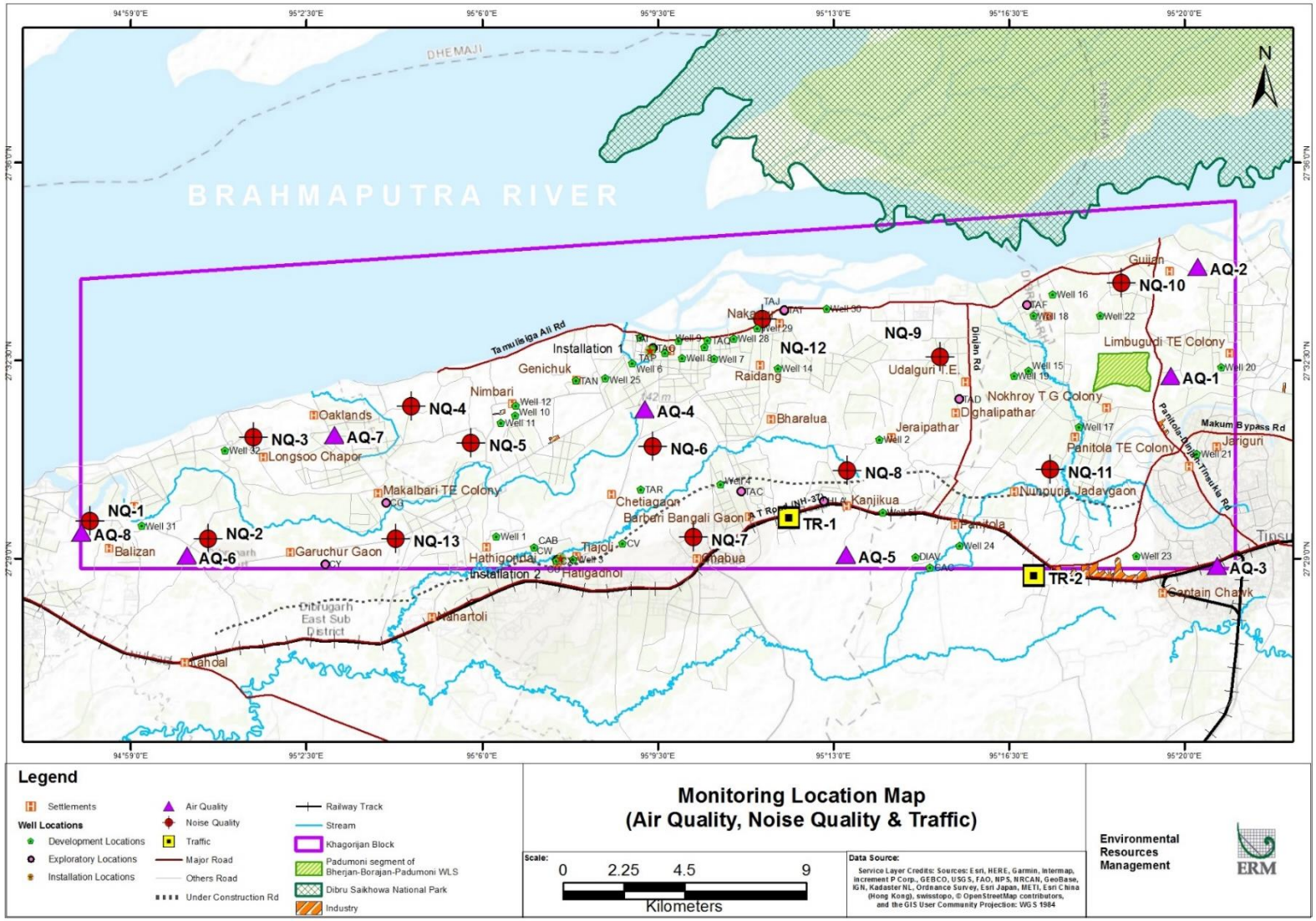
Ambient air quality was monitored at eight locations across the study area during October 2017-December 2017. The parameters studied were Particulate

Matter (PM_{10} and $PM_{2.5}$), Oxides of Nitrogen (NOx), Sulfur dioxide (SO_2), Carbon Monoxide (CO), Hydrocarbon (Total and Non-methane) and Volatile Organic Carbons (VOCs). Air quality monitoring locations were selected in residential areas. The monitoring locations were selected upwind, downwind and crosswind directions with respect to the Khagorijan Field within the study area to understand the baseline air environment in the study area. The monitoring location details are given in ***Table 3.7***. The air monitoring locations have been provided in ***Figure 3.5***.

Table 3.7 Air Monitoring Locations

Sl No	Monitoring Location Number	Geo-coordinates		Rationale for Selection
AQ1	Bagaltoli 1no Balipara	27° 32' 13.647"N	95° 19' 43.135" E	Upwind to the wells within the Khagorijan Field
AQ2	Guijan LG Road	27° 34' 09.291"N	95° 20' 15.666" E	Crosswind to the wells located at the Khagorijan Field
AQ3	Dhekiajuli Bengali	27° 28' 52.033"N	95° 20' 39.225" E	Crosswind to the wells within the Khagorijan Field
AQ4	Dhupabor Maijan	27° 31' 38.183"N	95° 09' 14.530" E	Downwind to the wells and production facility located at the central portion of the Khagorijan Field
AQ5	Kanjikhowa	27° 29' 03.856"N	95° 13' 14.951" E	Downwind to the wells located at the western part of the Khagorijan Field. Crosswind to the wells located at the central portion of the Field.
AQ6	Haribari Konwargaon	27° 29' 02.866"N	95° 00' 06.367" E	Downwind to the wells located at the eastern portion of Khagorijan Field
AQ7	Oakland Tea Estate	27° 31' 10.722"N	95° 03' 03.192" E	Downwind to the wells and production facility located at the central portion of the Khagorijan Field
AQ8	Hiloidhari	27° 29' 27.275"N	94° 58' 00.627" E	Downwind to the wells located at the eastern portion of Khagorijan Field

Figure 3.5 Air, Noise and Traffic Monitoring Locations



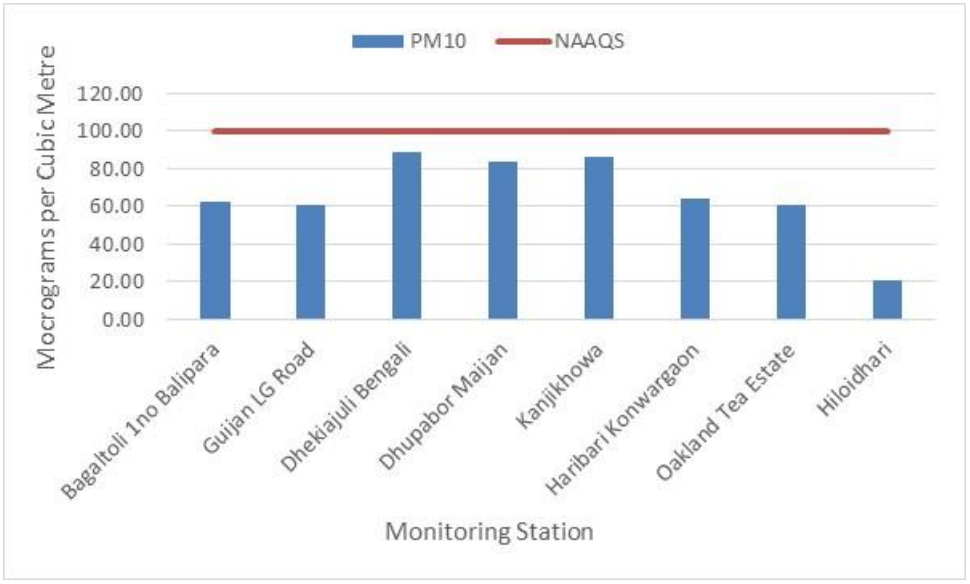
Interpretation of Monitoring Results

The result of the parameters monitored has been discussed in context of compliance to National Ambient Air Quality Standards (NAAQS)[1] of residential, commercial and industrial area. The station wise summary results are ***Table 3.3***. The in-detail results are provided in ***Annexure.3.4***.

Particulate Matter 10 (PM_{10})

The average concentration of PM_{10} in the Study Area ranged between 20.86 and 89.25 µg/m³. The average concentration of PM10 values at all stations were found to be in compliance to the NAAQS value of 100 µg/m³. Variation of PM_{10} values in at the monitoring stations are presented in the figure below.

Figure 3.6 Concentration of Particulate Matter 10 (PM_{10}) in the Study Area



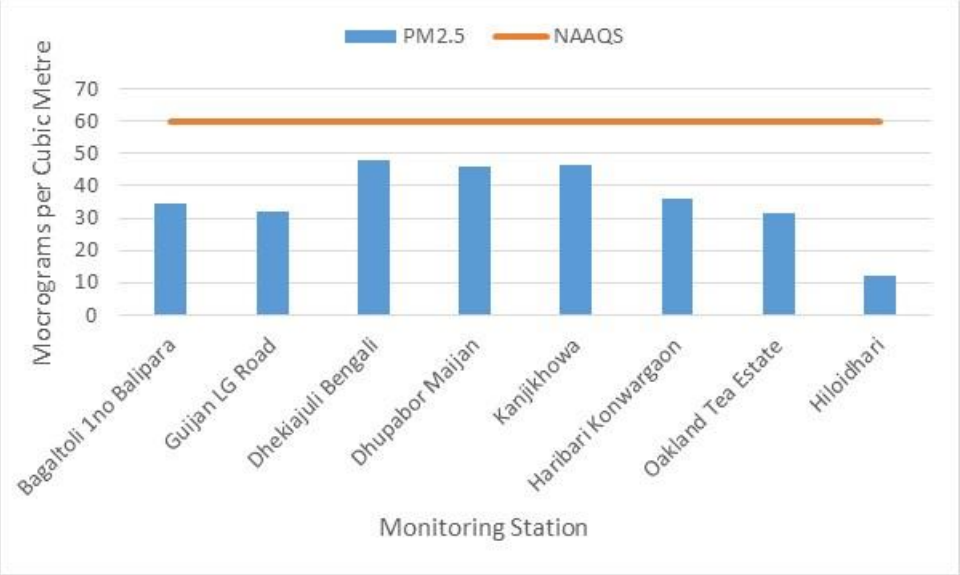
Source: Primary Monitoring

Particulate Matter 2.5 ($PM_{2.5}$)

The average concentration of Particulate Matter 2.5 ($PM_{2.5}$) in the study area ranged between 12.28 and 47.92 µg/m³. The average concentration was within the stipulated standard of 60 µg/m³. Variation of $PM_{2.5}$ values in at the monitoring stations are presented in the figure below.

[1] http://www.moef.nic.in/sites/default/files/notification/Recved%20national.pdf

Figure 3.7 Concentration of Particulate Matter 2.5 (PM2.5) in the Study Area

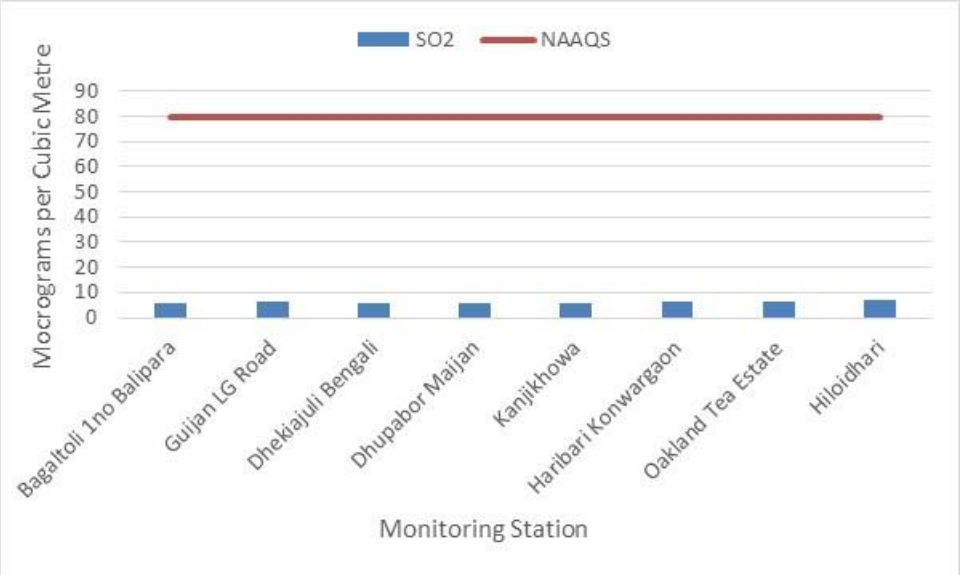


Source: Primary Monitoring

Sulfur Dioxide (SO_2)

The average concentration of Sulfur Dioxide (SO_2) in the study area ranged between 5.50 and 6.78 µg/m³. The average concentration reported across all the 8 monitoring locations were below the NAAQS value of 80 µg/m³. Variation of SO_2 values in at the monitoring stations are presented in the figure below.

Figure 3.8 Concentration of Sulfur Dioxide (SO_2) within Study Area



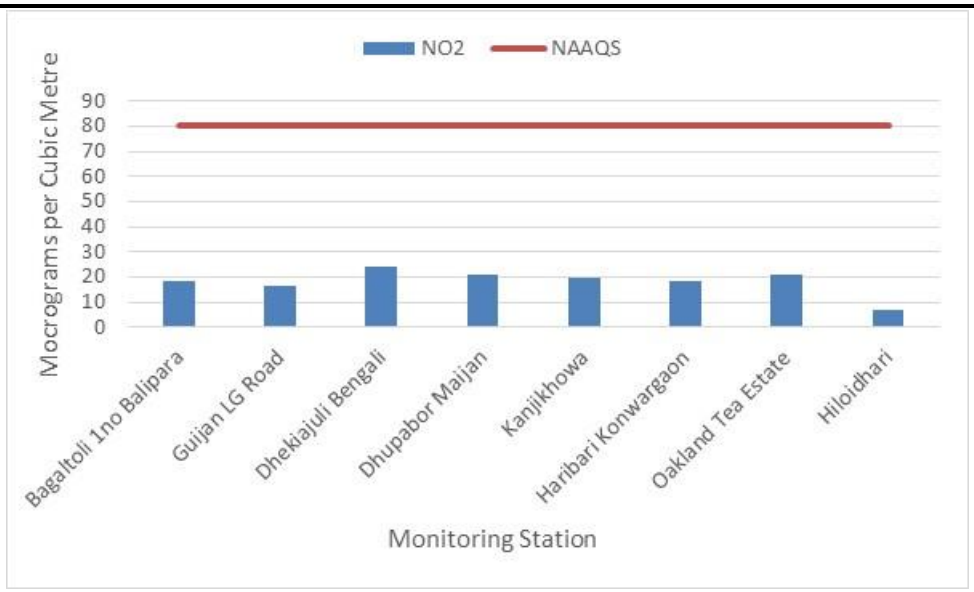
Source; Primary Monitoring

Nitrogen Dioxide (NO2)

The average concentration of NO_x in the study area ranged between 7.11 and 24.19 µg/m³. The average concentration reported across all the 8 monitoring

locations were below the NAAQS value of 80µg/m³. Variation of NO_2 values in at the monitoring stations are presented in the figure below.

Figure 3.9 Concentration of Nitrogen Dioxide (NO_2) in the Study Area

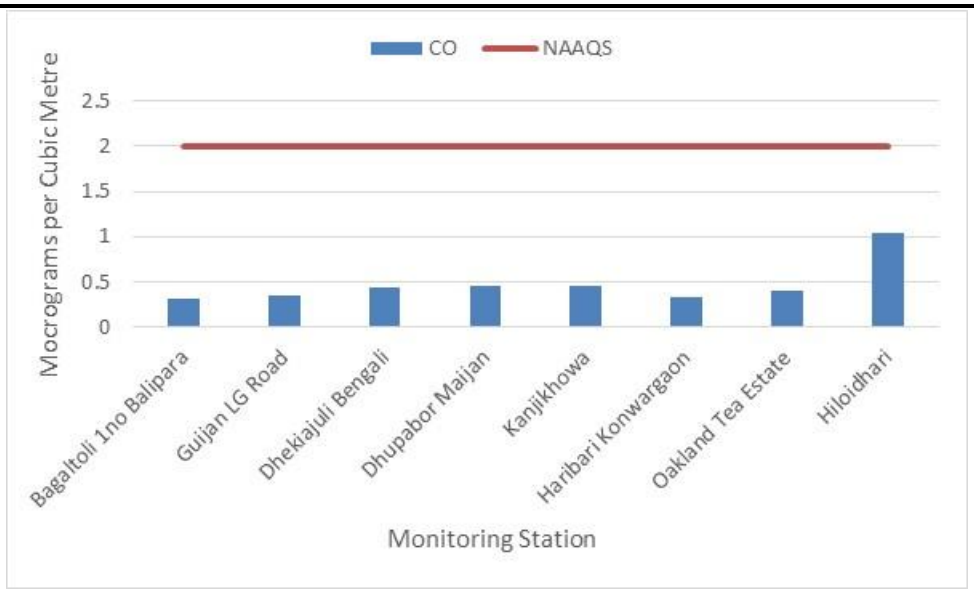


Source: Primary Monitoring

Carbon Monoxide (CO)

The 8 hour average concentration of Carbon Monoxide in the study area ranged between 0.32 and 1.04 mg/m³. The 8 hour average concentration of CO reported across monitoring locations were in compliance the NAAQS value of 2mg/m³. Variations of CO values in at the monitoring stations are presented in the figure below.

Figure 3.10 Concentration of Carbon Monoxide (CO) in Study Area



Source: Primary Monitoring

Total Hydrocarbons

The average methane concentration in the study area ranged between 0.90 and 1.60 ppm. There is no standard value for Methane in NAAQS.

Hydrocarbons-Non-Methane

The concentrations of non-methane hydrocarbon were recorded to be less than 0.5 ppm in the study area.

Volatile Organic Carbons (VOCs)

The concentrations of VOCs in the study area were recorded to be ranging between less than 2.08 – 2.86 $\mu g/m^3$.

Conclusion

The study area represents rural environmental setting with few brick kilns scattered in the area. The source of emission to air include brick kiln emission and emission from plying of vehicles at the dilapidated roads within the study area. Lower values for the pollutant levels at all the station could be attributed to the rural setting and absence of major industries in the study area.

Table 3.8 Summary of Ambient Air Monitoring

	PM_{10} (µg/m³)	$PM_{2.5}$ (µg/m³)	SO_2 (µg/m³)	NO_2 (µg/m³)	CO (mg/m³)	Total Hydrocarbon (ppm)	Hydrocarbon (as Non-Methane) ppm	VOC (µg/m³)
Bagaltoli 1no Balipara								
Average	89	48	6	24	0	1	2	2
Min	58	27	4	18	0	1	<0.5	<2.08
Max	134	73	8	29	1	1	2	3
Guijan LG Road								
Average	84	46	6	21	0	1	2	3
Min	54	32	4	12	0	1	<0.5	<2.08
Max	132	74	7	28	1	2	2	3
Dhekiajuli Bengali								
Average	86	46	5.97	19.35	0.45	0.90	<0.5	2.51
Min	65	35	4.50	12.20	0.15	0.63	<0.5	<2.08
Max	134	65	7.10	26.60	0.69	1.33	<0.5	2.66
Dhupabor Maijan								
Average	64	36	6.15	18.04	0.33	1.32	<0.5	<2.08
Min	36	20	4.20	10.20	0.12	0.64	<0.5	<2.08
Max	95	56	9.60	25.20	0.68	2.31	<0.5	<2.08
Kanjikhowa								
Average	60	32	6.19	20.67	0.40	1.20	<0.5	<2.08
Min	42	23	4.20	12.00	0.24	0.62	<0.5	<2.08
Max	82	48	8.50	28.50	0.67	2.30	<0.5	<2.08
Haribari Konwargaon								
Average	63	34	5.75	18.65	0.32	1.30	<0.5	<2.08
Min	36	20	4.50	10.20	0.15	0.43	<0.5	<2.08
Max	98	57	8.50	26.60	0.63	2.36	<0.5	<2.08
Oakland Tea Estate								
Average	64	34	5.80	19.26	0.47	1.60	<0.5	<2.08
Min	38	20	4.20	10.20	0.15	0.58	<0.5	<2.08

	PM_{10} (µg/m³)	$PM_{2.5}$ (µg/m³)	SO_2 (µg/m³)	NO_2 (µg/m³)	CO (mg/m³)	Total Hydrocarbon (ppm)	Hydrocarbon (as Non-Methane) ppm	VOC (µg/m³)
Max	98	56	8.50	26.60	0.88	2.51	<0.5	<2.08
				Hiloidhari				
Average	61	32	6.10	16.57	0.36	1.59	<0.5	<2.08
Min	32	19	4.30	11.20	0.16	0.63	<0.5	<2.08
Max	97	53	8.20	24.50	0.68	3.22	<0.5	<2.08

3.3.6 Ambient Noise Quality

Ambient noise monitoring was conducted at 13 stations within the study area. The noise levels have been monitored at residential zones to assess and evaluate the impact on ambient noise environment. The location of the ambient noise monitoring stations have been presented in ***Table 3.9*** and depicted in ***Figure 3.5*** for reference.

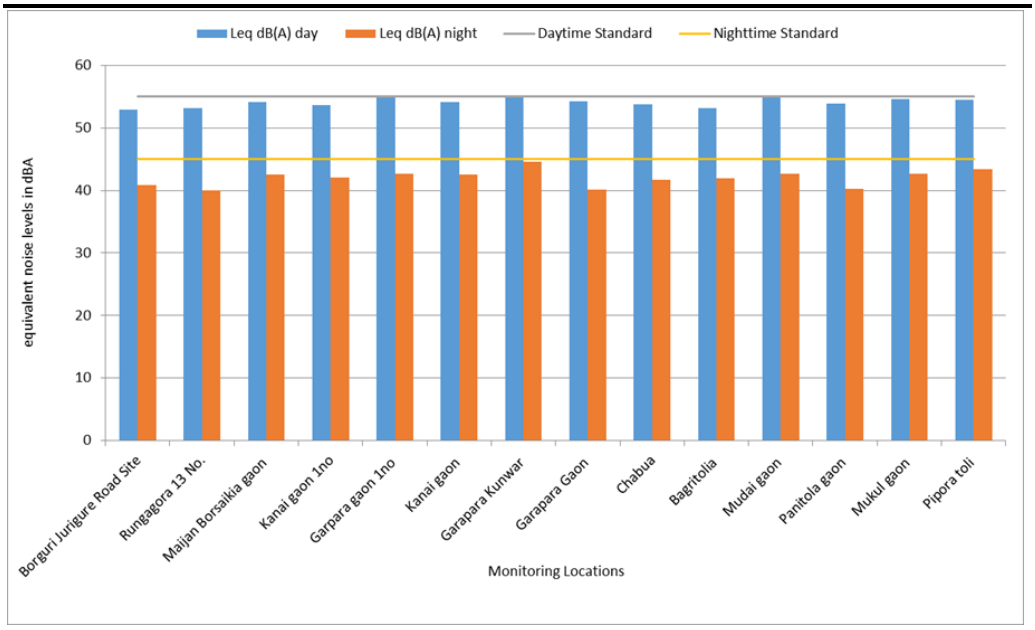
Table 3.9 Ambient Noise Monitoring Locations

Sl. No	Monitoring Location	Station Number	Geographical Coordinates		Category of Area/Zone
			Latitude	Longitude	
1.	Borguri Jurigure Road Site	NQ-1	27° 29' 39.511" N	94° 58' 10.864" E	Residential
2.	Rungagora 13 No.	NQ-2	27° 29' 20.849" N	95° 0' 32.198" E	Residential
3.	Maijan Borsaikia gaon	NQ-3	27° 31' 8.385" N	95° 1' 26.265" E	Residential
4.	Kanai gaon 1no	NQ-4	27° 31' 41.308" N	95° 4' 34.774" E	Residential
5.	Garpara gaon 1no	NQ-5	27° 31' 2.212" N	95° 5' 46.523" E	Residential
6.	Kanai gaon	NQ-6	27° 30' 58.806" N	95° 9' 23.961" E	Residential
7.	Garapara Kunwar	NQ-7	27° 29' 22.316" N	95° 10' 12.623" E	Residential
8.	Garapara Gaon	NQ-8	27° 30' 33.385" N	95° 13' 16.338" E	Residential
9.	Chabua	NQ-9	27° 32' 33.988" N	95° 15' 7.431" E	Residential
10.	Bagritolia	NQ-10	27° 33' 52.237" N	95° 18' 44.250" E	Residential
11.	Mudai gaon	NQ-11	27° 30' 34.132" N	95° 17' 19.513" E	Residential
12.	Panitola gaon	NQ-12	27° 33' 13.801" N	95° 11' 35.170" E	Residential
13.	Mukul gaon	NQ-13	27° 29' 20.880" N	95° 4' 16.520" E	Residential

The 24-hour baseline noise monitoring was conducted by using the portable sound meter (Lutron, SL-0423SD, unit: dB(A). Noise level (LAeq) were measured and recorded at a ten-minute interval and averaged at an hourly and daily (i.e. 24-hour) interval using the following formula:
LAeq = 10*Log $_{10}$ (Average (10^ ((X)/10))) where X is measured noise in dB(A). Sound pressure level (SPL) measurements in dB(A) was recorded for 24 hours with the equivalent noise values computed as Leq (Daytime) and Leq (Night time) for each location. Daytime is considered between 06:00 to 22:00 hours and night from 22:00 hours to 06:00 hours. The results so obtained were compared with ambient noise standards specified for respective category under the *Noise Pollution (Regulation & Control) Rules, 2000*.

The summary of noise quality results is presented in figure below. The in-detail results are provided in ***Annexure.3.5***.

Figure 3.11 Ambient Noise Monitoring Results



Source: Primary Monitoring Data; ERM

Interpretation of Primary Monitoring Results

The equivalent noise level as measured at the residential areas range between 52.9 -54.9 dB(A) at day time and between 40.0-44.6 dB(A) at night time. The equivalent day time noise values in all the locations (Borguri Jurigure Road Site, Rungagora 13 No, Maijan Borsaikia gaon, Kanai gaon 1no, Garpara gaon 1no, Kanai gaon, Garapara Kunwar, Garapara Gaon, Chabua, Bagritolia, Mudai gaon, Panitola gaon , Mukul gaon, Pipora toli) were in compliance to the day time standard of 55 dB(A) for residential areas. Equivalent day time noise levels were not found to be exceeding the day time noise standards. The equivalent night time noise values in all the locations (same locations as mentioned for day time) were in compliance to the night time standard of 45 dB(A) for residential areas.

3.3.7 Hydrogeology

Dibrugarh District[1]

As reported in Central Groundwater Board (CGWB) report for Dibrugarh District, unconsolidated alluvial deposits of Quaternary Age covers major part of the Dibrugarh district. Only about 4% area of the district is underlain by semi consolidated formation of Tertiary Age belongs to Disang and Barail Groups of rock. A single system of aquifer (granular zone) below a thin clay cover on top is present mainly in the southern part of the district. In the northern part, this single aquifer system is separated into a multiple aquifer system by thick clay partings. Thickness of aquifer increases from east to west. Ground water in the shallow aquifer group exists in unconfined to semi

[1] Ground Water Information Booklet Dibrugarh District, Assam. CGWB. 2013

confined condition. In general depth of tube wells varies from 35 to 45 m. The tube wells constructed down to a depth of 50 m yields 27 to 45 m^3/hour. The net ground water availability estimated in the year 2009 is 1794.65 mcm. The existing gross ground water draft 266.76 mcm and the stages of development are 15% only. Future provision for domestic and Industrial use is 31.08 mcm and for Irrigation, use is 1519.49 mcm.

Tinsukia District[1]

As reported in Central Groundwater Board (CGWB) report for Tinsukia District, the district can be divided into two broad hydrogeological units viz. (1) Tertiary Group of Semi-consolidated rocks (2) Quaternary alluvium of Unconsolidated sediments.

Tertiary group of sedimentary rocks are confined to the southernmost part of the district where ground water occurs in the shallow weathered zone and this may be developed through large diameter open wells. Ground water occurs in deeper aquifer consisting of Tipam sandstone and in boulders and gravel beds of Dihing group that are suitable for development through deep tube wells.

In alluvial plain areas, ground water occurs in regionally extensive aquifers down to explored depth of 250 m with reportedly very good yield prospect. The aquifers consist of sands of various grades and are suitable for both shallow and deep tube wells. Ground water rests at shallow depth and in major part of the district, depth to water level varies from 2 to 5 m bgl during pre-monsoon period and from 1.68 to 4.5 m bgl during post monsoon period. Long term water level trend study conducted by CGWB has shown that there has been no significant change of water level in the last 10 years.

The shallow tube wells tapping aquifers within 50 m depth are capable of yielding 20 – 50 m^3/hr at drawdown of less than 3 m. Medium to heavy duty tube wells constructed down to 100 – 150 m depth tapping 25 – 30 m of granular zones are yielding 50 – 100 m^3/hr.

The annual dynamic ground water resources of the district estimated by CGWB to be 159036 ha m, while the net annual ground water draft is 16697 ha m. The stage of ground water development is only 12% percent and the district is reported under "safe" category. The demand of ground water for domestic and industrial use projected till 2025 is estimated to be about 4257 ham and 125230 ham water will be still available for future irrigation development.

Tinsukia District has been categorized as non-notified and none of the Blocks are Over-Exploited or Critical. Qualitatively, there is high concentration of iron in some localities.

[1] Ground Water Information Booklet Tinsukia District, Assam. CGWB. 2013

3.3.8 Groundwater Quality

In order to establish the groundwater quality in the study area, monitoring was conducted at four stations within the study area. The ground water sampling has been conducted from tube wells adjacent to the project site to capture the existing quality of the ground water that can be used as a reference for future studies during construction and operation phase. The location of the groundwater monitoring stations has been presented in ***Table 3.10.***

Table 3.10 Groundwater Monitoring Locations in the Study Area

Sl No.	Monitoring locations	Station No	Latitude	Longitude	Source
1.	Bayjiahowa	GW-1	27° 28' 56.054" N	94° 59' 5.256" E	Tubewell
2.	Kasuwani Gaon	GW-2	27° 30' 41.256" N	95° 03' 36.982" E	Tubewell
3.	Tangri Gaon	GW-3	27° 32' 12.036" N	95° 08' 14.850" E	Tubewell
4.	Bogdungkinar	GW-4	27° 31' 12.664" N	95° 15' 36.724" E	Tubewell

Source: ERM

Groundwater Quality Results

The result of groundwater quality as sampled in the study area has been provided in ***Table 3.11***

Figure 3.12 Soil, Groundwater and Surface water Monitoring Locations

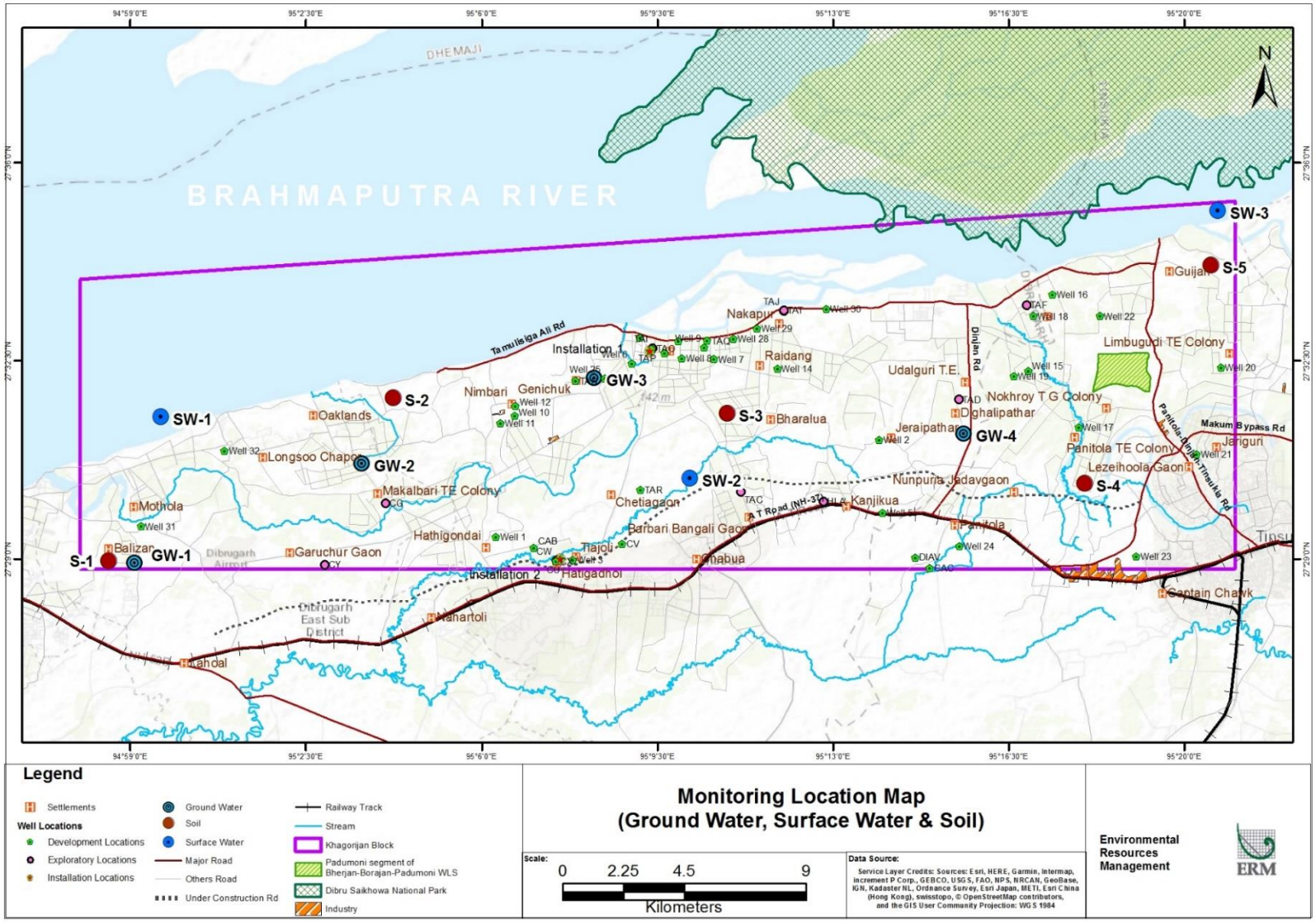


Table 3.11 Result of Ground Water Sampling

Sl No	Parameter	Unit	IS:10500		Bayjiahowa	Kasuwani Gaon	Tangri Gaon	Bogdungkinar
			Desirable Limit	Permissible Limit				
1.	Colour	Hazen	5	25	<1.0	<1.0	<1.0	<1.0
2.	Odour		Agreeable	Agreeable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable
3.	Taste		Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
4.	Turbidity	NTU, Max	5	10	<1.0	<1.0	<1.0	4
5.	Ammonia		0.5	No relaxation	<0.1	<0.1	<0.1	<0.1
6.	pH		6.5-8.5	No relaxation	6.59	6.75	6.22	6.18
7.	Dissolved Solids	mg/l	500	2000	56	118	160	112
8.	Total Hardness (as $CaCO_3$)	mg/l	300	600	31	63	63	59
9.	Copper (Cu)	mg/l	0.05	1.5	<0.02	<0.02	<0.02	<0.02
10.	Iron (Fe)	mg/l	0.3	1	<0.05	0.1	0.07	0.3
11.	Manganese (Mn)	mg/l	0.1	0.3	<0.02	<0.02	<0.02	<0.02
12.	Arsenic		0.01	0.05	<0.005	<0.005	<0.005	<0.005
13.	Chloramines (as Cl2)	mg/l	4	No relaxation	<0.3	<0.3	<0.3	<0.3
14.	Cobalt (as Co)	mg/l			<0.5	<0.5	<0.5	<0.5
15.	Selenium		0.01	No relaxation	<0.005	<0.005	<0.005	<0.005
16.	Total Chromium		0.05	No relaxation	<0.01	<0.01	<0.01	<0.01
17.	Silver		0.1	No relaxation	<0.005	<0.005	<0.005	<0.005
18.	Nitrate (NO_3)	mg/l	45	No relaxation	51	0.9	4	1.2
19.	Fluoride (F)	mg/l	1	1.5	<0.1	<0.1	<0.1	<0.1
20.	Zinc (Zn)	mg/l	5	15	<0.02	<0.02	0.04	0.1
21.	Aluminium (Al)	mg/l	0.03	0.2	<0.01	<0.01	<0.01	<0.01
22.	Chlorides (Cl)	mg/l	250	1000	37	43	71	35
23.	Sulphate (SO_4)	mg/l	200	400	<1.0	10	<1.0	<1.0
24.	Alkalinity as $CaCO_3$	mg/l	200	600	31	44	44	52

Sl No	Parameter	Unit	IS:10500		Bayjiahowa	Kasuwani Gaon	Tangri Gaon	Bogdungkinar
			Desirable Limit	Permissible Limit				
25.	Calcium (Ca)	mg/l	75	200	4.7	11	14	13
26.	Magnesium (Mg)	mg/l	30	100	4.6	8.5	6.7	6.4
27.	Residual free chlorine	mg/l	0.2	1	<0.1	<0.1	<0.1	<0.1
28.	Phenolic Compounds(C_6H_5OH)	mg/l	0.001	0.002	<0.001	<0.001	<0.001	<0.001
29.	Mineral Oils	mg/l	0.01	0.03	<0.01	<0.01	<0.01	<0.01
30.	Anionic detergents (MBAS)	mg/l	0.2	1	<0.02	<0.02	<0.02	<0.02
31.	Boron (B)	mg/l	0.3	1.5	<0.5	<0.5	<0.5	<0.5
32.	Barium (Ba)	mg/l	0.7	No relaxation	<0.05	<0.05	<0.05	<0.05
33.	Hydrogen Sulphide (as H2S)	mg/l	0.05	No relaxation	<0.01	<0.01	<0.01	<0.01
34.	Mercury (Hg)	mg/l	0.001	No relaxation	<0.001	<0.001	<0.001	<0.001
35.	Cadmium (Cd)	mg/l	0.003	No relaxation	<0.001	<0.001	<0.001	<0.001
36.	Cyanide	mg/l	0.05	No relaxation	<0.01	<0.01	<0.01	<0.01
37.	Lead (Pb)	mg/l	0.01	No relaxation	<0.005	<0.005	<0.005	<0.005
38.	Polynuclear Aromatic Hydrocarbon (PAH)	mg/l	0.0001	No relaxation	<0.0001	<0.0001	<0.0001	<0.0001
39.	Polychlorinated biphenyls (as PCB)	mg/l	0.0005	No relaxation	<0.0005	<0.0005	<0.0005	<0.0005
40.	Faecal coliform	/100ml	Shall not be detectable in 100 ml sample	Detected	Not Detected	Not Detected	Not Detected	Not Detected
41.	Total coliform	MPN/100ml	Shall not be detectable in 100 ml sample	Detected	Not Detected	Detected	Not Detected	Not Detected

Sl No	Parameter	Unit	IS:10500		Bayjiahowa	Kasuwani Gaon	Tangri Gaon	Bogdungkinar
			Desirable Limit	Permissible Limit				
42.	Bromoform	mg/l	0.1	No relaxation	<0.01	<0.05	<0.05	<0.05
43.	Bromodichloromethane	mg/l	0.6	No relaxation	<0.01	<0.05	<0.05	<0.05
44.	Dibromochloromethane	mg/l	0.1	No relaxation	<0.01	<0.05	<0.05	<0.05
45.	Chloroform	mg/l	0.2	No relaxation	<0.01	<0.05	<0.05	<0.05
46.	**Pesticides**							
47.	Alachlor	µg/l	20	-	<0.02	<0.02	<0.02	<0.02
48.	Atrazine	µg/l	2	-	<0.02	<0.02	<0.02	<0.02
49.	Aldrin	µg/l	0.03	-	<0.01	<0.01	<0.01	<0.01
50.	Alpha-HCH	µg/l	0.01	-	<0.01	<0.01	<0.01	<0.01
51.	Beta-HCH	µg/l	0.01	-	<0.01	<0.01	<0.01	<0.01
52.	Butachlor	µg/l	125	-	<0.02	<0.02	<0.02	<0.02
53.	Chlorpyrifos	µg/l	30	-	<0.02	<0.02	<0.02	<0.02
54.	Delta-HCH	µg/l	0.04	-	<0.01	<0.01	<0.01	<0.01
55.	Dieldrin	µg/l	0.3	-	<0.01	<0.01	<0.01	<0.01
56.	2,4-Dichlorophenoxyacetic acid	µg/l	30	-	<0.01	<0.01	<0.01	<0.01
57.	o,p-DDD	µg/l	1	-	<0.01	<0.01	<0.01	<0.01
58.	o,p-DDE	µg/l		-	<0.01	<0.01	<0.01	<0.01
59.	o,p-DDT	µg/l		-	<0.01	<0.01	<0.01	<0.01
60.	p ,p-DDD	µg/l		-	<0.01	<0.01	<0.01	<0.01
61.	p,p-DDE	µg/l		-	<0.01	<0.01	<0.01	<0.01
62.	p,p-DDT	µg/l		-	<0.01	<0.01	<0.01	<0.01
63.	Alpha -endosulfan	µg/l	0.04	-	<0.01	<0.01	<0.01	<0.01
64.	Beta-Endosulfan	µg/l	0.04	-	<0.01	<0.01	<0.01	<0.01
65.	Endosulfan sulfate	µg/l	0.04	-	<0.01	<0.01	<0.01	<0.01
66.	Ethion	µg/l	3	-	<0.02	<0.02	<0.02	<0.02
67.	Gama-HCH(Lindane)	µg/l	2	-	<0.01	<0.01	<0.01	<0.01
68.	Isoproturon	µg/l	9	-	<0.02	<0.02	<0.02	<0.02
69.	Malathion	µg/l	190	-	<0.02	<0.02	<0.02	<0.02

Sl No	Parameter	Unit	IS:10500		Bayjiahowa	Kasuwani Gaon	Tangri Gaon	Bogdungkinar
			Desirable Limit	Permissible Limit				
70.	Methyl parathion	µg/l	0.3	-	<0.02	<0.02	<0.02	<0.02
71.	Monocrotophos	µg/l	1	-	<0.02	<0.02	<0.02	<0.02
72.	Phorate	µg/l	2	-	<0.02	<0.02	<0.02	<0.02

- pH of the groundwater samples were recorded in the range of 6.18 to 6.75. The pH values of ground water samples of Tangri Gaon and Bogdungkinar were below the Acceptable Limit of 6.5 to 8.5 while the rest of the ground water samples were in compliance to the IS: 10500, 2012 drinking water standard of 6.5 to 8.5.
- Turbidity values of the groundwater samples ranged from <1.0-4 NTU. Turbidity value was within the acceptable limit of 5 NTU.
- Dissolved Solids –Concentration of dissolved solids in groundwater ranges between 56-160 mg/l. The values are lower than the acceptable limit of 500 mg/l and were in compliance to the permissible limit 2000 mg/l.
- Total hardness (as $CaCO_3$) –The values of total hardness ranged between 31 and 63 mg/l. The values in compliance to the acceptable limit of 300mg/l**.**
- Chlorides – The concentration of chlorides ranged between 35 and 71 mg/l. Almost all the stations revealed chloride concentrations in compliance to the acceptable limit of 250 mg/l.
- Alkalinity as $CaCO_3$–The alkalinity of the water samples monitored at study area ranged between 31 and 52 mg/l. Alkalinity were reportedly in compliance with the acceptable limit (200 mg/l) at all the locations.
- Fluoride-Fluoride levels in the groundwater samples were <0.1mg/l. The samples were found to be in compliance to the acceptable limit of 1.0 mg/l.
- Sulphate-Sulphate concentrations in the groundwater samples were found to be ranging between <1.0-10 mg/l. Sulphate concentrations in all the samples were found to be within the acceptable sulphate concentration limit of 200 mg/l.
- Nitrate-Nitrate concentrations in all groundwater samples were found to be in the range of 0.9-51 mg/l. Nitrate concentrations in majority of the samples were found to be within the acceptable nitrate concentration limit of 45 mg/l except in case of Bayjiahowa where the nitrate concentration was found to be 51 mg/l.

  Nitrate if consumed, is reduced within the body to nitrite, which is considered unsafe at much lower levels than nitrate. Nitrite is further reduced in the body to N-nitroso compounds that are widely considered to cause cancer and contribute to a variety of health problems which includes Blue-baby syndrome, birth defects, cancers, thyroid problems and a variety of other health concerns. It is therefore recommended to treat the groundwater of Bayjiahowa before consumption[1].
- Iron- The concentration of iron monitored at 4 locations were found to ranging between< 0.05 -0.3 mg/l. Iron concentrations in all the samples

[1] NITRATE IN DRINKING WATER: A Public Health Concern For All Iowans, Iowa Environmental Council, September2016, Executive Summary.

[*] Detection of coliforms in drinking water and its effect on human health - A Review, nternational Letters of Natural Sciences Online:2014-06-30 ISSN: 2300-9675, Vol. 17, pp 122-131 doi:10.18052/www.scipress.com/ILNS.17.122 © 2014 SciPress Ltd., Switzerland

were found to be within the acceptable iron concentration limit of 0.3 mg/l.

- Calcium- The concentration of calcium ranged between 4.7 and 14 mg/l in the study area. Calcium levels at all stations were found to be in compliance to the acceptable limit of 75 mg/l.
- Magnesium – The concentration of magnesium was observed to be in the range of 4.6 and 8.5 mg/l. Magnesium levels at all stations were found to be in compliance to the acceptable limit of 30 mg/l.
- Levels of cyanide (<0.01 mg/l), phenolic compounds (<0.001 mg/l), anionic detergents (<0.02 mg/l), Mineral oil (<0.01 mg/l) were found to be below detection limits in all the groundwater samples.
- Pesticides levels in the collected samples were found to be below detection limits.
- Concentrations of metals Cd, Cu, Hg, Pb, Mn were found to be below detection limits in the groundwater samples.
- Total and faecal coliforms were not detected in majority of the groundwater samples collected from the study area except in Kasuwani Gaon where total coliform were detected.

The presence of Total coliform bacteria is not likely to cause illness, but their presence indicates that the water supply may be vulnerable to contamination by more harmful microorganisms. *Escherichia coli* (*E. coli*) are the only member of the total coliform group of bacteria that is found only in the intestines of mammals, including humans. The presence of *E. coli* in water indicates recent faecal contamination and may indicate the possible presence of disease-causing pathogens, such as bacteria, viruses, and parasite. Therefore it is advised to properly treat the groundwater of Kasuwani Gaon prior to consumption.

Conclusion

The Concentration of majority of the parameters analysed were within the acceptable limit of IS:10500, 2012 standard. Few samples reveal values for parameters such as nitrate to be in exceedance to the respected acceptable limits. pH values of some groundwater samples were found to be below drinking water standard of IS 10500, 2012.

3.3.9 Drainage

The study area is included under the catchment of the River Brahmaputra which flows from the north eastern side to north western side. The channels traversing through the Field are Dangori River, Dinjan River etc. The drainage pattern of the major rivers traversing the study area is discussed below
The major and minor rivers, their tributaries draining through the study area is provided in ***Figure 3.14.***

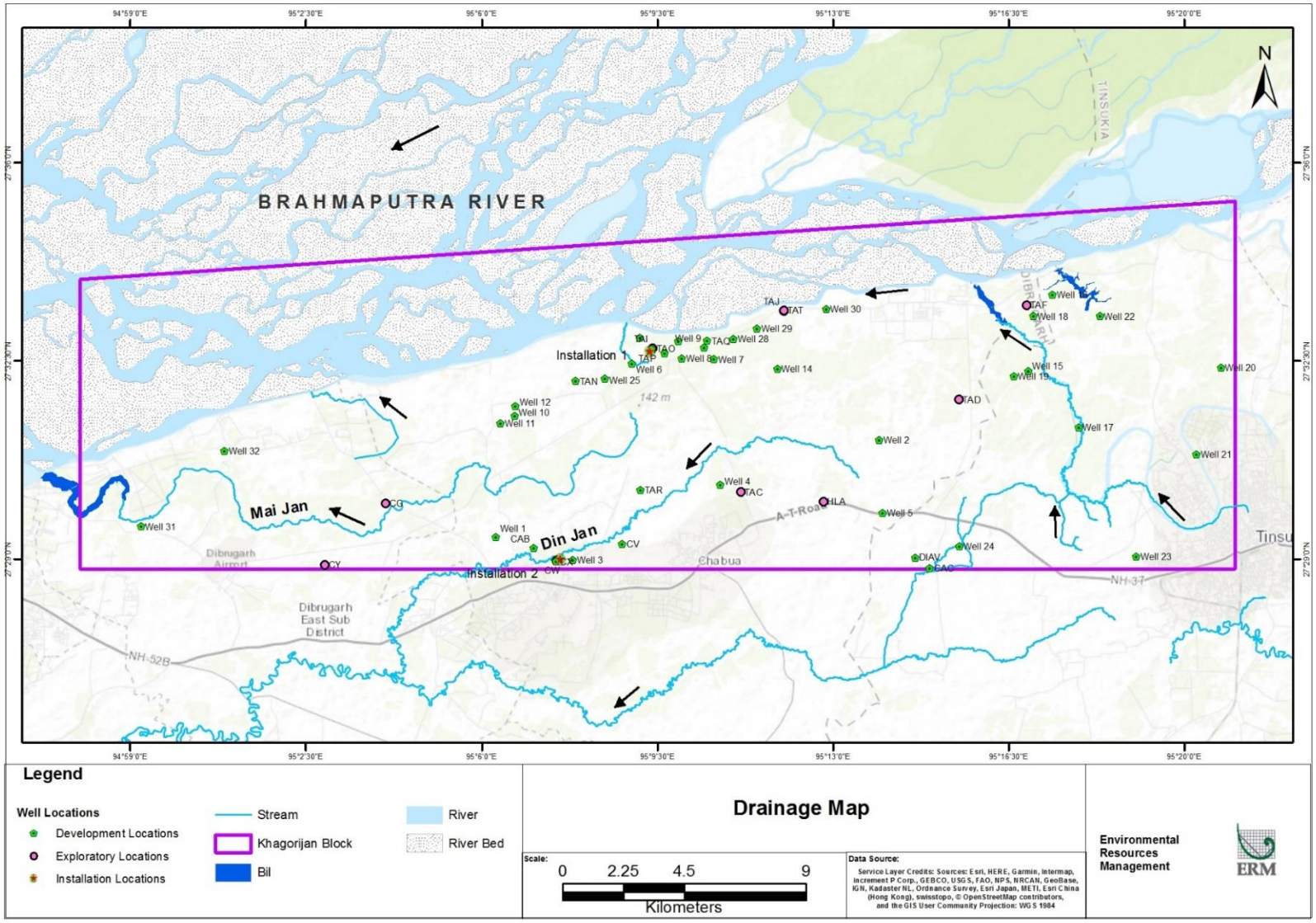
The Brahmaputra originates near Mansarovar Lake in Tibet. After flowing through Tibet, the river enters into Arunachal Pradesh and then to Assam.

Brahmaputra River flows adjacent to the block from north eastern to the north-western part. The branch of the Brahmaputra River, Dangori River flows within Field from north-eastern to the northwestern part. Dangori River branches off from the Lohit River and connects the Brahmaputra River near Rahmoria. The main course of Brahmaputra River flows north of the Dibru-Saikhowa National Park (DSNP).

The other major drainage channels within the Field are Dinjan, Maijan etc. Dinjan flows from central portion of the Field towards south west. Maijan river flows from the central portion of the Field first towards east and then towards north east to meet Brahmaputra River. Some marshy wetland areas are present near the Brahmaputra and Dibru Rivers and are used by the locals for fishing activities. The major wetland complex is known as the Maguri-Motapung wetland complex and is haven for migratory birds and is located at the north-eastern part of the Field. Though the largest water body of the complex is located outside the Field, however, two comparatively smaller wetlands (Dinjan Beel) are located near Guijan.

The drainage map of the study area is presented in ***Figure 3.9***
These surface water channels within the Field are primarily used for irrigation, bathing, washing and for catching fish. Surface run-off and discharge of drilling wastewater from the proposed wells located close to these channels have the potential to affect the water quality of these channels.

Figure 3.13 Drainage Map



3.3.10 Surface Water Quality

Surface water has been monitored at four locations within the study area. The sampling locations have been designed to capture the water quality of the water bodies within the study area that could be impacted due to the proposed drilling and production activities. The surface water monitoring locations in detail has been provided in ***Table 3.12*** and the locations are shown in ***Figure 3.13.***

Table 3.12 Surface water-monitoring locations

Sl No	Location	Station No	Latitude	Longitude
1	Brahmaputra River	SW 1	27° 31' 30.430" N	94° 59' 36.611" E
2	Dinjan River	SW 2	27° 30' 25.086" N	95° 10' 9.225" E
3	Dangori River	SW 3	27° 35' 8.926" N	95° 20' 40.557" E

Water sampling and analysis[1] was done during November 2017 following CPCB standard guidelines for physical, chemical and bacteriological parameters. Field parameters *viz.* temperature, pH, dissolved oxygen were analysed at the site. The results of the samples collected from the drainage channels in the study area have been discussed below with respect to CPCB's Water Use Criteria as provided in ***Annexure 3.6***.

Surface water Monitoring Results

The surface water primary monitoring results have been provided in ***Table 3.13.***

Table 3.13 Surface-water Monitoring Results

Sl No	Parameter	Location	Brahmaputra River	Dinjan River	Dangori River
		Sample Code	SW-1	SW-2	SW-3
1	Temperature	°C	22.1	19.7	26
2	pH at 25°C	None	7.01	6.67	6.39
3	Turbidity	N.T.U.	7	2.2	5
4	Electrical conductivity	µS/cm	158	222	56
5	Oil and Grease	mg/l	<1.4	<1.4	<1.4
6	Total Alkalinity (as CaCO3)	mg/l	70	87	31
7	Dissolved Oxygen	mg/l	7.8	6.2	6.0
8	Biochemical Oxygen Demand (as BOD)	mg/l	<2.0	<2.0	3.0
9	Chemical Oxygen Demand (COD)	mg/l	<4.0	<4.0	16
10	Total Dissolved Solids (as TDS)	mg/l	88	137	35

1 http://www.cpcb.nic.in/latest/guidelines-water.doc

Sl No	Parameter	Location	Brahmaputra River	Dinjan River	Dangori River
		Sample Code	SW-1	SW-2	SW-3
11	Total Hardness (as CaCO3)	mg/l	72	90	27
12	Free Ammonia	mg/l	<0.1	<0.1	<0.1
13	Chloride (as Cl)	mg/l	12	20	14
14	Fluoride (as F)	mg/l	0.16	0.28	0.33
15	Nitrate (as NO3)	mg/l	1.4	<0.5	1.1
16	Sulphate (as SO4)	mg/l	<1.0	<1.0	<1.0
17	Total Phosphorus	mg/l	<0.05	<0.05	0.09
18	Total Nitrogen (as N)	mg/l	1	<0.3	<0.3
19	Sodium (as Na)	mg/l	4.1	19	5
20	Potassium (as K)	mg/l	1.4	2.8	1.0
21	Iron (as Fe)	mg/l	0.4	0.2	2.4
22	Manganese (as Mn)	mg/l	<0.02	<0.02	<0.02
23	Boron (as B)	mg/l	<0.5	<0.5	<0.5
24	Sodium Adsorption Ration (as SAR)	None	0.21	0.43	0.41
25	Phenol	mg/l	<0.001	<0.001	<0.001
26	Faecal coliform	Detected/ Not Detected	Detected	Not Detected	Not Detected
27	Total coliform	MPN/100ml	23	4.5	<1.8

Source: ERM

Interpretation of Surface water Monitoring Results

Results of the water quality sampled near Brahmaputra River, Dinjan River and Dangori River are discussed below:

- pH – The pH value of the samples collected from Brahmaputra River was 6.67. pH value of the surface water of Dangori river was found to be 7.01 and Dinjan River was 6.39.
- Dissolved Oxygen (DO)–DO concentrations of the water samples collected from Brahmaputra River was 6.2 mg/l. DO value of the surface water of Dangori river was found to be 7.8 mg/l and Dinjan River was 6.0 mg/l.
- Biochemical Oxygen Demand (BOD) – The concentration of BOD for surface water samples of Brahmaputra River and Dangori River were reported to be <2.0 mg/l while the BOD concentration of Dinjan River was 3.0 mg/l.
- Chemical Oxygen Demand (COD) – The concentration of COD for the river water and Dangori River was reported to be between <4.0 mg/l; while the COD value of the Dinjan River was found to be 16 mg/l.
- Coliform bacteria–the load of total coliform was highest in the surface water sample of Dangori River collected near the project site (23 MPN/100 ml); followed by the Brahmaputra River water sample (4.5 MPN/100 ml). Total coliform level at the Dinjan River was found to be

<1.8 MPN/100 ml. Faecal coliform was detected at Dangori River whereas it was not detected in rest of the surface water samples.

- Total Dissolved Solids (TDS) - The TDS concentration of Brahmaputra River was 137 mg/l. The TDS concentration of the Dangori River was found to be 88 mg/l and Dinjan River was 35 mg/l.
- Total Suspended Solids – The suspended solids concentration of of Brahmaputra River water was 5.9 mg/l. Suspended solids concentrations of the Dangori River was found to be <2.5 mg/l while that of Dinjan River was 13.6 mg/l.
- Boron- Boron concentrations were found to be less than 0.5 mg/l for all the samples
- Sodium Absorption Ratio (SAR) - Sodium absorption ration for the surface water samples varied between 0.21-0.43.
- Salinity-Salinity values of the Brahmaputra River water samples was found to be 0.126 (In respect to KCl, equivalent salinity 35). While Dangori River water samples revealed salinity value of 0.091 and Dinjan River 0.04 (In respect to KCl, equivalent salinity 35).
- Oil and grease – The concentration of oil and grease at all the surface water samples were observed to be less than 1.4mg/l.
- Concentrations of phenol (<0.001 mg/l) were found to be below detection limit for all the samples
- Concentration of metals like lead (<0.005 mg/l), mercury (<0.001 mg/l), cadmium (<0.001 mg/l), total chromium (<0.01mg/l) were found to be below detection limits for all the samples.
- Arsenic – The concentration of Arsenic were found to be less than 0.005 mg/l.
- Free Ammonia - The concentration of Free Ammonia were found to be less than 0.1 mg/l

The river water in the area is used for the purpose of bathing and washing clothes (Class B of Designated Best Use Category of CPCB) and also for catching fish. Due to presence of Total Coliform Organisms in numbers less than 500 MPN/100 ml, at the river water samples the water is found to suitable for "B" class of water, i.e. outdoor bathing. The analyzed values reveal that all the samples were in compliance to the CPCB Class D i.e. *Propagation of Wild life and Fisheries*.

Figure 3.14 Primary Environmental Monitoring Photographs

Air



Ambient air quality monitoring at Dhekiajuli Bengali



Ambient air quality monitoring at Bagalitola 1 No. Balijan



Ambient air quality monitoring at Haribari Konwargaon



Ambient air quality monitoring at Guijan LG Road

Groundwater



Groundwater sampling at 28



Groundwater sampling 29

Surface Water



Surface water sample collection from Brahmaputra River



Sampling at Dangori River Downstream

Soil	
	
Soil sample collection from Kosowani Pathar	Soil sample collection from Balijan

3.3.11 Traffic Analysis

As discussed in ***Section 2.3.2***, the proposed locations in Khagorijan Field area can be accessed through NH 37 Road and Panitola Dibrugarh Road. Traffic monitoring station was selected at NH 37 near Chabua and at Panitola - Dibrugarh Road. Traffic survey was conducted continuously for 24 hours, one time during the study period. The traffic survey was done for both way movement of vehicles and categorized as heavy motor vehicles (truck, bus, dumper, tanker and trailer), light motor vehicle (car, jeep, van, matador, tractor, tempo and mini bus), two/three wheelers (scooter, motor cycle, auto, moped) and non-motorized vehicles (bicycle, tricycle). Summary of traffic observed in the study area is presented in ***Table 3.14,*** detail result is provided in ***Annexure 3.7***.

Table 3.14 Traffic Values observed in the Project study area

Description	NH 37	Panitola Dibrugarh Road
Heavy Motor Vehicles (in Number), 24 hours	1594	1656
Light Motor Vehicle (in Number), 24 hours	5954	5504
Two/Three Wheelers (in Number), 24 hours	2734	2804
Non-motorized Vehicles	801	794
Total PCU (Nos.) in 24 Hours (To & From)	21025	10758
Average PCU Flow/Hr	876	846
Max PCU (Nos)/Hr	1540	1571
Min PCU (Nos)/Hr	73	108
Minimum PCU Hours	01:00-02:00	01:00-02:00
Maximum PCU Hours	16:00-17:00	15:00-16:00

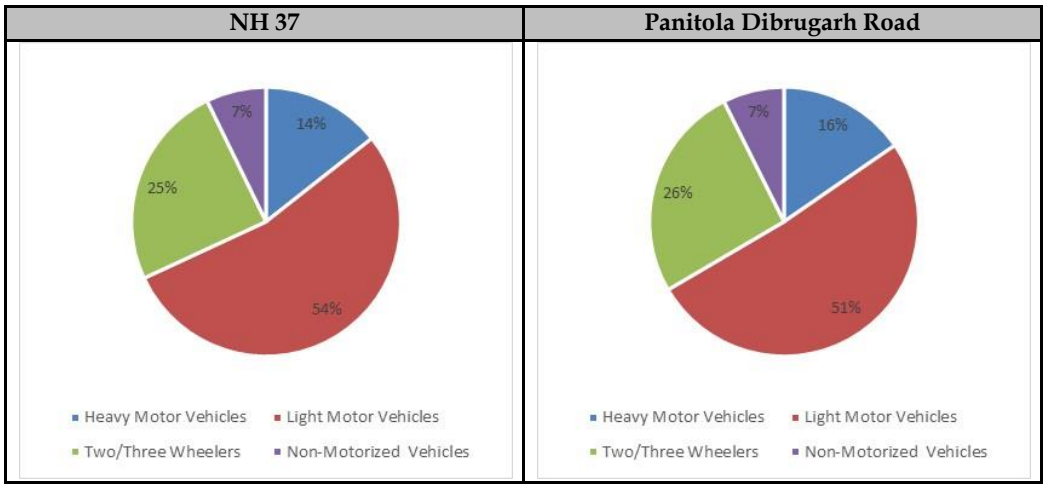
Interpretation of Traffic Survey Results

Total 21025 PCU and 10758 PCU was recorded at the traffic monitoring station at NH 37 and Panitola- Dibrugarh Road respectively. As per observation made for traffic density, on an average 876 PCU and 846 PCU was recorded per hour at the locations, respectively. It was also noticed that major contributor (nearly 54% and 51%) of the vehicular traffic at NH 37 Road and

Panitola-Dibrugarh Road was light motor vehicle (Car, Jeep, Van, Matador, Tractor, Tempo, Mini Bus) followed by Two and Three wheelers which is 25% and 26% respectively.

Figure 3.15 illustrates contribution of different type of vehicle towards total vehicular traffic at NH 37 Road and Panitola Dibrugarh Road

Figure 3.15 ***Contribution of Different Type of Vehicle at NH 37 and Panitola Dibrugarh Road***



3.3.12 Natural Disaster

Assam is prone to natural hazards such as earthquake, flood and cyclone.

Earthquakes

Assam lies in Zone V, the most severe seismic zone (as per Bureau of Indian Standards (BIS) 2000). 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 (occurred in 1950) causing large scale damage to lives and properties in this region.

3.4 BIOLOGICAL ENVIRONMENT

3.4.1 Introduction

The State of Assam is located in the Bio-geographic zone of both 9A: Brahmaputra Valley and 9B-North-East Hills (Rodgers & Panwar, 1988[1]) and is extremely rich in bio-diversity. Situated in the Indian sub-region of Oriental Zoo-geographic region, local flora and fauna bear a very close affinity and resemblance with floral and faunal components of Indo-Malayan and Indo-Chinese sub-regions.

[1] Rodgers, W.A. and Panwar, S.H. (1988) Biogeographical classification of India. New Forest, Dehra Dun, India.

3.4.2 Objectives

Primary ecological surveys were conducted as a part of this EIA with the following objectives:

Flora

- Identification of floral species (terrestrial and aquatic), sensitive habitats, endangered species and forest land falling within Khagorijan Field;
- Classification of flora for any endangered or protected species or endemic floral species prevailing in Khagorijan Field based on field surveys;
- Identification of areas protected under international conventions, national or local legislation for their ecological, landscape, cultural or other related value; and
- Identification of aquatic flora in the water bodies falling within Khagorijan Field.

Fauna

- Identification of fauna (specifically amphibians, birds, mammals and reptiles);
- Identification and classification of any species recognized as threatened (in accordance with International Union for the Conservation of Nature [IUCN] Red List ver. 2018-1), or according to the schedules of the Wildlife (Preservation) Act 1972 and amendments);
- Identification of areas which are important or sensitive for ecological reasons including their breeding, nesting, foraging, resting, over wintering areas including wildlife migratory corridors /avian migratory routes; and
- Identification and assessment of aquatic ecological resources within Khagorijan Field.

3.4.3 Methodology

Desktop Review & Secondary Data Collection

A desktop review (published document, etc.) was conducted to determine the forest area (Toposheet and Satellite imagery), vegetation type (Champion and Seth, 1968[1]), floral and faunal assemblage in the study area. Secondary baseline data regarding sensitive ecological habitat (National Park, Sanctuary, Ecological Sensitive Area, Migratory Corridor, etc.), flora & fauna in the study area, forest cover was collected from published and unpublished documents. Stakeholder consultations (Forest Department, Local People etc.) were also carried out to understand the major flora & fauna in the study area, pressure on forest resources, presence of any Schedule I species.

[1] Champion H.G. and Seth S. K. 1968. A Revised Survey of the Forest Types of India. Nataraj Publishers. Dehradun.

Baseline & Primary Survey

Baseline survey was carried out to determine the existing ecological conditions and was designed to fill any data gaps, and to facilitate an adequate assessment of the project's impacts upon ecology and the development of appropriate mitigation measures. Baseline survey was conducted during November-December 2017 for habitat survey, flora & faunal assemblage within Khagorijan Field.

Primary survey was carried out in the targeted study area for habitats (terrestrial and aquatic), identification of floral and faunal species (terrestrial and aquatic) and related sensitivities i.e. within i.e. within 1 km of the proposed well sites and production facilities.

Floral Analysis

Eighteen (18) sample plots were studied covering various habitats within Khagorijan Field. The details of the sample plot studied are given in ***Table 3.15.***

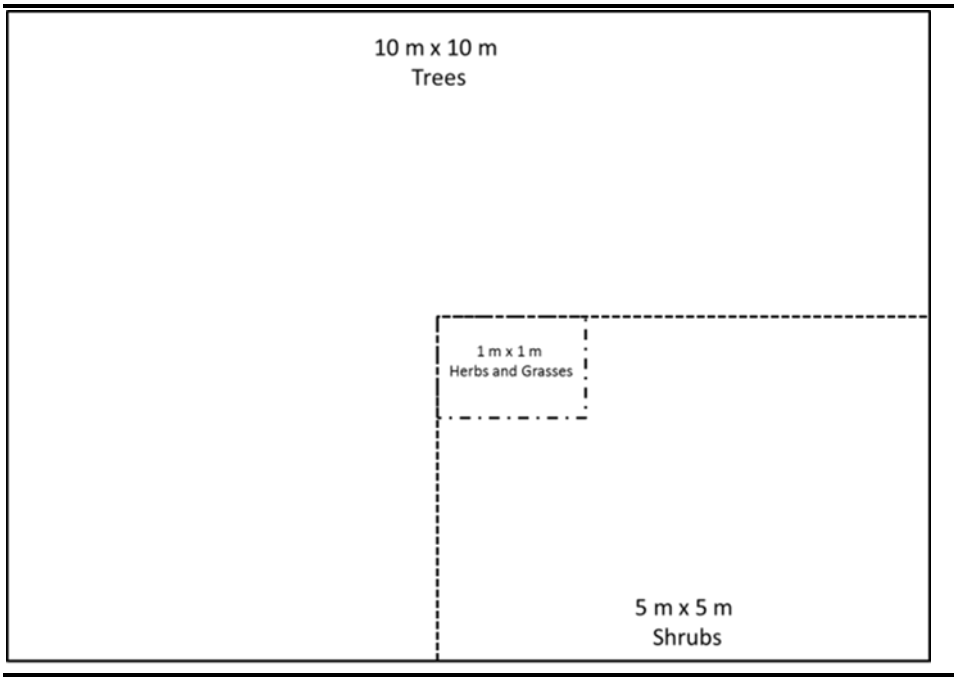
Table 3.15 Details of the Sample Plot

Code	Habitat Type	Latitude (Northing)	Longitude (Easting)
KG1	Agricultural	27°31'47.79"N	95° 2'10.91"E
KG2	Agricultural	27°29'27.47"N	95°13'21.22"E
KG3	Agricultural	27°31'13.71"N	95°15'45.43"E
KG4	Agricultural	27°29'23.45"N	95°18'56.50"E
KG5	Homestead Plantation	27°28'52.81"N	95° 7'21.52"E
KG6	Homestead Plantation	27°33'50.04"N	95°16'47.02"E
KG7	Homestead Plantation	27°30'23.29"N	95°11'5.92"E
KG8	Homestead Plantation	27°29'58.86"N	95° 4'12.41"E
KG9	Homestead Plantation	27°29'29.07"N	95°13'22.79"E
KG10	Homestead Plantation	27°31'31.87"N	95°15'45.81"E
KG11	Riparian	27°31'52.18"N	95° 2'13.25"E
KG12	Riparian	27°33'8.93"N	95° 8'41.71"E
KG13	Riparian	27°34'12.23"N	95°17'27.64"E
KG14	Riparian	27°29'17.00"N	95° 8'23.49"E
KG15	Tea Plantation	27°28'51.01"N	95° 7'13.47"E
KG16	Tea Plantation	27°33'17.99"N	95°11'43.78"E
KG17	Tea Plantation	27°29'32.21"N	94°59'27.33"E
KG18	Tea Plantation	27°31'23.60"N	95° 6'59.97"E

Source: ERM Primary Monitoring

Quantitative data was collected using standard quadrate methods of sample plot size 10 m x 10 m for trees, 5 m x 5 m for shrubs and 1 m x 1 m for herbs and grasses. Frequency, Density, Abundance and IVI were calculated. Sample plot is described in ***Figure 3.16***.

Figure 3.16 Description of Sample Plot



Species diversity was calculated based on Shannon Weiner Index (1) for the trees, shrubs and herbs.

Phyto-sociological Analysis

Phytosociology provides frequency, abundance, density and Important Value Index (IVI) of plant species. Formulae used for calculating IVIs are provided in ***Annexure 3.8***. Location of the quadrats is shown in ***Figure 3.18***.

3.4.4 Terrestrial Ecosystem

The Khagorijan Field falls under administrative districts of Tinsukia and Dibrugarh in Assam. Tinsukia district has 1536 sq. km under the forest cover, i.e. 40.53 percent of its total geographical area whereas Dibrugarh district has 758 sq. km under the forest cover, i.e. 22.42 percent of its total geographical area. (State of Forest Report 2011, FSI).

Forest Types

Owing to the huge amount of annual rainfall, forest types occurring in this region are primarily of Tropical Evergreen Forest and Tropical Semi-Evergreen Forest. Apart from forest having luxuriant tree growth different types of swamp forests as well as extensive grasslands can also be found in areas which remain water logged for particular time of the year. (Champion and Seth Forest classification).

(1) Shannon CE & W Weaver 1949 The Mathematical Theory of Communication. University of Illionis Press. Urbana, IL USA.

1/1/1B/C1 Assam valley Tropical wet evergreen forest: The forest is characterized by several layers of canopy. The top canopy is dominated almost entirely by *Dipterocarpus macrocarpus* which occurs in patches, attaining girth of 7m and height up to 40 Meters. Other species found in the top canopy are *Amoora walllichii, Terminalia myriocarpa, Artocarpus chaplasha.* They stand over a closed evergreen middle canopy of about 30m, which is mostly dominated by *Mesua ferrea* and *Vatica lanceaefolia*. The other species that grow sporadically in the lower canopy are *Terminalia belerica, Canarium resiniferum, Terminalia chebula, Sapium baccatum, Dysoxylum binectiferum* etc. There is also a undergrowth of mainly composed of woody shrubs like Kasidoria (*Myrsine capitellata*), *Osbekia* spp., Sorat (*Laportea crenulata*), Kaupat (*Phrynium placentarium*), Borgitora (*Alpinea allughas*) etc. climbers and epiphytes are also abundant. This type of forest can be found in Borajan and Padumoni segments of Bherjan Borajan Padumoni Wild Life Sanctuary and isolated patches of Dibru Saikhowa National Park.

1/2/2B/C1a Assam Valley Tropical semi evergreen forest: This forest is mainly characterised by a closed, largely evergreen community of trees with varying proportion of deciduous trees, mainly as a broken top storey. Less uniform and imposing than the tropical evergreen forest but still including tall and large trees. Middle story is dense and varied undergrowth including much cane etc. Buttresses are a common feature and strangling figs are numerous. This type of forest can be found in core area of Dibru Saikhowa National Park and Bherjan and Borajan sections of Bherjan Borajan Padumoni Wild life sanctuary. Main species of this type of forest include *Artocarpus chaplasha, Alphonsea ventricosa, Castonopsis indica, Canarium* spp., *Dillenia indica, Dysoxlum procerum, Mesua ferrea,* etc. The undergrowth and climbers are *Myrsine capitellata, Osbekia* spp., *Laportea cranulata, Phrynium placentarium* etc.

1/2/E1 Cane brakes: It is mainly characterized by an impenetrable thorny thicket sometimes with a few tall trees standing over it, sometimes without. The stems are typically trailing, but some species are more or less erect. Within the study area this forest can be found in the core of Dibru Saikhowa National Park. Some of the species that represent this type of forest are *Calamus* sp., *Arundo donax* etc.

1/3/3C/C3b East Himalayan moist mixed deciduous forests: This forest is mainly characterized by a tall more or less closed forest in which the individual trees often of quiet large size. Community is mostly well mixed but there is a dominance of deciduous species that grows on well-drained soil. There is an abundant undergrowth of mostly shrubs but no grass unless burnt. With burning grass many become abundant with coarse tufted species absent. This type of forest can be found in Dibru Saikhowa National Park. Some of the species that can be found in this forest are *Lagerstroemia* sp., *Terminalia bellerica, Amoora* sp. etc.

1/3/1/S2b Eastern Hollock Forests: This forest is mainly characterized by extensive stretch of tall grass savannah forest with occasional scattered trees growing in areas which receive a minimum rainfall of 1500mm. large trees like *Terminalia myriocarpa* or *Lagerstoemia* sp. are mostly predominant. Other species that can be found are *Vatica lanceaefolia, Duabanga* sp., *Pterosparmum*

acerifolium etc. This type of vegetation can be found in Dibru Saikhowa National Park.

1/4/4D/SS1 Eastern seasonal swamp forests: This forest is mainly characterized by even and dense forest with canopy at about 20m. For the greater part of rain the soil remains water logged. This type of vegetation can be found in Bherjan and Borajan part of Bherjan Borajan Padumoni Wild Life Sanctuary. Some of the species that can be found in this forest are *Altingia excelsa, Michelia doltsopa, Dillenia indica, Terminalia chebula, Bischofia javanica,* etc.

1/4/4D/SS2 Barringtonia swamp forests: This forest is characterized by open crop of evergreen trees of medium height mostly comprised of few species, often pure crop, but it may be much denser and with or without a thick undergrowth of evergreen species. Some of the ground, particularly the higher parts, may be under course savannah grass. Climbers are few. The most important factor that promotes in this types forest growth is annual flood during monsoons. This is the most abundant forest type in the Dibru-Saikhowa National Park. Species mostly associated with this forest are *Salix tetrasperma, Bischofia javanica,* etc.

1/4/4D/2S1: Eastern wet alluvial grasslands: Vegetation is mainly dominated with sea of grass growing up to 2m in height with occasional trees growing up to 3 m in height. In the higher land *Mesua ferrea* becomes predominant in the top canopy. Associated with it are found other species namely *Altingia excelsa, Michelia doltsopa, Dillenia indica, Terminalia chebula, Bischofia javanica* etc.

Floral Diversity

Floral diversity of the different habitats within the Khagorijan Field is presented below

Forest area

Floral Composition of Padumoni section of Bherjan Borajan Padumoni Wild Life Sanctuary: Padumoni part of the Bherjan Borajan Padumoni Wild Life Sanctuary is characterized by *Assam valley Tropical wet evergreen forest (1/1/1B/C1).* Major portion of the forest of this part of the protected area is characterized by this forest type. The forest is composed of several canopy layers. The top canopy is dominated almost entirely by Hollong (*Dipterocarpus macrocarpus*) which grow upto 40 Meters. The other species that are found to occur sporadically are *Amoora wallichii, Terminalia myriocarpa, Artocarpus chaplasha, Altingia excelsa, Michelia champa e*tc. Middle canopy is dominated by *Mesua ferrea* and *Vatica lanceaefolia*. The other species that grow sporadically in the lower canopy are *Terminalia belerica, Canarium resiniferum, Terminalia chebula, Sepium baccatum, Dysoxylum binectiferum* etc. The undergrowth is composed of woody shrubs like Kasidoria (*Myrsine capitellata*), *Osbeckia* spp., Sorat (*Laportea creanulata*), Kaupat (*Phrynium placentarium*), Bogitora (*Alpinea allughas*) etc. are also found.

Floral Composition of Dibru-Saikhowa National Park:

The original natural vegetation of the National Park was tropical wet evergreen rainforest (*1/1/1B/C1 Assam valley Tropical wet evergreen forest*) with

grassland and reed beds (*1/4/4D/2S1: Eastern wet alluvial grasslands and 1/4/4D/SS: Eastern seasonal swamp forests)* in the riverine tracts and depressions. During the great earthquake of 1950, large parts of the reserve sank by a few meters, resulting in the regular flooding of the area. This was followed by the emergence of a new type of vegetation. 'Salix swamps' (*1/4/4D/SS2 Barringtonia swamp forests)* and deciduous forest now dominate the reserve, and evergreen forest is now restricted to a few patches. About a third of the national park is covered with *Salix tetrasperma* and *Bischofia javanica,* the most abundant tree species. *Dipterocarpus macrocarpus* trees, which were common before 1950, are now rare. Grassland and reed beds cover another third of the park (*1/3/1/S2b Eastern Hollock Forests and 1/4/4D/2S1: Eastern wet alluvial grasslands)*. The main reed and grass species are *Arundo donax*, *Phragmites karka*, *Imperata cylindrica*, *Saccharum* spp. etc. The core area of Dibru Saikhowa Biosphere Reserve is a mosaic of habitat types, the diversity of which is reflected in the faunal diversity it supports. The core is characterized by littoral and swamp forests, semi-evergreen forests, deciduous forests and patches of wet evergreen forests. Apart from this 38 species of orchid can be found in the Dibru Saikhowa National Park.

Roadside Plantation

Trees planted along the major roads in the study area. Some important tree species are *Alstonia scholaris, Aegle mermelos, Melia azedarach, Artocarpus heterophyllus, Bombax ceiba, Ficus religiosa, Lagerstroemia speciosa* etc.

Village Woodlot

Naturally or planted trees on community or private land comprise of the village woodlot areas. Bamboo and timber woods are planted in this area. Some important tree species are *Mangifera indica, Melia azedarach, Aegle marmelos, Delonix regia, Ficus religiosa, Syzygium cumini, Gmelina arborea, Areca catechu,* etc.

Tea Garden

Most of the tea gardens have shade trees and plantation along the garden roads. These are mostly nitrogen fixing plant species, *viz*. *Albizia* sp., other species include *Gmelina arborea, Areca catechu, Artocarpus heterophyllus* etc.

Riparian Vegetation: Vegetation along riverbanks of Brahmaputra, Dangori and Dinjan rivers etc. within the Khagorijan Field include species like *Syzygium cumini, Bombax ceiba, Ficus hispida*, *Alstonia scholaris, Anthocephalus sinensis, Gmelina arborea* etc.

Figure 3.17 Photographs of Different Type of Habitats in Khagorijan Field



Forest



Riparian Vegetation



Homestead Plantation



Agricultural Land



Tea Plantation



Tea Plantation

<u>*Floral Diversity*</u>: 282 numbers of plant species has been recorded from the area, which includes 139 species of trees, 74 species of shrubs and herbs, 19 species of grasses, 12 species of climbers and 38 species of epiphytes. The detailed listing of floral species recorded in the study area is given in ***Annexure 3.8***.

Endemic, Threatened & Endangered Floral Species

The Wildlife (Protection) Act 1972 prohibits picking, uprooting, damaging, destroying, acquiring or collecting six species of plants from forest land and any area specified, by notification, by the Central Government [Clause 17A of Chapter IIIA (Protection of Specified Plants), page 346 of Handbook Vol. 1]. The six species are: Beddome's cycad (*Cycas beddomei*), Blue Vanda (*Vanda coerulea*), Kuth (*Sassurea lappa*), Ladies slipper orchids (*Paphiopedilum* spp.),

Pitcher plant (*Nepenthes khasiana*), Red Vanda (*Rananthera imshootiana*). None of these species is recorded in the forests of the study area during the EIA.

Phytosociological Analysis

Out of the total four enumerated tree species from tea plantation areas maximum relative density and IVI values were observed for *Alstonia scholaris (*RD-8.96/IVI-31.9*)* followed by *Albizia chinensis* (RD-7.46/IVI-29.9) and *A. lebbeck* and *A. procera* (RD-4.48/IVI- 17.8).

Out of the total fourteen enumerated tree species from homestead plantation maximum relative density and IVI values were observed for *Areca catechu (*RD-38.81/IVI-55.0*)* followed by *Melia azedarach* (RD-8.96/IVI-38.1) and *Cordia dichotoma* (RD-4.48/IVI- 17.5).

Out of the total five enumerated tree species from riparian vegetation maximum relative density and IVI values were observed for *Bombax ceiba (*RD-2.99/IVI-18.6*)* followed by *Gmelina arborea* (RD-5.97/IVI-20.2) *Neolamarckia cadamba* (RD-1.49/IVI-8.1).

Out of the total six enumerated tree species from agricultural land maximum relative density and IVI values were observed for *Alstonia scholaris* (RD-2.99/IVI-10.8) followed by *Lagerstroemia speciosa* (RD-1.49/IVI-8.6) and *Pongamia pinnata* (RD-2.99/IVI-8.3).

The list of tree species and their ecological parameters are given in ***Table 3.16.***

Table 3.16 Phytosociology of Tree species within the Study Area

Species	Relative Frequency	Relative Density	Relative Dominance	IVI
Tea Plantation				
Albizia lebbeck	1.0	4.48	12.4	17.8
Albizia procera	1.5	4.48	11.8	17.8
Albizia chinensis	2.5	7.46	19.9	29.9
Alstonia scholaris	3.0	8.96	20.0	31.9
Homestead Plantation				
Artocarpus heterophyllus	1.0	2.99	8.2	12.2
Areca catechu	6.5	38.81	9.7	55.0
Melia azedarach	1.2	8.96	28.0	38.1
Livistona jenkinsiana	1.0	1.49	4.4	6.9
Ficus hispida	1.0	1.49	1.9	4.4
Lagerstroemia speciosa	1.0	1.49	5.7	8.2
Syzygium cumini	1.0	1.49	3.8	6.2
Alstonia scholaris	2.0	2.99	6.9	11.8
Spondias pinnata	1.0	1.49	1.9	4.3
Mimusops elengi	1.0	1.49	1.3	3.8
Erythrina variegata	1.0	1.49	4.1	6.6

Thespesia populnea	2.0	2.99	5.9	10.9
Cordia dichotoma	1.0	4.48	12.0	17.5
Cascabela thevetia	1.0	1.49	0.3	2.8
Riparian Vegetation				
Ficus hispida	1.0	1.49	0.7	3.2
Gmelina arborea	1.3	5.97	12.9	20.2
Alstonia scholaris	1.0	1.49	2.9	5.4
Neolamarckia cadamba	1.0	1.49	5.6	8.1
Bombax ceiba	1.0	2.99	14.7	18.6
Agricultural Land				
Melia azedarach	1.0	1.49	4.5	7.0
Lagerstroemia speciosa	1.0	1.49	6.1	8.6
Alstonia scholaris	1.0	2.99	6.8	10.8
Thespesia populnea	1.0	1.49	3.0	5.5
Cordia dichotoma	1.0	1.49	4.0	6.5
Pongamia pinnata	1.0	2.99	4.3	8.3

Shrubs in the study area were represented by nine species. *Camelia sinensis* was found to be the most dominant species having highest relative density as recorded at tea plantation. *Melastoma malabathricum* was dominant with high relative density in homestead plantation and *Cleodendron viscosum* was dominant in agricultural land while *Tamarix gallica var. indica* was found to be the having the highest relative density for riparian vegetation area.

The list of shrub species and their ecological parameters are given in ***Table 3.17***.

Table 3.17 Phytosociology of Shrub species

Species	Relative Frequency	Relative Density	RVI
Tea Plantation			
Camelia sinensis	22.3	202.27	224.5
Homestead Plantation			
Melastoma malabathricum	1.5	3.90	5.4
Hibiscus rosa-sinensis	1.0	3.90	4.9
Bergera koenigii	1.0	1.30	2.3
Lantana camera	1.0	1.30	2.3
Euphorbia sp.	1.0	1.30	2.3
Agricultural Land			
Cleodendron viscosum	2.5	6.49	9.0
Melastoma malabathricum	1.0	1.30	2.3
Ricinus communis	2.0	2.60	4.6
Lantana camera	2.0	2.60	4.6
Riparian Vegetation			
Tamarix gallica var. indica	1.5	3.90	5.4

Herbs and fern species in the study area are represented by 20 species. *Dryopteris filix-mas* were found most dominant herb species in tea plantation. *Leonurus sibiricus* was dominant in homestead plantation, *Ipomoea fistulosa* was found to dominant in riparian vegetation while *Leucas asperra* was dominant in case of agricultural lands. The list of herbs and grass species and their ecological parameters are given in ***Table 3.18.***

Table 3.18 Phytosociology of Herbs and ferns

Species	Relative Frequency	Relative Density	RVI
Tea plantation			
Ageratum conyzoids	1.0	1.5	2.5
Oxalis corniculata	1.0	1.5	2.5
Leucas asperra	1.0	1.5	2.5
Centella asiatica	1.0	1.5	2.5
Dryopteris filix-mas	2.0	6.1	8.1
Diplazium esculentum	1.0	1.5	2.5
Pteris sp.	1.0	1.5	2.5
Homestead Plantation			
Ageratum conyzoids	1.0	3.0	4.0
Eupatorium odoratum	2.0	6.1	8.1
Spilanthes acmella	0.5	1.5	2.0
Leucas asperra	2.0	3.0	5.0
Colocasia esculenta	1.0	3.0	4.0
Solanum nigrum	1.7	7.6	9.2
Leonurus sibiricus	3.0	13.6	16.6
Centella asiatica	3.0	4.5	7.5
Polygonum sp.	5.0	7.6	12.6
Dryopteris filix-mas	1.0	6.1	7.1
Pteris sp.	2.0	3.0	5.0
Riparian Vegetation			
Eupatorium odoratum	2.0	6.1	8.1
Leucas asperra	2.0	3.0	5.0
ludwigia parviflora	1.0	1.5	2.5
Colocasia esculenta	1.7	7.6	9.2
Polygonum hydropiper	1.0	1.5	2.5
Ranunculus sceleratus	1.5	4.5	6.0
Ipomoea fistulosa	2.0	9.1	11.1
Centella asiatica	1.0	1.5	2.5
Trapa natans	1.0	1.5	2.5
Dryopteris filix-mas	2.0	3.0	5.0
Agricultural Land			
Ageratum conyzoids	1.0	1.5	2.5
Eupatorium odoratum	2.5	7.6	10.1
Leucas asperra	3.3	15.2	18.5
Solanum indicum	1.0	1.5	2.5

Species	Relative Frequency	Relative Density	RVI
Solanum xanthocarpum	1.0	1.5	2.5
Colocasia esculenta	1.5	4.5	6.0
Zea mays	6.0	9.1	15.1
Centella asiatica	1.5	4.5	6.0
Polygonum sp.	3.0	4.5	7.5

Species Richness

The species richness of the different habitats was calculated based on total number of species. Species richness was highest for homestead plantation (30 plant species) followed by agricultural land (19 plant species), riparian vegetation (17 plant species). Species richness was lowest for tea plantation with 12 plant species.

Species Diversity

The species diversity (1) is calculated based on Shannon Weiner Index (H'). The H' values calculated for different habitat types are presented in ***Table 3.19***. Highest diversity value was observed for homestead plantation (H'=2.88) followed by agricultural land (H'=2.65) and riparian (H'=2.62), while tea plantation (H'=1.04) showed the minimum value.

Table 3.19 Species Richness and diversity within Study Area

S No.	Habitat Type	Total no. of plots studied	Species Richness	Shannon Weiner Index (H')
1	Tea Plantation	4	12	1.04
2	Homestead Plantation	6	30	2.88
3	Riparian	4	17	2.62
4	Agricultural	4	19	2.65

The Importance Value gives an overall estimate of the influence of importance of a plant species in the community. It can be interpreted from the phytosociological survey that *Alstonia scholaris* was found to be the most dominant plant species in the tea plantation and agricultural land, *Areca catechu* in homestead plantation and *Bombax ceiba* in riparian vegetation area. All the habitat types showed high H' values which indicate diverse plant communities, a greater number of successful species and ecologically stable ecosystems. Among the habitat types under study homestead plantation showed most diverse ecosystem compare to the other habitat types.

Wildlife Habitat

A part of the Khagorijan Field falls within the south western part of Dibru Saikhowa National Park (DSNP). Also the Padumoni Segment of Bherjan-

(1) On the diversity scale, biologically r3ealistic H' values range from 0 (only one species present with no uncertainty as to what species each individual will be) to about 4.5 (high uncertainty as species are relatively evenly distributed). In theory, the H'value can be much higher than 4.5, although most real world estimates of H' range from 1.5 to 3.5

Borajan-Padumoni Wildlife Sanctuary (BBPWLS) is located within the Khagorijan Field. Apart from these two protected areas tea garden plantation covers huge tracts of land within the block as well as in the surrounding region. As tea gardens have very low human population density and settlement within them are isolated and patchy, tea gardens acts as wildlife movement corridor between isolated protected areas, as well as habitat for huge diversity of avian fauna and even large cats like leopards. Proposed wells located within 10 km of the DSNP and BBPWLS is shown in the table below.

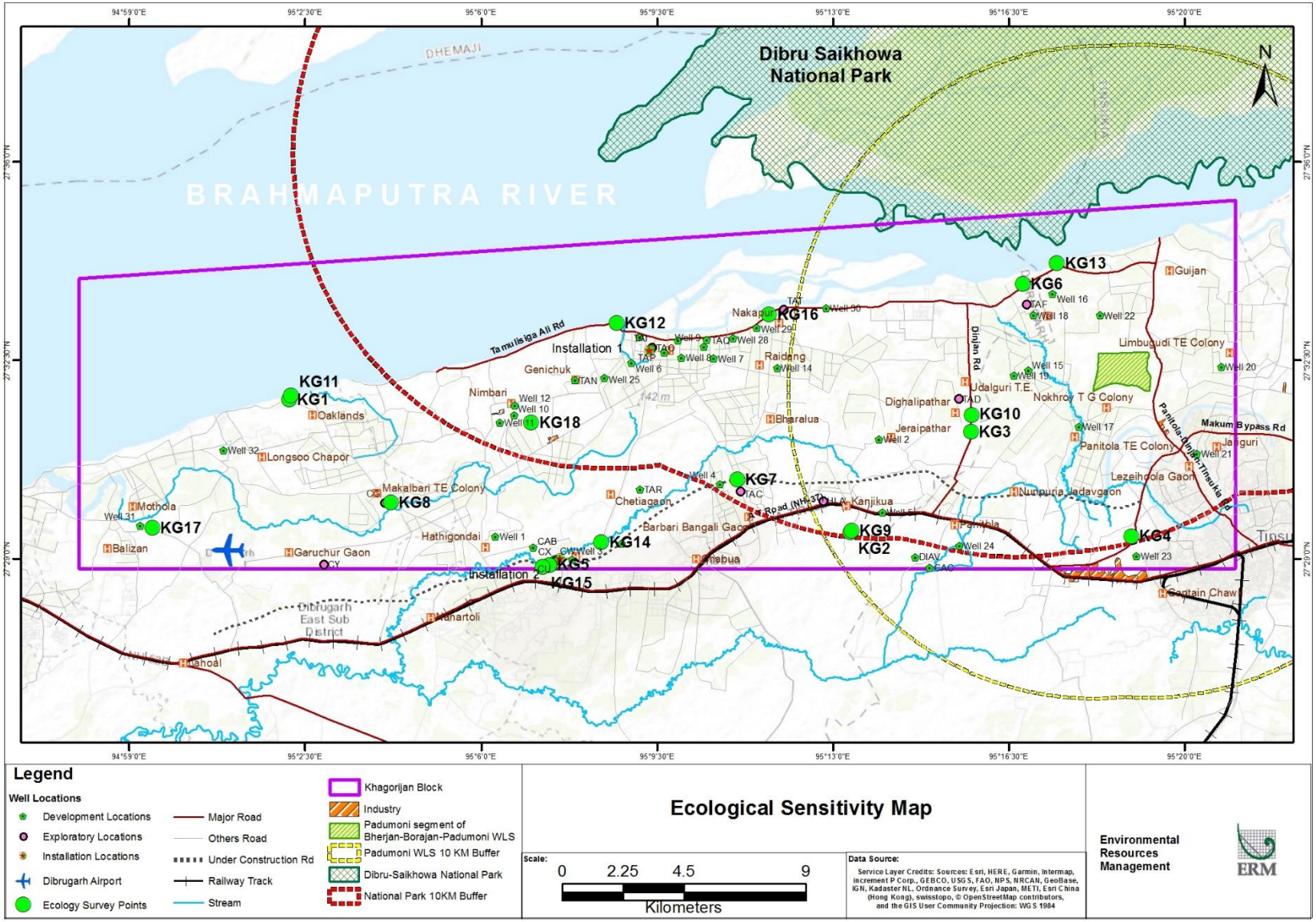
Table 3.20 Facilities within the Ecosensitive Zone of Bherjan-Borajan-Padumoni Wildlife Sanctuary and Dibru-Saikhowa National park

S no.	Protected Area	Wells/Production Facility
1	DSNP	Well 21, Well 23, Well 17, Well 18, Well 24, Well 11, TAR, Well 2, CAC, DIAV, HLA, Well 30, TAN, Well 20, Well 22, Well 16, TAF, Well 15, Well 19, Well 14, Well 5, Well 4, TAQ, Well 9, Well 7, Well 8, Well 13, Well 6, Well 26, Well 27, Well 28, Well 29, Well 12, Well 10, Well 25, TAD, TAJ, TAT, TAC, TAP, TAI, TAO, E Khagorijan (Production installation)
2	Padumoni Segment of BBSWLS	Well 21, Well 23, Well 17, Well 18, Well 24, Well 2, CAC, DIAV, HLA, Well 30, Well 20, Well 22, Well 16, TAF, Well 15, Well 19, Well 5, TAD,

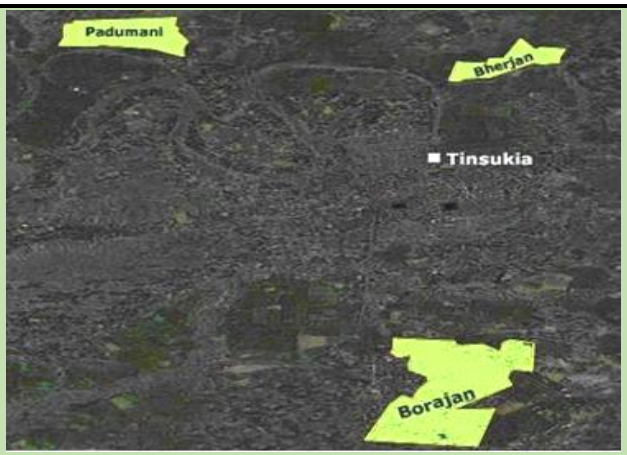
OIL will take Wildlife Clearance from the Standing Committee of National Board of Wildlife (NBWL) for the wells falling within the eco-sensitive zone of DSNP and BBPWLS.

Khagorijan Field ecosensitive map along is show at ***Figure 3.18*.**

Figure 3.18 Ecological sensitivity Map of Khagorijan Field



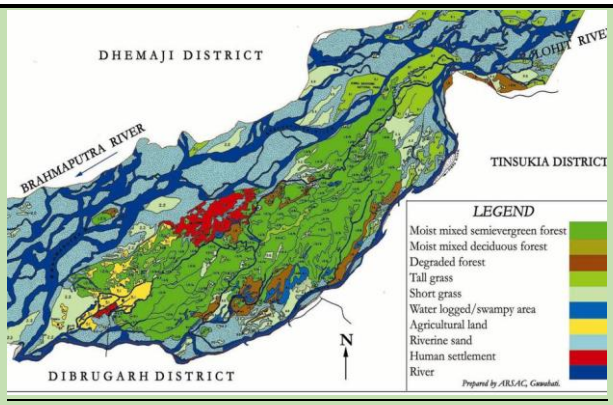
Box 3.1 Bherjan - Borajan - Padumoni Wildlife Sanctuary



The sanctuary is made up of three separate patches of forest located around Tinsukia town. From Tinsukia town - Bherjan block is 3 kms away, Borajan block is 6 kms away and Padumoni block is 5 kms away. Total size of the sanctuary is 7sq km. The sanctuary is popular for the tropical semi-evergreen forests and the surrounding beautiful tea estates. Bird watching is a popular activity in this sanctuary.

Mammal: Bherjan-Borajan-Padumoni Wild Life Sanctuary has been recognized as a prime habitat for seven primate species. These are Hoolock Gibbon (*Hylobates hoolock),* Slow Loris (*Nycticebus coucang),* Pig Tailed Macaque (*Macaca nemestrina),* Assamese Macaque (*Macaca assamensis),* Capped Langur (*Presbytis pileatus),* Stump Tailed Macaque (*Macaca arctoides*) and Rhesus Macaque (*Macaca mulatta).* Primate populations are more prominent in Borajan part of the Sanctuary. This part of the protected area consists of considerably large patches of tropical wet evergreen forest. Study conducted by individual researchers have indicated that Borajan part of the forest has enough food trees and resting places for primates. In Bherjan & Padumoni, Hoolock gibbon is not found but other primates are commonly sighted in these two parts. Apart from primates few leopards, wild pigs, lesser cats, etc. have made this sanctuary as their home. The Sanctuary also provides home for different species of squirrels such as common giant flying squirrel (*Petaurista petaurista),* Pallas's squirrel (*Callosciurus erythraeus),* Irrawaddy squirrel (*Callosciurus pygerythus.)* etc.
Birds: 84 species of birds have been found including Osprey, Kingfisher, Indian Pied Hornbill, Lineated Barbet, Woodpecker, Drongo, Common Mynah, Bulbul, Magpie Robin, Wagtail and varieties of woodland birds.

Box 3.2 The Dibru-Saikhowa National Park



The Dibru-Saikhowa National Park and Biosphere Reserve is located in Tinsukia and Dibrugarh districts of Assam. A small part of the buffer zone is in Dhemaji district. The area lies in the Indo-Burma Global Biodiversity Hotspot. The terrain of the park is flat and it is situated in the floodplains of the Brahmaputra and the Lohit Rivers. The buffer along with the core is also significant in the fact that it forms an overlap for two major avian migratory flyways- the East Asian and central Asian. The elevation of the park varies from 110– 126 above mean sea level. Other rivers that traverse along the park are the Dibru and the Dangori. The area of the biosphere reserve is 765 sq km which is managed on a core-buffer strategy. 340 sq km of the area constitutes the core while the remaining 425 sq km constitutes the buffer. The core area of DSBR is a mosaic of habitat types, the diversity of which is reflected in the faunal diversity it supports. The core is characterized by littoral and swamp forests, semi-evergreen forests, deciduous forests and patches of wet evergreen forests.

Mammal: Wide range of habitats of the National Park houses about 36 wild mammal species. Apart from small cats like jungle cat and leopard cat, big cats like tiger, leopard and illusive clouded leopard can be found in the national park. A wide range of grazers from large Asian Elephant and Wild Asian Water buffalo to small herbivores like hog deer and barking deer makes the park their home. Unique animals like Bengal slow loris, Himalayan Hoary-bellied squirrel, Malayan Crestless Porcupine, Chinese pangolin, feral horse and many others can be found in the park. Owing to the presence of creeks and rivers within the national Park as well as in its surrounding viable population of aquatic mammals like Gangetic river dolphin and Eurasian otter are also present in the park.

Birds: About 500 species of birds can be found in Dibru-Saikhowa National Park. In fact, the area is so rich in avian biodiversity that BNHS, along with Birdlife International have declared the core as an Important Bird Area [A1 (Threatened Species) & A2 (Endemic Bird Area 131: Assam Plains)] while Stattersfield (1998) has classified Dibru-Saikhowa as Assam Plains Endemic Bird Area. The core is home to highly range-restricted avifauna, such as the Marsh prinia, Black breasted Parrotbill and the Jerdon's Babbler. Resurrection of highly endangered avifauna like the Bengal Florican and white winged wood duck is a distinct reality at Dibru-Saikhowa.

Herpeto fauna: The national park is home to 18 amphibian species, 11 species of turtle, 18 species of lizard including 2 species of monitor lizard and 23 species of snakes.

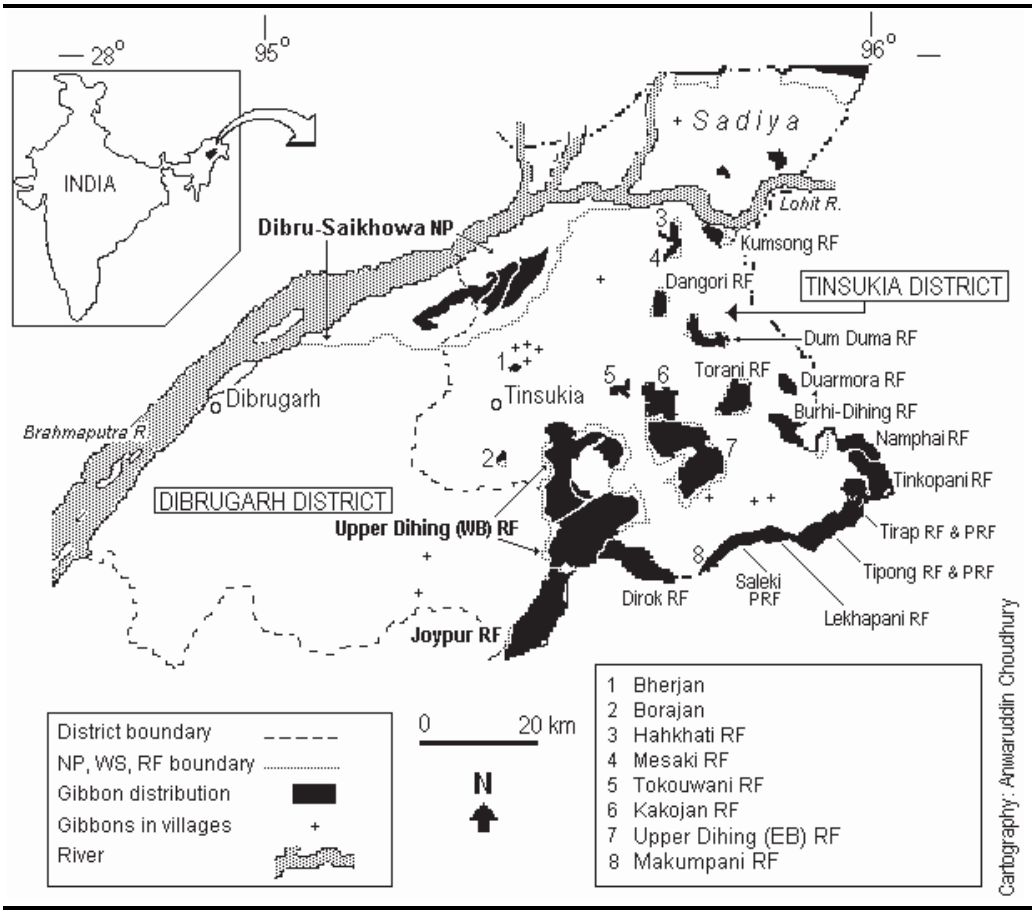
Fishes: As many as 104 species of fishes are found in the Dibru-Saikhowa national Park.

The different animal habitats observed at the study area are described below:

<u>*Primate Habitat*</u>: The tropical wet evergreen forests of the area provide an ideal habitat for primate species. In Tinsukia district, the Hoolock gibbon occurs in all regions excluding the wide riverbeds of the Brahmaputra and Lohit (***Figure 3.15***) as is evident from the distribution pattern. Within the Khagorijan block Hoolock gibbon population is present within the core of Dibru Saikhowa National Park. Though Padumoni section of the Bherjan Borajan Padumoni Wild Life Sanctuary is located inside the field area, hoolock gibbon population is not reported from there. Hoolock Gibbon population is only reported from the Borajan Segment of Bherjan-Borajan-Padumoni Wildlife Sanctuary, which is located about 4.5 km from Khagorijan Field area. In Bherjan & Padumoni

other primates like Assamese macaque (*Macaca assamensis*), Pig tailed macaque (*Macaca nemestrina*), Rhesus macaque (*Macaca mulatta*), Capped Langur (*Presbytis pileatus*), are reported. Species which are not strictly confined to top canopy like Rhesus macaque and Pig tailed Macaque can be found throughout the study area, including in proximity to the settlements.

Figure 3.19 Hoolock Gibbon Habitat in Tinsukia and Dibrugarh Districts



Source: Anwaruddin Choudhury; The Hoolock Gibbon (Hoolock hoolock) in Tinsukia and Dibrugarh districts of Assam, India, Asian Primates Journal 1(2), 2009

<u>*Carnivores*</u>**:** Within the study area large cats like Tiger and Clouded leopard are present only in the core areas of DSNP. But another member of the big cat family Leopard, is much more widely distributed in the study area. It is found in BBPWLS. Apart from that large portion of the Khagorijan Field area is under tea garden plantation. This large tea garden plantation also acts as leopard habitat. Since there is virtually no prey base within the forest segments of Padumoni, leopards prefer residing in surrounding tea gardens where prey in the form of dogs and livestock is available. So leopard can be encountered around well locations located within tea garden estate (Well 20, Well 22, Well 16, TAF, Well 15, Well 19, Well 14, Well 5, Well 4, TAQ, Well 9, Well 7, Well 8, Well 13, Well 6, Well 26, Well 27, Well 28, Well 29, Well 3, CAB, Well 12, Well 10, Well 1, CY). Other small cats like jungle cat and leopard cat is found in the protected areas within the Field as well as in the tea garden plantation. Other carnivores like Sloth bear, Wild dog, Jackal is found in DSNP. Jackal is also found in the protected forest patches of Bherjan-Borajan-Padumoni Wild Life Sanctuary.

Herbivores: Within the Khagorijan block no large herbivores permanently resides outside the DSNP. Within the National Park area Different types of forests, extensive grassland and marshes provide ample food like grass, bamboo, berries, shrubs fruits, aquatic vegetation etc. that supports large herbivores like Asian Elephants and Wild Asian buffalo. The national park also houses a unique large herbivore that is feral horse (True semi wild, borne free and living free). About 79 feral horses are reported from the National Park. Though these large herbivores live inside the National park, during monsoon when the National park gets flooded, Elephants and Wild Asian Buffalo crosses the Lohit River and takes temporary refuge in the Tea gardens of Dinjan and Guijan area.

Elephants on the south bank of the Brahmaputra are divided into eastern, central and western populations. The eastern population is spread over lower Dibang Valley, Lohit, Changlang and Tirap in Arunachal Pradesh, Tinsukia, Dibrugarh, Sibsagar, Jorhat and Golaghat in Assam, and Mon, Tuensang, Mokokchung and Wokha in Nagaland. The population lost its contiguity with the north bank in the 1970s and the central area of South Bank in the 1980s. An estimated 1200 elephants occupy about 4500 sq. km of forests in the area, though they also use tea plantations and agricultural lands as they move.

Birds - Assam harbours a highly diverse bird life. Choudhury (2000)[1] has listed 820 bird species from the State, which include some 280 migrants from the northern latitudes.

Totally, there are 46 IBAs in Assam; nearly half are not legally protected. Forty-five sites have been identified on the basis of threatened, 13 on the basis of restricted range species also. Fourteen sites qualify as Congregatory criteria (A4), besides qualifying A1 criteria also. As many sites qualify 2 or 3 criteria, the grand total is much more than 46. Out of which only Dibru-Saikhowa Complex and Bherjan-Borajan-Padumoni are located within the study area.

Table 3.21 IBA's Located within Khagorijan Field

IBA site codes	IBA site names	IBA criteria
IN-AS-13	Dibru-Saikhowa Complex	A1, A2
IN-AS-06	Bherjan-Borajan-Padumoni	A1

A1= Threatened species; A2 = Restricted Range species; A3= Biome species; A4=Congregatory species

Faunal Diversity

Amphibians

A total of five species of amphibians were observed or identified during consultation with local villagers within 1 km of the proposed well sites. None of the species bear any conservational significance. These species includes *Duttaphrynus melanostictus, Hoplobatrachus tigerinus, Limnonectus limnocharis,* etc. The details of the species are given in ***Table 3.22***.

[1] Anwaruddin Choudhury.2000. The Birds of Assam. Gibbon Books. WWF North East Regional Office.

Table 3.22 Amphibians observed/reported from the Khagorijan Field

Sl. No.	Scientific Name	Common Name	Source	Wildlife Schedule	IUCN Category
1	*Duttaphrynus melanostictus*	Common Indian Toad	CC, PS	-	LC
2	*Hoplobatrachus tigerinus*	Common Indian Bull Frog	CC, PS	V	Not assessed
3	*Limnonectus limnocharis*	Field Frog	CC, PS	-	Not assessed
4	*Polyypedates* sp.	Tree Frog	CC	-	Not assessed
5	*Uperodon globulosus*	Balloon Frog	CC, PS	-	LC

Notes: PS- Primary survey by ERM; CC-Community Consultation; Schedule – V (Indian Wildlife Protection Act -1972); LC-Least Concern, (IUCN Version 2018-1)

Reptilian Species

Reptilian fauna recorded during primary survey within 1 km of the well sites includes *Python bivittatus*, *Bungarus fasciatus*, *Ptyas mucosa*, *Calotes versicolor* and *Mabuya carinata* etc. The details of reptiles are given in ***Table 3.23.***

Table 3.23 Reptiles observed/reported from the Khagorijan Field

Sl. No.	Scientific Name	Common Name	Source	Wildlife Schedule	IUCN Category
1.	*Bungarus fassiatus*	Banded krait	CC	II	LC
2.	*Calotes versicolor*	Common garden lizard	PS	-	LC
3.	*Hemidactylus flaviviridis*	House wall lizard	PS	-	LC
4.	*Mabuya carinata*	Common skink	CC, PS	-	LC
5.	*Naja naja*	Indian cobra	CC	II	LC
6.	*Ptyas mucosus*	Rat snake	CC	II	LC
7.	*Python molurus*	Indian rock python	CC	I	NT
8.	*Varanus bengalensis*	Bengal Monitor Lizard	FD,CC	I	Least Concern

Notes:; PS- Primary survey by ERM; CC-Community Consultation; Schedule – I-III (Indian Wildlife Protection Act -1972); LC-Least Concern, (IUCN Version 2018-1); NT-Near Threatened (IUCN 2018-1)

The detailed checklist of reptilian species reported by the forest department has been presented in ***Annexure 3.9***.

Avifauna

Primary survey within 1 km of the proposed well sites recorded 64 avian species. The list include six Schedule I species viz. *Gyps bengalensis* (White backed Vulture), Shikra (*Accipiter badius*), Black Kite (*Milvus migrans*), Black-winged Kite (*Elanus caereleus*), Short-toed Snake Eagle (*Circaetus gallicus*) and Common Kestrel (*Falco tinnunculus*). IUCN Critically endangered species like *Gyps bengalensis* (White backed Vulture) were also reported from study area.

Identified avifaunal species from the Khagorijan Field is provided in ***Table 3.24.***

Table 3.24 Avifaunal Species observed in the Study Area during Primary Survey

Sl. No	Scientific Name	Common Name	Wildlife Schedule	IUCN Category
1.	*Acridotheres tristis*	Indian Myna	IV	LC
2.	*Aegithina tiphia*	Common Iora	IV	LC
3.	*Alcedo atthis*	Small Blue Kingfisher	IV	LC
4.	*Amaurornis phoenicurus*	White breasted Waterhen	IV	LC
5.	*Apus affinis*	House swift	IV	LC
6.	*Ardeola grayi*	Pond Heron	IV	LC
7.	*Athene brama*	Spotted Owlet	IV	LC
8.	*Bubulcus ibis*	Cattle Egret	IV	LC
9.	*Caracias benghalensis*	Blue Jay or Roller	IV	LC
10.	*Columba livia*	Common Pigeon	IV	LC
11.	*Corvus macrorhynchos*	Jungle Crow	IV	LC
12.	*Corvus splendens*	House Crow	IV	LC
13.	*Cuculus micropterus*	Indian Cuckoo	IV	LC
14.	*Dendrocitta vagabunda*	Rufous Tree Pie	IV	LC
15.	*Dicrurus adsimilis*	Black Drongo or King Crow	IV	LC
16.	*Dicrurus remifer*	Lesser racket-tailed drongo	IV	LC
17.	*Dinopium benghalense*	Golden backed Woodpecker	IV	LC
18.	*Eudynamys scolopacea*	Asian Koel	IV	LC
19.	*Gyps bengalensis*	White backed Vulture	I	CR
20.	*Halcyon smynenssis*	White breasted Kingfisher	IV	LC
21.	*Hydrophasiarzus chirugus*	Pheasant-tailed Jacana	IV	LC
22.	*Lanius schach*	Long-tailed Shrike	IV	LC
23.	*Metopidius indicus*	Bronze winged Jacana	IV	LC
24.	*Milvus migrans*	Black Kite	I	LC
25.	*Motacilla alba*	White Wagtail	IV	LC
26.	*Nectarinia asiatica*	Purple Sunbird	IV	LC
27.	*Oriolus xanthornus*	Black headed Oriole	IV	LC
28.	*Passer domestica*	House sparrow	IV	LC
29.	*Psittacula Krameri*	Roseringed Parakeet	IV	LC
30.	*Pycnonotus cafer*	Redvented Bulbul	IV	LC
31.	*Streptopelia chinensis*	Spotted Dove	IV	LC
32.	*Sturnus contra*	Pied Myna	IV	LC
33.	*Vanellus indicus*	Red wattled Lapwing	IV	LC
34.	*Megalaima asiatica*	Blue-throated Barbet	IV	LC
35.	*Copsychus saularis*	Oriental Magpie Robin	IV	LC
36.	*Saxicola torquata*	Common Stonechat	IV	LC
37.	*Tachybaptus ruficollis*	Lilttle Grebe	IV	LC
38.	*Hirundo rustica*	Barn Swallow	IV	LC
39.	*Anas crecca*	Common Teal	IV	LC

Sl. No	Scientific Name	Common Name	Wildlife Schedule	IUCN Category
40.	*Anastomus Oscitans*	Asian Openbill	IV	LC
41.	*Lanius cristatus*	Brown Shrike	IV	LC
42.	*Sturnus malabaricus*	Chestnut-tailed Starling	IV	LC
43.	*Anas poecilorhyncha*	Indian Spot Billed Duck	IV	LC
44.	*Himantopus himantopus*	Black-winged Stilt	IV	LC
45.	*Casmerodius albus*	Great Egret	IV	LC
46.	*Plegadis falcinellus*	Glossy ibis	IV	LC
47.	*Porphyrio porophyrio*	Purple Swamphen	IV	LC
48.	*Hydrophasianus chirurgus*	Pheasant-winged Jacana	IV	LC
49.	*Accipiter badius*	Shikra	I	LC
50.	*Elanus caeruleus*	Black-Winged Kite	I	LC
51.	*Falco tinnunculus*	Common Kestrel	I	LC
52.	*Phalacrocorax niger*	Little Cormorant	IV	LC
53.	*Actitis hypoleucos*	Common Sandpiper	IV	LC
54.	*Tadorna ferruginea*	Ruddy Shelduck	IV	LC
55.	*Circaetus gallicus*	Short-toed Snake Eagle	I	LC
56.	*Charadrius dubius*	Little Ringed Plover	IV	LC
57.	*Hierococcyx varius*	Common Hawk Cuckoo	IV	LC
58.	*Nycticorax nycticorax*	Black-crowned Night Heron	IV	LC
59.	*Oriolus xanthornus*	Black-hooded Oriole	IV	LC
60.	*Acridotheres fuscus*	Jungle Myna	IV	LC
61.	*Cisticola joncidis*	Zitting Cisticola	IV	LC
62.	*Prinia inornata*	Plain Prinia	IV	LC
63.	*Orhotomus sutorius*	Common Tailorbird	IV	LC
64.	*Turdoides striatus*	Jungle Babbler	IV	LC

Notes: Schedule – I-IV (Indian Wildlife Protection Act -1972); LC-Least Concern, (IUCN Version 2018-1); CR- Critically Endangered (IUCN 3.1); VU- Vulnerable (IUCN 2018-1)

Detailed checklist obtained from forest department revealed presence of about 502 species of birds. The detailed avian checklist provided by the forest department has been provided at ***Annexure 3.10.***

Mammals

The BBPWLS and DSNP is also home to a wide variety of mammals like tiger, leopard, clouded leopard, Asian Elephant, Wild Asian Water buffalo, hog deer, barking deer, Bengal slow loris, Hoolock gibbon, Himalayan Hoary-bellied squirrel, Malayan Crestless Porcupine, Chinese pangolin, feral horse and many others. The mammalian species recorded during primary survey or reported by the local villagers and forest department personnel from within 1 km of the proposed drilling locations is presented at ***Table 3.25.***

Table 3.25 Mammalian species recorded/reported in the study area

Sl. No	Scientific Name	Common Name	Source	Wildlife Schedule	IUCN Category
1.	*Canis aureus*	Jackal	CC	II	LC
2.	*Felis chaus*	Jungle Cat	CC	II	LC
3.	*Herpestes edwardsi*	Common Mongoose	CC+PS	II	LC
4.	*Macaca mulata*	Rhesus Macaque	CC+PS	II	LC
5.	*Pteropus giganteus*	Indian Flying Fox	CC+PS	IV	LC
6.	*Rattus rattus*	Common House Rat	CC+PS	-	LC
7.	*Panthera pardus*	Common leopard	CC	I	VU
8.	*Nycticebus bengalensis*	Slow Loris	CC	I	VU
9.	*Hylobates hoolock*	Hoolock gibbon	CC+PS	I	EN
10.	*Elephas maximus*	Elephant	CC	I	EN

Notes: PS-Primary Survey; CC-Community Consultation. Schedule – I, IV (Indian Wildlife Protection Act -1972); EN- Endangered; VU- Vulnerable; NT-Near Threatened, LC-Least Concern, (IUCN Version 2018-1).

Detailed checklist of mammals recorded by the forest department presented in ***Annexure 3.11.***

3.4.5 Aquatic Ecosystem

Aquatic Habitat: The Khagorijan Field falls within the catchment of Brahmaputra River, Dangori River which flows through the north western part of the Field. The Dibru-Saikhowa National Park in the north eastern part of OIL Field provides diverse types of aquatic habitat. The National Park is basically a flood plain of the river Brahmaputra. The entire area is traversed by several rivulets and nallahs and is completely inundated in the monsoons. There are a large number of perennial and seasonal channels which criss-cross the core area. Apart from the above there are several perennial beels and marshes in different locations of the Park.

In the eastern part of the Khagorijan Field, the Maguri-Motapung wetland complex near the southern buffer of Dibru-Saikhowa National Park is another important wetland habitat within the field area. Two wetland areas located near Guijan, known as Dinjan beels are also part of the Maguri-Motapung wetland complex. The largest wetland (Maguri beel) is located 3 km from the boundary of Khagorijan Field.

Following aquatic ecological groups has been studied.

Macrophytes

Seasonal wetlands and marshy lands are suitable habitat for aquatic macrophytes. A total of 13 species of aquatic macrophytes were recorded from these aquatic ecosystems. The most dominant macrophytes encountered during the survey are *Commelina benghalensis, Cyperus rotendus, Cyperus rotendus, Eichornia crassipes, Hydrilla verticillata, Ipomea aquatic, Lemna natans Nyphaea totus, Oplismenus* sp., *Phargmites Karka, Pistia stratiotes, Sagittaria sagittifolia, Vallisneria* sp.

Plankton

For the study of plankton, 50 litre water was filtered through plankton net. The water sample then preserved by adding formaldehyde solution and transferred to 100ml vial for microscopic analyses. Plankton genera/species recorded from the study area during primary survey is presented at the table below.

Table 3.26 Plankton Recorded from the Study Area

S No	Monitoring Location Code	Monitoring Location Name	Phytoplankton recorded	Zooplankton recorded
1	SW1	Brahmaputra River	*Navicula* sp., *Nitzschia* sp.,	*Brachionus angularis, Keratella cochlearis, Moina micrura, Mesocyclops leuckarti*
2	SW2	Dinjan River	*Navicula* sp., *Nitzschia* sp., *Phacus* sp., *Chlorella* sp.	*Ceriodaphnia cornuta, Moina micrura, Mesocyclops leuckarti*
3	SW3	Dangori River	*Navicula* sp., *Nitzschia* sp., *Phacus* sp.	*Brachionus angularis, Brachionus quadridentatus, Keratella cochlearis, Alona quadrangularis, Bosmina longirostris, Ceriodaphnia cornuta, ,Moina micrura, Diaphanosoma sarsi, Mesocyclops leuckarti , Tropocyclops prasimus, Heliodiaptomus viduus*

Source: ERM Primary Monitoring

Icthyofauna

33 species were reported from the study area by the local villagers and fishermen. The list of fish species reported are presented in ***Annexure 3.13.***

Aquatic Birds

Some common water birds like Cattle egret, Indian Pond heron, Red wattled lapwing, White Wagtail, grey wagtail, Common sandpiper, Little Ringed Plover, Black Winged Stilt, White Breasted Waterhen, White Throated Kingfisher, Pheasant tailed Jacana, Bronze Winged Jacana, Great Egret, Ruddy Shellduck etc.

Aquatic Mammals

Two aquatic mammals were reported from in the study area, they are Eurasian otter (*Lutra lutra*) and Gangetic Dolphin (*Platanista gangetica*). Both of these two animals can only be encountered in the Brahmaputra River and the numerous streams flowing through the Dibru-Saikhowa National Park.

3.2 SOCIOECONOMIC ENVIRONMENT

A socio economic assessment of the positive and negative impacts on the people likely to 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 OIL's commitment towards the CSR 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.

This section deals with the baseline socio-economic environment of the following:

- 12 development and exploratory oil well drilling activity in Tinsukia district
- 42 development and exploratory oil well drilling activity in Dibrugarh district
- 2 production oil well drilling activity in Dibrugarh district

The following section discusses the methodology used for the socio-economic assessment. The subsequent sections discuss the baseline profile of the district and the villages within the study area. The information provided has been primarily derived from the secondary sources (Census of India). In addition primary information was also collected during the discussions at the villages with the local community members. The village wise secondary data (obtained from Census, 2011) has been taken into consideration for analysing the socio-economic profile in a comparative manner for wells and production facilities.

3.2.1 Area of Influence

The study area for detail socio economic assessment and community consultation was limited in the villages located within 1 km radius around the proposed wells and production facility as these are the villages which are directly or indirectly most impacted by the project. These villages are primarily selected based on reconnaissance surveys, census data information, topo sheet maps, understanding of the project and professional judgment. Total 129 villages located in 6 revenue circle in Dibrugarh districts are located within the area of influence. Proposed well and production facility wise list of village has been summarized in the ***Annexure 2.1.***

The demographic profile in terms of total population, household size, sex ratio of the selected villages with in the area of influence has been summarized in the sections below, while the detailed demographic profile of the study area villages has been provided in ***Annexure 3.10.***

3.2.2 Methodology

The social assessment was primarily based on the analysis of the secondary data obtained from the census survey 2011 and Community consultations. Following tools were 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.

Stakeholder Identification

At the beginning of the EIA process, the ERM team conducted a preliminary identification of probable stakeholders. An inventory of actual / potential stakeholders, including local groups and individuals, local institutions like the 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.

Stakeholder Consultations

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 1 Km periphery were 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 OIL's CSR activity.

3.2.3 General Socioeconomic Profile

The demographic profile in terms of total population, household size and sex ratio of the above-mentioned selected villages in the block has been summarized in the sections below, while the detailed demographic profile of the study area villages has been provided in ***Annexure 3.10.***

Population and Household Size

Kandulibari Grant 4 No. F.S.16 NLR (4405) has the highest population among the study area villages followed by Mukalbari T.E. (3198). The lowest populations were recorded in Piporatoli with a total population of 57. The household size of the study area villages generally ranged within 4.04 to 5.87 with an average household size of 4.82. Population and household of those villages summarized in the ***Annexure 3.12.***

Sex Ratio

The average sex ratio of the area of influence is 923 and it is lower than the state averages of Assam (958) and country average (943). The highest sex ratio is recorded in Kharjan Grant (1065) followed by Dangar Chuk (1023) and the lowest sex ratio was been recorded at Piporatoli (676). Detail is summarized in ***Annexure 3.10.***

Scheduled Caste (SC) & Scheduled Tribes (ST)

The overall demographic data of study area villages shows 7.84% of the population to be under SC category whereas 0.79% population belongs to scheduled Tribe category. Highest schedule tribe (11.25%) was observed in Raidang and highest schedule cast (78.23%) population was observed in Maricha Gaon. Apart from that Details of SC and ST population are given in ***Annexure 3.10.***

Education & Literacy

The study of the literacy profile in the region is relevant in order to have an understanding whether the proposed project can utilize skilled human resources available within the area.

According to 2011 census data, the literacy rate in Dibrugarh and Tinsukia district are 72.80% and 70.9% respectively, whereas the state literacy rate of Assam is 73.18%. But the average literacy rate of area of influence observed as 67.70% which is also lower than the state and district literacy rate. The highest literacy rate was observed in Lezaihula Gaon (95.11%) and the lowest in Kharjan Gaon (33.50%). Average male and female literacy rate in the study area

was recorded at 76.57% and 58.22%, which is lower than the district percentage of 80.04% and 64.80% of Dibrugarh but higher than the district percentage of 66.66% and 53.25% of Tinsukia District respectively. Details are given in ***Annexure 3.11.***

Economic Activity & Livelihood Pattern

The relevance of economic activity and livelihood pattern is important in the context of the study since depending on the existing situation one can predict the impact of the project activity on the economy of the region.

The total working population ratio in the study area villages varies from 24.01% to 57.51%, of the total workforce, Chengdhora revealed the highest percentage of workforce with 57.51% workers while Balijan Pani Era revealed the lowest workforce percentage (24.01%).Village wise details are incorporated in ***Annexure 3.12.***

Major population in the study area villages either are workers in nearby Tea Estates or involved in agricultural crop cultivation as a source of their livelihood. Apart from the tea estates, the study area mainly comprises of monocropped land with paddy being the major agricultural produce. Apart from paddy cultivation, inhabitants of study area villages are also involved in tea cultivation in their homestead land. The "Cultivator" category contributes highest workforce category constituting about 49.62% of the population resides in area of influence. Some fraction of the study area population is also reported working in Govt. and Private sector at Dibrugarh.

3.2.4 Basic Amenities and Infrastructure

Drinking Water facilities

The Census data reveals that drinking water facility exits in all the villages. There are different types of drinking water facility available in study area. The Tube wells are present in all the villages (29), whereas tap water supply not present. Rest of the villages are depends upon covered or uncovered well in the influenced area.

Other than drinking water people also depends on the above mention facility for their daily activity. Villagers reside near river also use river water for their domestic purpose. Other than river or stream, surface water body in the villages is very less in number.

Medical Facilities

In Dibrugarh district, there are 46 primary health centres and 8 community health centre and 3 hospitals at present. But, in the influenced area there is no hospital present for the medical facility, but there are 9 numbers of hospitals are present between 5-10 Kms from the influenced area. One primary health centres has been located in the area of influence.

In Tinsukia district, there are three sub divisional hospitals, 4 Primary Health Centers and 10 Community Health Center. In the villages considered for the study, there are 3 Primary Health Centre but there are no hospitals located within this area.

Educational Facilities

As per census 2011, all villages have the provision of educational facilities. Government primary schools and government middle schools are present in most of the villages fallen in the influenced area; on the other hand, government secondary schools are only present in 11 villages, where as two villages has the facility of govt. Senior secondary school. Govt. Arts and science colleges are not present in influenced area, but 2 colleges has been located at 5-10 kms distance from the study site.

As per census 2011, all three selected villages have the provision of educational facilities. Primary schools are present in all identified villages; on the other hand, middle schools are present in 5 villages. However, secondary, senior secondary schools and college are present in Tinsukia a area, which is 5-10 kms and more than 10 km away from the selected villages respectively.

Transport & Communication

Assam Trunk Road (AT Road) i.e. NH-37 is the major road connecting the study area with Dibrugarh Town and Moran town and is being used by the local people as a route of transportation. Apart from that village road and other district road are also connects the study area with Dibrugarh and Tinsukia. Pucca paved road is present in almost every village. The public transport system is yet to reach its highest efficacy since there is no public transport system in most of the sampled villages. Villagers depend on the private auto or jeep. The post facility is available within 5 to 10 km from all sample villages.

Power Supply

Electricity is available in all study area villages through a stable 220V electricity supply adequate for domestic, agricultural and other purposes.

Post and Telecommunication

In this era of telecommunication, access to mobile phone is within every bodies reach. All villages from sample study area have the access to post- office and other private courier services.

Community Consultation

Public consultation was carried out with the objective of finding out about people's views and opinion on issues relating to the project, its operations and

also to the peripheral development. In this backdrop, extensive public consultations were conducted during the socio economic assessment as part of EIA study. Suggestions were also received from participants on managing of project functions so that it does not have any adverse impacts on the community living in the area adjoining the project, better targeting community development programs, ensuring community involvement and cooperation in the operation of the project. The feedback from the continued consultation will facilitate the project in developing strategies to address these issues in consensus with the communities residing around the project.

Community consultations in this project are mainly carried out the village located in 1km periphery of proposed development well and production facilities at Khagorijan Filed. Proceedings of the community consultations are provided in ***Annexure 3.13***.

The summary findings of the consultations carried out have been discussed below:

- Majority of the people in the area are cultivators and paddy is the major agricultural produce. Apart from paddy cultivation, household tea cultivation is also common. Many people also work at the local tea estates; few are engaged in public and private organizations in the urban areas of Dibrugarh, Tinsukia etc.
- Majority of the houses in the rural and urban areas have electrical connections. However, the locals reported frequent power failures during the consultation.
- Water requirement is catered through tap water and household borewell/tube well facility in the village areas.
- It was reported during consultations that all parents send their children to the primary school. Almost every village has a primary school; however, percentage of students pursuing higher education is comparatively less.
- OIL India has CSR intervention including road construction, boundary wall construction, mobile medical facility etc. in majority of the village where their existing well site is present.
- Community people residing in tea garden complaining about the water which is accidentally come out from the drilling site reduce the productivity of the tea garden
- People residing in and around the well drilling site face problem due to heavy noise during drilling. They have also mention that OIL also compensate to the nearby houses for noise problem.

Figure 3.20 Photographs of Community Consultation in the Khagorijan Field



4 IMPACT ASSESSMENT AND MITIGATION MEASURES

This section identifies and assesses the potential impacts in the environment that could be expected from the proposed oil & gas development drilling and construction and operation of production facilities in Khagorijan Field Dibrugarh and Tinsukia Districts of Assam. The Project activities will affect the physical, social and ecological environment in three distinct phases:

a. Pre-drilling
b. Drilling
c. Decommissioning
d. Construction of associated production facilities
e. Operation of associated production facilities
f. Laying of interconnecting pipeline

Impacts are identified and predicted based on the analysis of the information collected from the following:

- Project information (as outlined in Chapter**2**);
- Baseline information (as outlined in Chapter**3**).

The identification of likely impacts during construction and operation phases has been carried out based on likely activities having their impact on environmental and socio-economic parameters. The details of the activities and their impacts have been worked out in the following sections.

4.1 IMPACT ASSESSMENT METHODOLOGY AND APPROACH

4.1.1 Identification of Potential Impact

The potential impacts have been identified through a systematic process whereby the activities (both planned and unplanned) associated with the project have been considered with respect to their potential to interact with environmental and social resources or receptors. The impact identification matrix is presented in ***Table 4.1***.

4.1.2 Impact Assessment Methodology

Impact identification and assessment starts with scoping and continues through the remainder of the impact assessment process (IAP). The principal impact assessment (IA) steps are summarized in ***Figure 4.1.*** Detailed Impact Assessment Methodology is presented in ***Annexure 4.1.***

Figure 4.1 Impact Assessment Process

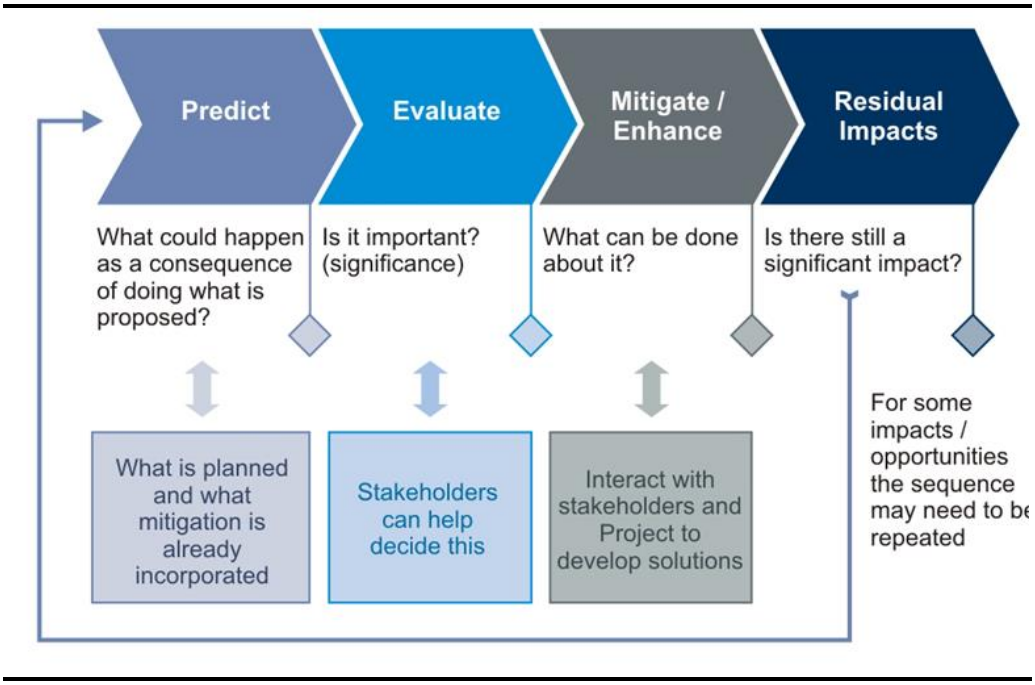


Table 4.1 Impact Identification Matrix

			Physical Environment										Biological Environment				Socio-economic Environment					
	Project Activity	**Aspect**	Aesthetics & Visual impacts	Air Quality	Noise Quality	Land use	Soil Quality	Local Drainage & Physiography	Surface water quality	Ground water Resources	Ground water quality	Road & Traffic	Terrestrial Habitat & Flora	Wildlife habitat & Fauna	Aquatic Habitat & flora,	Aquatic wildlife habitat & fauna	Influx of Population	Common Property Resources	Job & Economic Opportunity	Economy & Livelihood	Conflict with local people	Occupational Health & Safety	Community Health & Safety
A.	**Pre-Drilling and Construction of Production facilities**																						
A.1	Land procurement for drill sites																						
A.1.1		*Procurement of tea garden land*				X														X			
A.1.2		*Procurement of homestead plantation area*				X														X			
A.2	Clearance of vegetation																						
A.2.1		Removal of vegetation	X										X										
A.2.2		Generation of dust	X	X									X									X	X
A.3	Site filling, grading & levelling																						
A.3.1		*Loss of top soil*					X																
A.3.2		*Raising of site with earth material*						X															
A.3.3		*Compaction of soil*					X																
A.3.4		*Generation of dust*	X	X									X									X	X
A.3.5		*Surface runoff from construction site*							X						X	X							
A.4	Earth Work for construction of waste pits cellar pit																						
A.4.1		*Storage of earth and fugitive emission during dry season*	X	X									X									X	X
A.4.2		*Surface runoff from excavated material storage area into land/stream*					X		X							X							
A.6	Transport of fill materials, construction material, equipment & manpower																						
A.6.1		*Exhaust emission and fugitive from fill materials, construction materials*		X									X									X	X
A.6.2		*Generation of noise*			X									X									X
A.6.3		*Generation of reintrained dust*	X	X									X									X	X
A.6.4		*Plying of vehicle through narrow access road*																					X
A.6.7		Road accident																					X
A.8	Storage and handling of construction material																						
A.8.1		*Generation of fugitive dust*	X	X									X									X	X
A.8.2		*Surface runoff from construction material storage area into nearby land/stream*					X		X						X	X							
A.9	Storage & handling of fuel, lubricants, paints & other chemicals, etc.																						
A.9.1		*Spillage of oil, lubricant, etc. from storage & handling*					X				X												X
A.9.2		*Surface runoff from spillage area into nearby land/stream*					X		X		X												X
A.10	Operation of heavy machineries & equipment																						
A.10.1		*Exhaust emission*		X									X										X
A.10.2		*Generation of noise*			X									X									X
A.10.3		*Spillage of oil*																					

			Physical Environment										Biological Environment				Socio-economic Environment							
	Project Activity	**Aspect**	Aesthetics & Visual impacts	Air Quality	Noise Quality	Land use	Soil Quality	Local Drainage & Physiography	Surface water quality	Ground water Resources	Ground water quality	Road & Traffic	Terrestrial Habitat & Flora	Wildlife habitat & Fauna	Aquatic Habitat & flora,	Aquatic wildlife habitat & fauna	Influx of Population	Common Property Resources	Job & Economic Opportunity	Economy & Livelihood	Conflict with local people	Occupational Health & Safety	Community Health & Safety
A.10.4		*Discharge of machineries wash water into open soil & river*					X		X						X	X							
A.11	Souring of construction water																						
A.11.1		*Sourcing of ground water for construction activity*								X								X					
A.12	Generation & disposal of construction waste																						
A.12.1		*Storage construction waste on open soil*					X				X												X
A.12.2		*Disposal of construction waste in non-designated area*	X				X				X												X
A.12.3		*Spillage of used oil from storage area*					X				X												X
A.12.4		*Surface runoff from construction waste storage area*					X		X						X	X							
A.13	Sourcing of construction workers																						
A.13.1		*Engagement of local person for construction work*															X		+	+	X		
A.13.2		*Hiring of construction workers from outside*																			X		
A.14	Operation of labour camp																						
A.14.1		*Sourcing of ground water for potable use*								X								X					
A.14.2		*Generation of MSW, storage & disposal of open soil*	X				X				X												X
A.14.3		*Generation of domestic waste water & discharge without treatment*									X												X
A.14.4		*Interaction with local community*																					X
B	**Drilling of wells**																						
B.1	Physical presence of drilling facility																						
B.1.1		*Illumination from facility*	X																				
B.1.2		*Drill Rig, DG Set, Pota cabins, machineries*	X																				
B.2	Operation of Drilling rig & associate machineries																						
B.2.1		*Noise generation from rig, mud pump, etc.*			X																	X	X
B.2.2		*Cutting of ground water table*								X													
B.2.3		*Accidental leakage of drill mud in ground water*								X													X
B.3	Storage and disposal of drill cuttings & spent mud																						
B.3.1		*Improper disposal of drill cuttings & spent mud from waste pits*					X				X												X
B.3.2		*Accidental leakage of spent mud and leachate from waste pit*					X				X												X
B.3.3		*Surface runoff from waste pit*					X		X						X	X							
B.4	Storage, treatment and discharge of process waste water																						
B.4.1		*Accidental discharge of untreated waste water into nearby land, stream*					X		X		X				X	X							
B.4.2		*Overflow of untreated waste water from waste pit*					X		X		X				X	X							
B.5	Storage and handling of oil, lubricant, chemical, etc.																						
B.5.1		*Spillage on open soil*					X				X												
B.5.2		*Surface runoff from spillage site*					X		X		X				X	X							
B.6	Storage, handling and disposal of waste oil and other hazardous waste																						
B.6.1		*Spillage on open soil*					X				X												

			Physical Environment										Biological Environment				Socio-economic Environment						
	Project Activity	**Aspect**	Aesthetics & Visual impacts	Air Quality	Noise Quality	Land use	Soil Quality	Local Drainage & Physiography	Surface water quality	Ground water Resources	Ground water quality	Road & Traffic	Terrestrial Habitat & Flora	Wildlife habitat & Fauna	Aquatic Habitat & flora,	Aquatic wildlife habitat & fauna	Influx of Population	Common Property Resources	Job & Economic Opportunity	Economy & Livelihood	Conflict with local people	Occupational Health & Safety	Community Health & Safety
B.6.2		*Surface runoff from spillage site*					X		X		X				X	X							
B.6.3		*Disposal on non-designated site*					X				X												
B.7	Operation DG sets																						
B.7.1		*Exhaust emission*		X																			X
B.7.2		*Generation of noise*			X																	X	X
B.8	Transport of chemical, oil & lubricant, equipment & manpower																						
B.8.1		*Exhaust emission from transport vehicles*		X																			X
B.8.2		*Generation of noise*			X																	X	X
B.8.3		*Generation of reinterned dust*	X	X																			X
B.8.4		*Plying of vehicle through narrow access road*										X											X
B.8.5		*Road accident*																					X
B.9	Storage and Disposal of MSW																						
B.9.1		*Spillage of MSW from storage bin*					X				X												
B.9.2		*Disposal in non-designated site*	X				X				X												
B.10	Sourcing of process water																						
B.10.1		*Souring from ground water*								X								X					
B.11	Sourcing of construction workers																						
B.11.1		*Engagement of local person for drilling work*															+	+					
B.11.2		*Hiring of construction workers from outside*																			X		
B.13	Flaring during testing																						
B.13.1		*Emission from flare stack*		X																			X
C.	**Decommissioning of Wells**																						
C.1	Dismantling of rig and production facilities																						
C.1.1		*Noise generation during dismantling of rigs and associate facilities*			X									X									X
C.1.2		*Improper capping of waste pits and generation of leachate*									X			X									
C.2	Transport of drilling rigs, machineries & equipment and fill materials																						
C.2.1		*Exhaust emission from transport vehicles*		X																			X
C.2.2		*Generation of noise*			X									X								X	X
C.2.3		*Generation of reinterned dust*																					
C.2.4		*Plying of vehicle through narrow access road*										X											X
C.2.5		*Road accident*																					X
D.1	**Operation of OCS, GCS and FGGS**																						
D.1.1	Flaring of excess gas	*Emission of pollutants*		X																			
D.1.2	Separation of oil and gas from formation water	*Discharge of formation water*							X						X								
D.1.3		*Spillage of oil*					X																

			Physical Environment										Biological Environment				Socio-economic Environment						
	Project Activity	**Aspect**	Aesthetics & Visual impacts	Air Quality	Noise Quality	Land use	Soil Quality	Local Drainage & Physiography	Surface water quality	Ground water Resources	Ground water quality	Road & Traffic	Terrestrial Habitat & Flora	Wildlife habitat & Fauna	Aquatic Habitat & flora,	Aquatic wildlife habitat & fauna	Influx of Population	Common Property Resources	Job & Economic Opportunity	Economy & Livelihood	Conflict with local people	Occupational Health & Safety	Community Health & Safety
E	**Laying of pipeline**																						
E.1.1	Site clearance and soil removal	*Removal of vegetation and top soil*	X	X									X										
E.2.1	Trenching	*Generation of dust*																					
E.3.1	Transportation and Transfer of pipes to construction site	*Exhaust emission*		X																			
E.4.1	Workforce engagement	*Generation of domestic solid waste & disposal*					X																
E.5.1	Testing of pipeline	*Wastewater discharge*							X														

4.2 ASSESSMENT OF IMPACT

Based on the Impact Identification Matrix (***Table 4.1***) for Project activities and likely impacted resources/ receptors from construction and operational phases of the proposed Project, the potential impacts are discussed in the following sections:

4.2.1 Potential Impact Aesthetic and Visual

Source of Impact: Aesthetics and visual impacts from different phases of the project activities can result from:

- Pre-drilling Phase and Construction of Production facilities and laying of pipeline:
  - Removal of vegetation from the land required for the drilling of development wells and production facilities;
  - Emission of fugitive dust and deposition on vegetation and property;
  - Storage of construction materials;
  - Storage and disposal of construction waste, municipal waste etc.
- Drilling Phase:
  - Physical presence of rig and associated equipment;
  - Emission of fugitive dust and deposition on vegetation and property;
  - Disposal of MSW.
- Decommissioning:
  - Unplanned disposal of decommissioning waste materials in the vicinity of the well sites;
  - Emission of fugitive dust and deposition on vegetation and property.
- Presence of production facilities:
  - Operation of flare stacks

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

- Storage facility for construction materials will be provided within the proposed well sites and production facilities;
- Labour camp with sanitation facility, solid waste collection facilities will be set up in within the proposed well sites and production facilities.

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

Removal of vegetation: The proposed development well sites will be developed to house the drill pad, storage facilities, drilling facility, site office etc. Majority of the development wells have been proposed at places (either homestead

plantation, agricultural land or tea estates) where vegetation exists. The area will be cleared of the vegetation to accommodate the abovementioned facilities. Similarly, the area proposed for establishing the production facilities and pipeline will be cleared of any existing vegetation. The clearance of vegetation is likely to cause visual and aesthetic impacts at surrounding localities such as Guijan, Dinjan etc. It has been estimated that approximately 3 ha of land will be required for the well sites, 4 to 7 ha for the proposed facilities and 10m RoU for pipelines. As the area is low and not contiguous (except for pipelines), the affected area will less and hence the impact will be low.

Storage of construction & fill materials: The construction materials will be stored in the covered shed as well in open stack within the well sites/production facilities. Improper storage of these materials is likely to cause visual and aesthetic impacts on surrounding localities.

Fugitive dust emission: Fugitive dust emission will happen during well site preparation, drilling and decommissioning phases and during the construction of the production facilities for the proposed project. There are households within 0.2 km of the proposed well sites and production facilities. The dust will be deposited in the nearby vegetation and property and likely to cause visual and aesthetic impacts on surrounding localities.

Disposal of MSW: The villages within the Khagorijan Filed have no municipal solid waste disposal site; as practice most of the organic waste is disposed within the homestead land for manure and other wastes are either recycled or disposed in their own premises. MSW will be generated from the drill sites and production facilities during all phases. The disposal of MSW in open area around the village is likely to cause visual and aesthetic impacts at surrounding localities.

Disposal of decommissioning waste: The waste material will be generated during site decommissioning phase. If these materials stored within the site or disposed in non-designated area, this is likely to cause visual and aesthetic impacts at surrounding localities.

Physical presence of rig and associated equipment: The setting up of rig, DG set and other machineries will create an impression of an industrial setup at the drill sites. The drill sites are all located in rural settings. The industrial setup is likely to cause visual and aesthetic impacts at surrounding localities. The drill site would have bright illumination arrangements. The physical presence and illumination at the project facilities is likely to cause visual and aesthetic impacts at surrounding localities of the area.

Flare stack at OCS/FGGS: The illumination from flare stack through all night may be source of visual discomfort for the local people or fauna. However, the

closest settlement close to the OCS/FGGS facilities is approximately 0.2 km away kilometre away and the settlements in the area in general are surrounded with plantations and hence away from the line of sight.

Laying of interconnected pipelines: The route of the pipeline will be close to RoU of existing road for minimum disturbance. To avoid, densely populated area, the pipeline will be routed through agricultural land. The trenching activity, the storage of soil on the RoU (10m) of the pipeline and the temporary storage of pipelines will create visual disturbance and will be aesthetically displeasing.

Removal of vegetation, generation and deposition of fugitive dust, storage of materials and wastes, presence of rig and equipment at drill site, illumination from OCS/FGGS and noise generated from the drill sites may cause visual and aesthetic impact however, the same can be easily revert to earlier stage with mitigation; so the scale of impact is ***medium***. The visual impact can be noticed by the nearby people; i.e. within 0.5 km from the project site- so the extent of impact is ***local***. The above-mentioned activities can occur only in phase of drilling life cycle; however, vegetation removal has ***long-term*** impact. Hence, the impact magnitude is **medium**.

The environmental setting of the area reveals that the study area has a typical rural setting - flat terrain with agricultural land, villages with homestead plantation and tea garden. The people in the area have experienced drilling activity. The receptor sensitivity can be categorized as ***medium***.

The aesthetics and visual impact is assessed to be ***moderate*** (*Ref.* ***Table 4.6:*** *Impact Significance Matrix without mitigation*).

<u>*Mitigation Measures*</u>: The mitigation measures to minimize the above-mentioned impacts are as follows:

- All the construction activities will be restricted within the designated site;
- Fugitive dust will be suppressed with periodic water sprinkling;
- Appropriate shading of lights to prevent scattering;
- On completion of work all temporary structures, surplus materials and wastes will be completely removed from site and disposed at a designated area;
- Construction wastes, decommissioning waste and municipal solid waste temporarily stored at the sites will be transported to the designated disposal site/facility at regular intervals;
- Flare stack of OCS/FGGS will be provided with Chinese hat;
- The pipelines once laid will be covered with burrowed soil and levelled as per the surrounding land; and
- The boundary wall of the production facilities will be covered with creepers to blend with the surrounding.

Residual Impact: Considering the implementation of above-mentioned mitigation measures the residual impact is assessed to be **minor** (*Refer **Table 4.7** Impact Significance Matrix with mitigation*)

4.2.2 Potential Impact on Land Use

Source of impact: The sources land use impacts can result from:

- Procurement of land for development wells (~3 ha), production facilities (~4 ha to 7 ha).

Assessment of Impact: Land will be required for proposed drill sites and the associated production facilities. As mentioned in *Section 2.4.3,* the drill sites are proposed in tea garden, agricultural land, homestead plantation areas. The associated production facilities are proposed in agricultural land and tea gardens. This will lead to conversion of land use from tea garden, homestead plantation, agricultural and forestland to industrial land.

Land use change may lead to impact on income and livelihood; this has been discussed in socio-economic impact section.

As discussed (*Ref. Section 2.5.1 land procurement process*), OIL usually procures land through negotiated purchase from private owners. OIL does not plan to reinstate the land after drilling activity; hence, the land use change is ***permanent*** impact. As per preliminary assessment, approximately 0.73 sq. km of tea garden land, 1.04 sq.km of agricultural land, 0.90 sq.km of homestead plantation, 0.07 sq.km of forest land and 0.06 sq.km of other land will be required for this project. Maximum wells are proposed in the homestead plantation areas, tea garden, and agricultural land. If compared with the total area of Khagorijan Filed, the conversion is 0.73% for agricultural land, 0.92% for homestead plantation and 0.57% for tea garden areas. Hence, the scale of impact is ***low***. The impact will be limited to the local since the land belongs to people living in and around the proposed sites, however the duration will be long term. The magnitude will be ***small***. The resource sensitivity is ***low*** since the maximum land impacted will be of homestead plantation, tea garden and agricultural land. The impact on land use is assessed to be ***minor*** (*Ref. **Table 4.6:** Impact Significance Matrix without mitigation*).

4.2.3 Potential Impact on Soil Quality

Source of Impact: Soil quality impacts can result from:

- Pre-drilling Phase and construction of production facilities and laying of pipelines:
  - 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:

- Construction waste generated from the drill sites/production facilities will be utilized for backfilling within the site itself;
- MSW generated from the labour camp and construction sites will be transferred to the disposal site at Dibrugarh/Tinsukia in consultation with authority;
- Dedicated paved storage area will be identified for the drilling chemicals, fuel, lubricants and oils within the drill sites;
- Paved storage areas will be provided for storage of oils, lubricants at the production facilities;
- HDPE lined pits will be considered for the disposal of unusable drilling mud cuttings and drilling wastewater etc.

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

Removal of top soil: Before site development activity, the top soil of the site if not properly stripped and stored for future use, the entire volume of top soil will be permanently lost or fertility/soil characteristics will be changed.

Handling of oil, chemical and waste: The drilling chemicals, cement for mud preparation, fuel & lubricants will be stored in dedicated paved storage areas within drill sites/production facilities. The hazardous waste (spent oil & used oil), batteries, e-waste and municipal waste will be stored within the drill sites/production facilities before final disposal. Thus, the contamination of soil can happen only due to accidental spillage of fuel, lubricants and paints from storage areas and during the transfer of fuels and chemicals. The contamination of soil with fuel, lubricants and paints may affect the soil microbes and bacterial growth and can affect the soil quality.

Storage and disposal of drill cuttings and spent mud: It is estimated that nearly about 350-400m^3 drill cuttings and 900-1200 m^3 spent drilling mud is likely to be generated from each drilling operation. The project design takes into account construction of a HDPE lined impervious pits for storage of drill cuttings, drilling mud and drilling fluid respectively and their disposal in accordance with "CPCB Oil & Extraction Industry Standard – Guidelines for Disposal of Solid Wastes" in their planning stage. The flooding history of the

area and rainfall intensity will be taken into account while designing the depth of the pits. It can be stated here as high flood levels taken into considerations for the previous drilling programmes at the drill sites, the same considerations would also be undertaken here. Further with OIL committing to the use of primarily water based mud and eco-friendly polymer based mud (will also be used if required for deeper sections after providing intimation to the Pollution Control Board), the drill cuttings and waste drilling mud generated are likely to be non-hazardous in nature. Spillage of drill cuttings and spent mud on nearby open soil may lead to change of soil characteristics due to chemical contamination.

Surface runoff during monsoon season from disturbed construction site, construction material & waste storage area and spillage area have the potential to degrade soil quality due to deposition of foreign materials, hydrocarbon and other hazardous waste.

Production facilities

The construction of the associated facilities will result in long term conversion of land. Hence, instead of simply storing it in mound forms the top soil removed will be used at the periphery of the facilities for greenbelt development /tree plantation within the site.

Pipeline

The soil dug during trenching will be reused for covering after laying the pipelines. Care will be taken to restore the location of the concealed pipelines to its earlier state. The process will be completed within a very short period of time (1-2 months).

Primary monitoring results of soil quality results shows that there is no contamination of heavy metals in the nearby agricultural land, homestead plantation or tea garden areas (*Refer Section 4.5.5*) hence the resource sensitivity is termed as **medium**.

Contamination of soil from wastes, contaminated surface runoffs from the drill sites/production facilities may cause perceptible changes of the soil quality hence, the scale of impact is considered to be ***medium***. The above mentioned soil quality impacts will be localized within the project site or immediate vicinity hence the extent of impact would be ***local***. The duration of impact will spread across phases of the project life cycle hence duration is considered as ***medium*** term. The magnitude of the impact is assessed to be **medium**.

The significance of impact on soil quality is assessed to be **moderate** (*Ref. **Table 4.6:** Impact Significance Matrix without mitigation*).

Mitigation Measures: The mitigation measures to minimize the above-mentioned impacts are as follows:

- Properly stripping of top soil and conserve it for future use;
- The top soil will be stored in mound form, with height less than 2m, slope of angle not more than 30˚ and covered with jute mat to prevent erosion;
- Restrict movement of vehicles within the site only to designated areas to prevent any compaction of soil;
- Restricted project and related activities during monsoon season;
- Drainage system at site is to be provided with sedimentation tank and oily-water separator to prevent contaminants, especially oil and grease, from being carried off by surface runoff;
- Manage spills of contaminants on soil using 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.
- Testing of drill cutting to determine if they are hazardous in nature and accordingly planning for their disposal.

Residual Impact: Considering the implementation of above mentioned mitigation measures, impact on soil quality is assessed to be ***minor*** (*Refer* ***Table 4.7*** *Impact Significance Matrix with mitigation*).

4.2.4 Potential Impact on Topography & Drainage

Well Sites

Potential impact on drainage and topography *viz*. alteration of drainage pattern and water logging are anticipated during well site preparation and raising of the well site and access roads. The sites will be raised to a height of one and half a meter more than the high flood level of past ten-twenty years. This may lead to alteration of onsite micro-drainage pattern leading to potential problems of water logging in the agricultural land and low lying areas abutting the drill site. This problem is likely to be further aggravated due to heavy rainfall experienced by the area throughout the year. Approach roads have to be constructed for few proposed sites. The length of the site approach road will vary between 100 to 250m only. Approach road may interfere with the drainage of surface run-off during rainfall.

Production facilities

Similar to the proposed well sites, the site of the proposed production facilities will be raised to a height of one and a half meters above the high flood level of past ten-twenty years. The raising of the height of the construction site above the surrounding land may lead to waterlogging of the adjacent land or disrupt the existing drainage pattern.

The extent of the impact will be **local**, i.e. within the site and immediate vicinity; duration will be **long term,** as OIL will purchase the land and retain

the sites and scale will be **medium** as the damage would be irreversible but can be brought back to original conditions with mitigations. The magnitude will be **medium**. The sensitivity will be **medium**, as human receptors in the vicinity may experience the impact, the impact significance is assessed to be ***moderate*** (*Ref.* ***Table 4.6:*** *Impact Significance Matrix without mitigation*)

Mitigation Measure

- Levelling and grading operations will be undertaken with minimal disturbance to the existing contour, thereby maintaining the general slope of site; and
- Cross drainage structures will be constructed in approach road for drainage of run-off.

Residual Impact Significance

The implementation of the above mitigation measures will help mitigate the impacts on topography and drainage however, the residual impact significance will reduce to **minor** (*Refer* ***Table 4.7*** *Impact Significance Matrix with mitigation*).

4.2.5 Potential Impact on Air Quality

Source of Impact: Potential impact on ambient air quality during different phase of the project could arise due to:

- Predrilling phase, construction of production facilities:
  - 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.

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

- Operation of Production facilities
  - Emission from GG sets
  - Emission from flare stacks

Embedded Control Measures: Project embedded 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/GG set stacks would have adequate height, as per statutory requirements, to 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 following section.

Fugitive emission: Fugitive dust emissions due to the proposed project will 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. However, generation of such fugitive dust is likely to 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 will generally settles down on the adjacent areas (i.e. < 500 m from the source) within a short period due to its larger particle size.

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

Impacts from Operation of DG/GG sets and Flaring: The proposed project will involve the operation of two diesel driven 1000 KW generators for drilling of each development wells; additionally one 200 KW generator will be required to meet power demand of the residential camp and other emergency requirements. Moreover, power at the production installation would be sourced through 216 KW GG sets.

Combustion of fuel in a DG sets typically happens at high temperatures resulting in generation of considerable amounts of NOx. The SO_2 concentration in emissions is dependent on the Sulphur content in fuel burnt and particulate matter consisting of unburnt Carbon particles. The emissions from the DG set will be discharged into the atmosphere through a stack of height about 7 m from ground level and will be dispersed into the surrounding atmosphere.

Combustion of natural gas in GG sets will primarily generate CO_2, unburnt hydrocarbons, NOx etc. Since sour gas[1] and mercaptans are not expected, so SO_2 would not be considered as a priority pollutant.

Flaring of gases primarily during the drilling testing phase will contribute to additional air pollution. Flaring will involve high temperature oxidation process to burn combustible gases that may be generated from the proposed well sites. Emissions from flaring will include CO_2, carbon particles (soot), unburnt hydrocarbons, CO and other partially burned or altered hydrocarbons, NOx. Since sour gas and mercaptans are not expected, so SO_2 generation is not expected. The flaring will only be intermittent and will not last for more than a few days.

Elevated flaring (30m) will be done during operation of production installations to burn the excess gas vented from the process vessels. NOx emission is associated with the flaring activity.

In order to predict the Ground Level Concentrations (GLCs) at various distances from the source, of the above mentioned pollutants, an air modelling exercise ISC-ST3 has been undertaken and is discussed in the impact prediction section below. The following input parameters (Refer ***Table 4.2***) have been considered in the impact prediction modelling undertaken using ISC-ST-3.

Table 4.2 Input Parameters Considered for Modelling

Emission sources	Stack height (m)	Stack dia. (m)	Stack gas temp. (K)	Stack gas velocity m/s)	Emission Rate (g/s)		
					PM	NO_2	HC
1250 KVA DG	7	0.30	749.4	17	0.007	1.836	0.004
250 KVA DG	3	0.30	708.7	17	0.003	0.188	0.008
Flare Stack (Well testing)	9	0.5	1273	20.0	-	0.149	-
Flaring Stack (OCS)	30	0.5	1273	20	-	0.1496	-
216 KW GG sets	3	0.457	1273	20	-	0.2117	0.0029

Though, ISC-ST3 is a refined model, the model run was carried out based on micro- meteorology to predict air quality impacts for an average 24 hr period that may be caused by peak power utilization at the drill site. The model was run for operation of two 1000 KW DG (approximately 1250 KVA) set and one 200 KW (approximately 250 KVA) DG sets and also 216 KW GG sets. ISC-ST3 model considers wind towards the direction of flow. To predict the

[1] sulphur-containing materials such as hydrogen sulphide (sour gas) or mercaptans

incremental concentrations of the pollutants due to the proposed project activities, the concentration values for these pollutants estimated during the baseline monitoring at Haribari Konwargaon (AQ6) and for flaring and GG set operation from Installation-1, Dhupabor Maijan village (AQ4) was also taken into account (refer ***Table 4.3*** and ***Table 4.4***), ***Figure 4.2, Figure 4.3*** and ***Figure 4.4*** presents the isopleths of distribution of NO_x, PM, and HC respectively due to operation of DG sets. ***Figure 4.5*** shows the isopleth of distribution of NO_x concentrations due to flaring. ***Figure 4.6*** represent isopleth of distribution of NOx due to flaring at production installations. ***Figure 4.7*** and ***Figure 4.8*** represent isopleths of distribution of NOx and hydrocarbons respectively due to operation of GG sets at production installation.

Table 4.3 Predicted GLC for Air Pollutants

Pollutants	**Predicted maximum GLC (µg/m³)**		
	Incremental Maximum Concentration	**Distance from well/production facility (km)**	**Direction**
DG Set			
NOx	30.994	2831	SW
PM	0.167	2549	SW
HC	0.221	2549	SW
Flare Stack (Well Testing)			SW
NOx	0.799	3397	SW
Flare Stack (production facility)			SW
NOx	0.799	2100	SW
GG Set (Production facility)			
NOx	0.3396	4600	SW
HC	0.0047	4600	SW

Figure 4.2 Predicted Incremental Concentration of NO_x - operation of DG sets

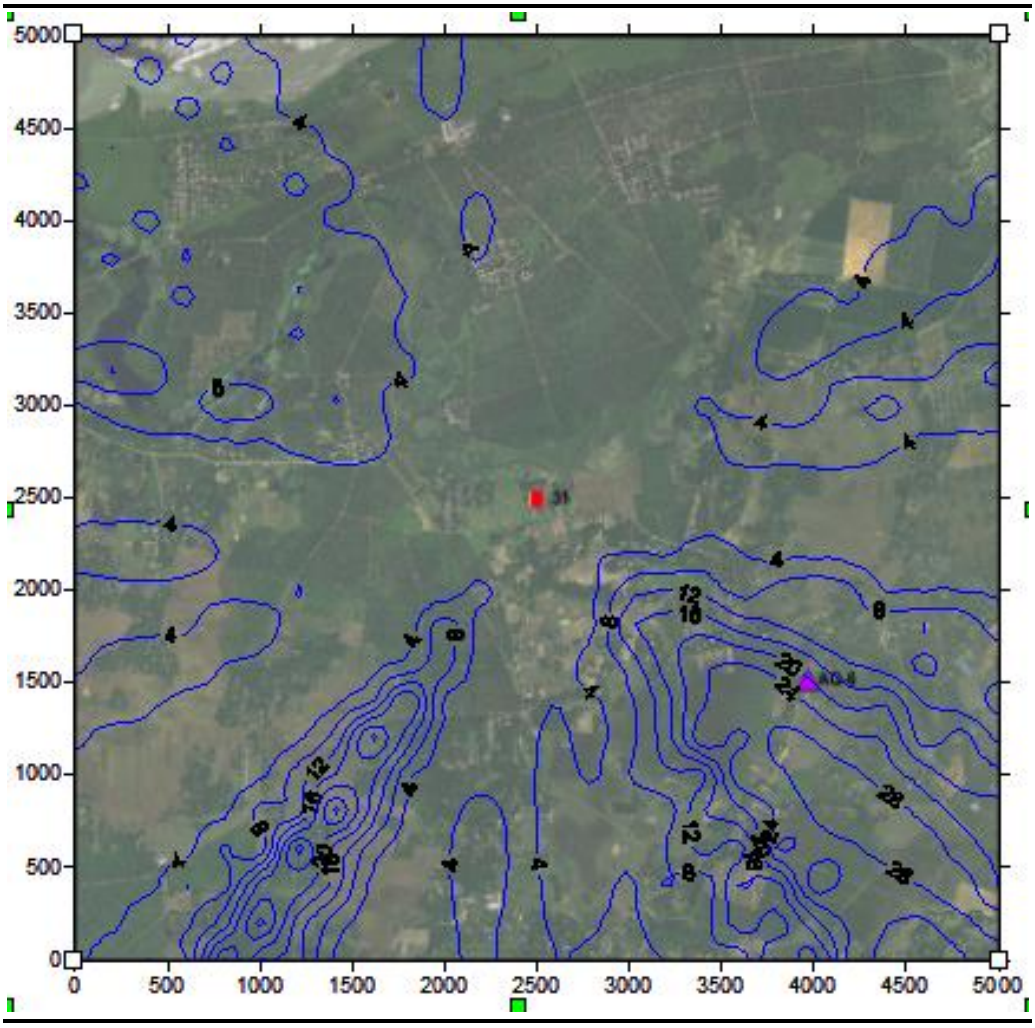


Figure 4.3 Predicted Incremental Concentration of PM -operation of DG sets

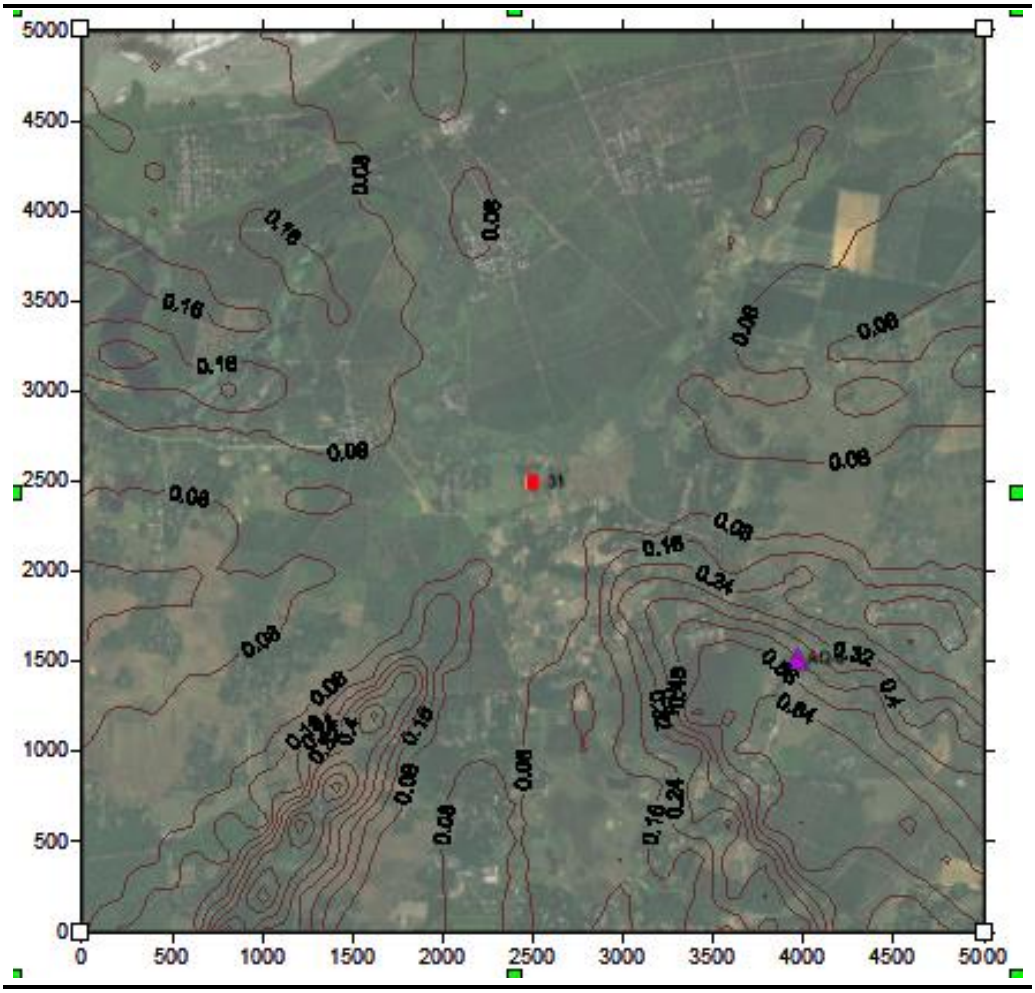


Figure 4.4 Predicted Incremental Concentration of HC -operation of DG sets

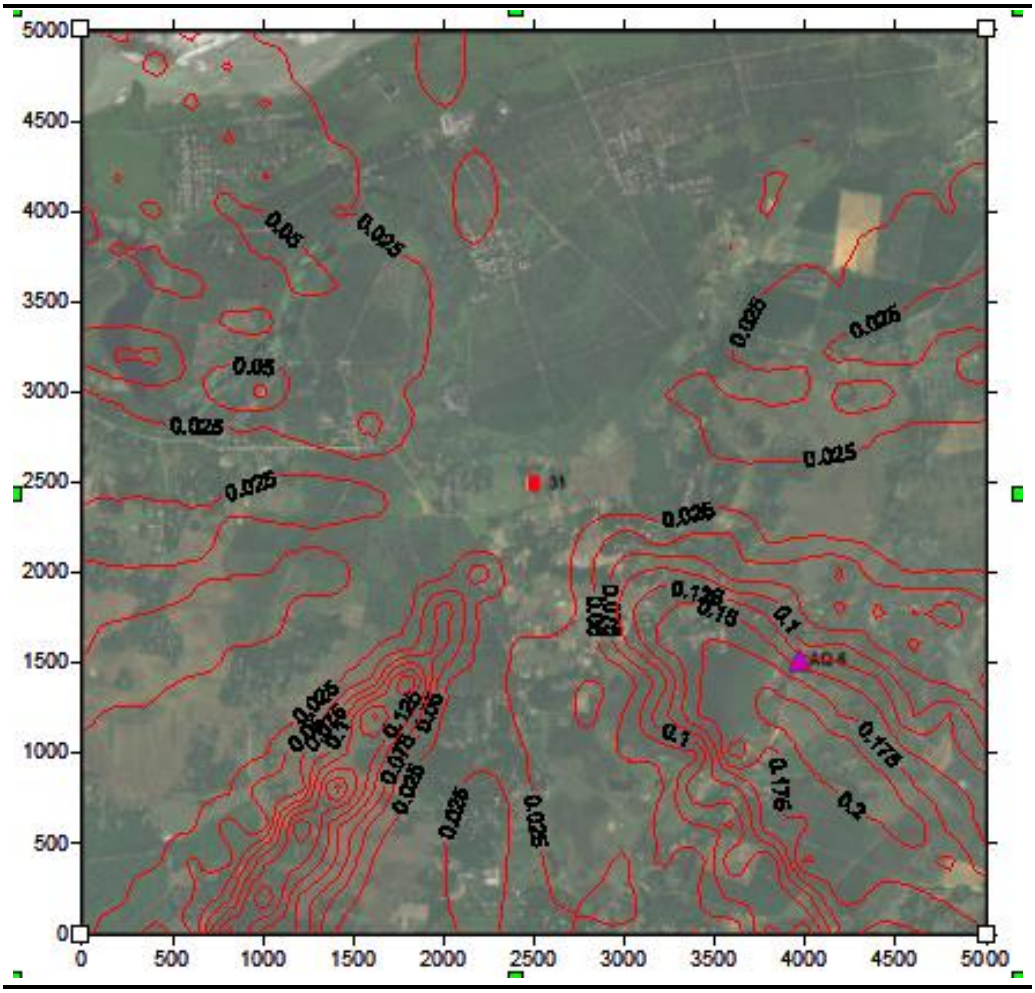


Figure 4.5 Predicted Incremental Concentration of NO_x -Flaring from well testing

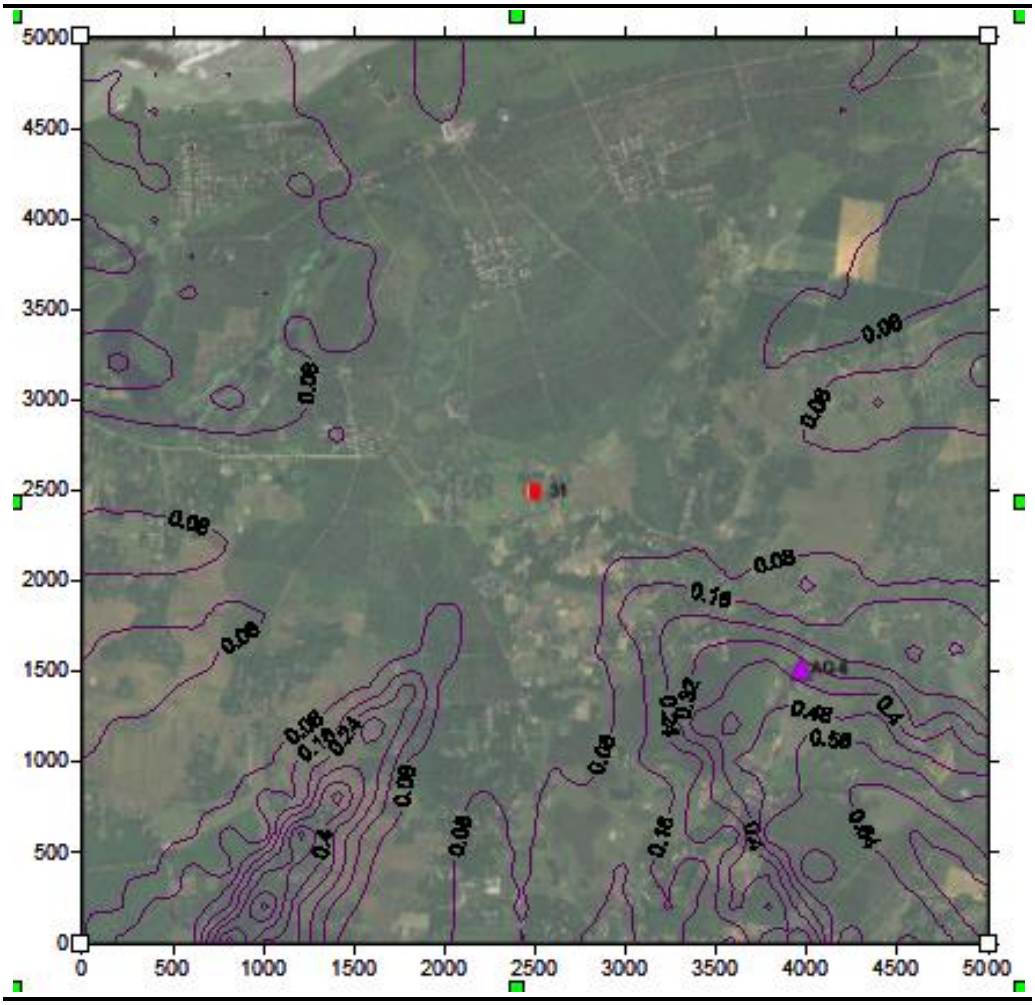


Figure 4.6 Predicted Incremental Concentration of NO_x Flaring from OCS

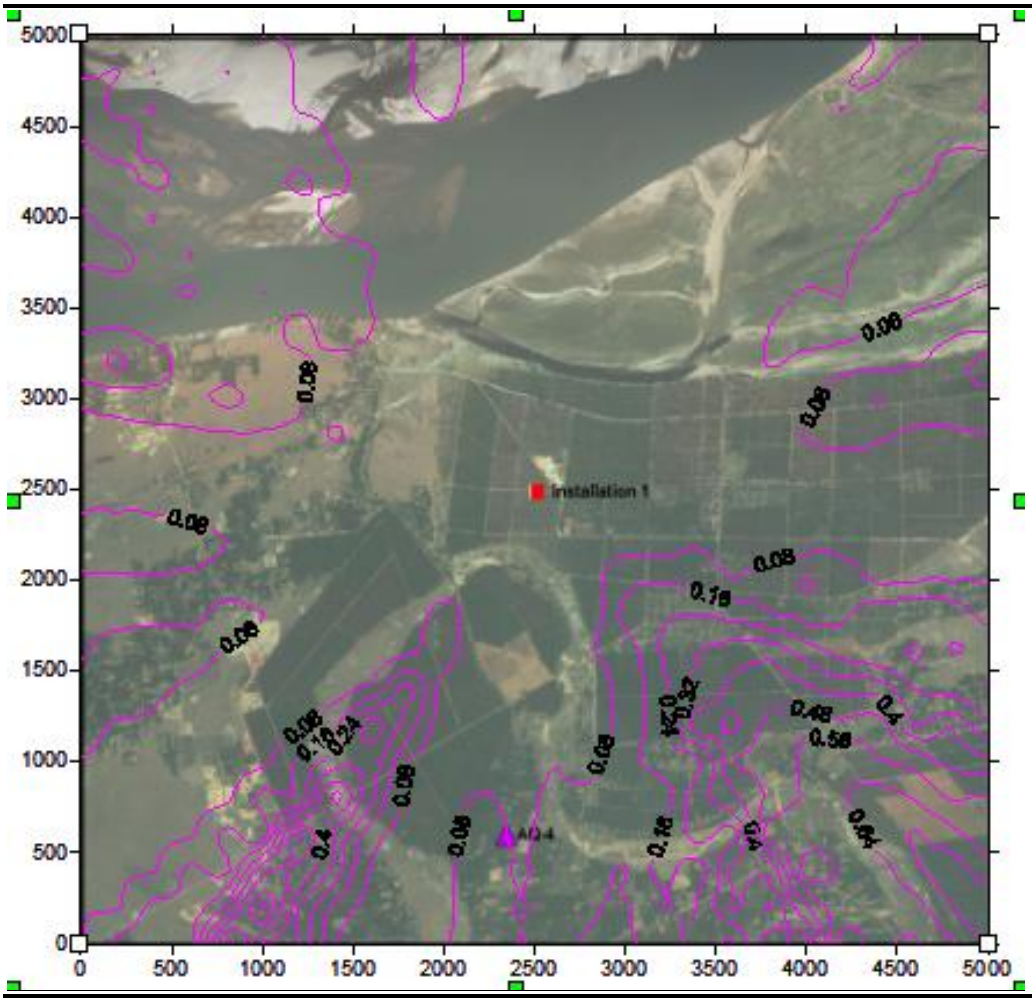


Figure 4.7 Predicted Incremental Concentration of NO_x-Operation of GG sets

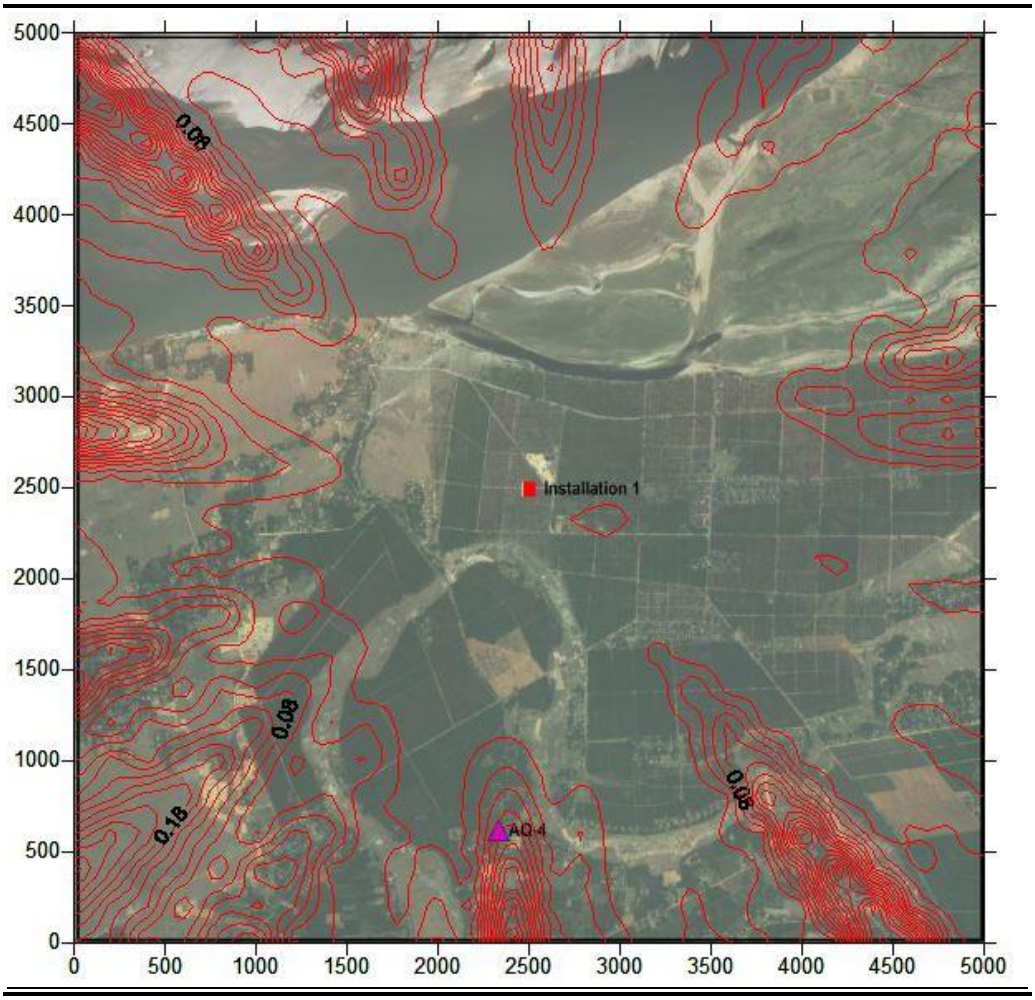
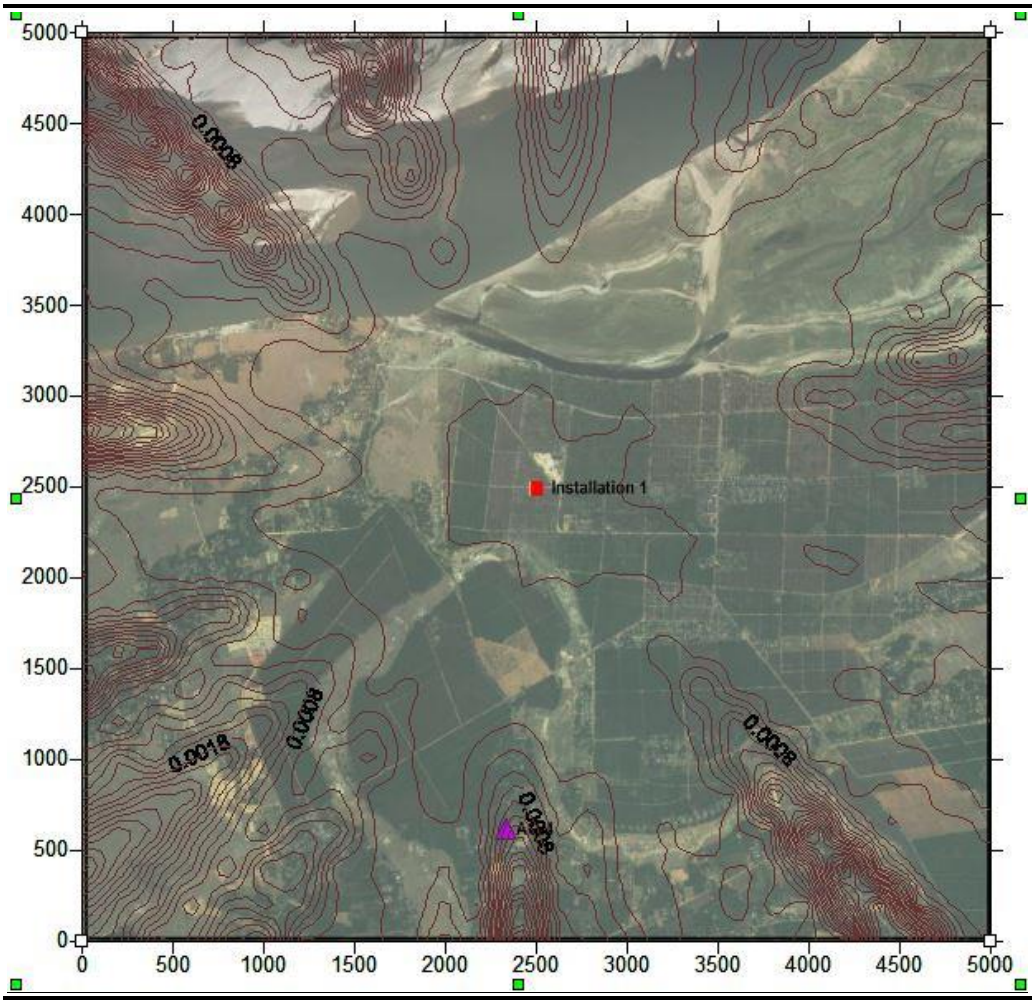


Figure 4.8 Predicted Incremental Concentration of HC-Operation of GG sets



The predicted Ground Level Concentrations (GLC) for PM, NOx, SO_2 and HC at different locations where air monitoring was conducted is provided in ***Table 4.4.***

Table 4.4 Projected Ambient Air Quality Concentrations from Drill Site/production facilities at ambient air quality monitoring location

Pollutants	Incremental Concentration (µg/m³)	Average Baseline Values (µg/m³)	Predicted Total Concentration (µg/m³)
DG Set			
NOx	11.824	18.65	30.474
PM	0.00678	63.00#	63.00678
HC	0.1025	850.21*	850.3125
Flaring Stack			
NOx	0.2067	18.04	18.2467
GG Set			
NOx	0.1233	18.04	18.1633
HC	0.0017	863.31*	863.3117

PM_{10} *values have been considered* Baseline values for total hydrocarbon only considered*

The baseline air quality monitoring results shows that concentrations of PM, NO_2 were within the NAAQS values and hence it can be considered that the

air environment is not polluted and the receptor sensitivity is considered as **medium**.

The generation of PM, SO_2, NO_2 from site preparation, drilling and decommissioning activities and construction and operation of production facilities have the potential to cause change in baseline air environment, however, the same is not envisaged to lead to exceedance of NAAQS values. Hence, the scale of impact is considered as ***medium***. The duration of the drilling activity will be ***medium term***. The emissions are likely to be dispersed within 3.5 km from the drill sites hence the extent is considered as ***regional***. The impact magnitude is assessed to be **moderate**.

Significance of impact on air quality due to the proposed drilling programme is assessed to be ***moderate*** (*Ref.* ***Table 4.6:*** *Impact Significance Matrix without mitigation*).

Mitigation Measures: The proposed mitigation measures are as follows:

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

- Carry out regular water sprinkling at the site during dry season especially during the construction and decommissioning activities;
- Efforts would be made to maintain the stockpile against the wall or obstruction so that it works as a windbreak and the fugitive emissions by strong winds can be avoided;
- The trucks used for transport of fill material during the site preparation and debris transport during the decommissioning shall be provided with impervious sheeting;
- During construction, the approach road will be kept clean, free from mud and slurry to prevent any entrainment of dust;
- Waste from construction site will not be burned;
- 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 speed of 20 km/hr 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 (S<0.5%) will be used in diesel powered equipment and best management practices would be adhered to;
- Vehicle / equipment air emissions will be controlled by good practice procedures (such as turning off equipment when not in use); and

- 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 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.

Residual Impact: Considering the implementation of above mentioned mitigation measures, the residual impact on ambient air quality is assessed to be **minor** (*Refer **Table 4.7** Impact Significance Matrix with mitigation*).

4.2.6 Potential Impact on Noise Quality

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

- Pre-drilling phase, Construction of Production facilities and pipeline laying:
  - Operation of machineries & equipment;
  - Vehicular traffic;
  - 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.

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

- All vehicle and equipment involved in site development and drilling activity will be provided with noise control measures;
- Well maintained equipment and vehicles will be used;
- All DG/GG sets would be provided with acoustic enclosures; and
- Appropriate PPEs (e.g. ear plugs) will be used for by workers while working near high noise generating equipment.

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

Operation of construction machinery/equipment: The construction activities such as transportation of raw materials for civil works, operation of heavy equipment and construction machinery are likely to cause increase in the ambient noise levels in and around the drill sites/production facilities. The noise generated from the above mentioned activities likely to be attenuated within 500m from the construction sites. The noise generated from drill sites may cause discomfort for the villagers who are within 500m.

Noise from Vehicular Traffic: As vehicles supplying, material and manpower to the sites will pass through site access and approach road, it will result in increase in traffic density (compared to existing traffic) in the approach road and resultant significant increases in noise levels in the settlements immediate adjacent to the road. The impact will be more significant for residents living adjacent to the approach road where houses are located very close to the road. The noise pressure level caused by movement of a heavy truck, at a distance of about 5 m from the road, has been measured to be as high as 75- 80 dB(A) though it gets averaged out when expressed in Leq terms. This may cause considerable incremental noise disturbances to residents near site approach roads.

Operation of drilling rig and ancillary equipment: Operational phase noise impacts are anticipated from operation of drilling rig and ancillary equipment *viz*. shale shakers, mud pumps and diesel generators. Studies indicate that noise generated from operation of drilling rig generally varies in the range of 88-103 dB(A). Other contributors of high noise level at the well site include shale shakers, mud pumps and diesel generators. The average equivalent noise levels of drilling rig and ancillary equipment is estimated to 95 dB(A).

Further, considering drilling to be a continuous operation, noise generated from aforesaid equipment has the potential to cause discomfort to the local communities residing in proximity (within 500m) of the rig facility. Occupational health and safety impacts *viz*. Noise Induced Hearing Loss (NIHL) is also anticipated for personnel working close to such noise generating equipment until they are wearing appropriate personnel protective equipment.

Noise Level Prediction

A noise modelling exercise has been undertaken based on standard noise attenuation equations to predict noise levels from drilling rig near sensitive receptors. A noise attenuation plot has been developed considering natural attenuation by distance with noise level predictions only expected to help in planning and decision-making.

The cumulative noise generated from rig, mud pump, DG sets and shale shakers was calculated to be 95.0 dB(A). Noise attenuation equations (without any noise barrier) show that the normal attenuated noise at any receptor points located at a distance of about 100 m and 200 m from the fence-line of

the rig, will be in the range of about 75.0dB(A) and 69.0 dB(A) respectively. In the absence of an acoustic barrier, the predicted noise levels were found to exceed the daytime noise standard of i.e. 55dB (A) which may lead to discomfort to neighbouring communities.

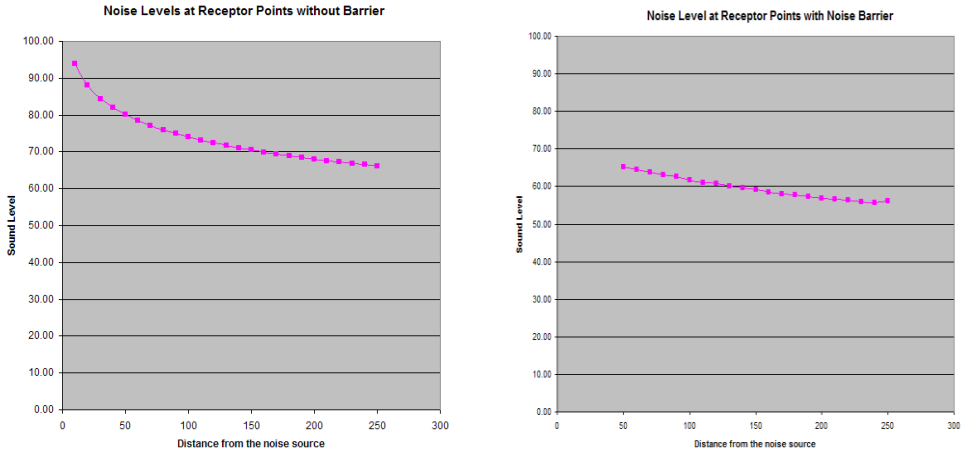
Noise generated from the operation of production facilities will be from gensets, running of crude oil despatch pump sets, gas compressors, formation water pumps, boilers, etc. Acoustic gensets will be used in the installations. Sound generated from the GG sets and pumps would be in similar as compared to the drill sites and they area also expected to be attenuated to baseline levels within 0.5 km from the site.

The scale of impact of the above mentioned activities is considered to be **high** as the changes of baseline noise level the immediate vicinity of the drill sites/production facilities are likely to regularly exceed the standard regularly. The extent of impact is considered as **local** as noise would be attenuated within 0.5 km of the sites. The duration of impact is also considered as **medium-term** spread across several phases of the project lifecycle. The magnitude of impact assessed to be **medium**. The sensitivity of the receptors is **high** as human receptors are present within 0.2 km of all the well sites and production facilities. The impact on ambient noise level assessed to be **major** (*Ref. **Table 4.6:** Impact Significance Matrix without mitigation measures*).

Mitigation Measures:

With the introduction of a noise barrier such as a screen at the fence-line with a height of 4 m the noise level may be reduced. This control measure will reduce the noise levels near sensitive receptors at 50m to about 65.98 dB (A). The noise level can further be reduced by usage of screen that has absorptive surfaces. These surfaces would help absorb the noise and reduce it to acceptable levels. However, a detailed noise modelling exercise to look at option of noise reductions will be conducted at the design stage to determine the barrier specifications. The noise attenuation plot with and without acoustic barrier is presented in ***Figure 4.9***.

Figure 4.9 ***Predicted Noise Pressure Levels at Receptor Points (with and without barrier)***



The additional mitigation measures as proposed are as follows:

- Maintenance of vehicles and machineries;
- Restrict all noise generating operations, except drilling, to daytime;
- Provide Personnel Protective Equipment (PPE) like ear plugs/muffs to workers at site;
- Restriction of unnecessary use of horns by trucks and vehicles near settlement areas;
- Provide noise barrier in sensitive locations.

Residual Impact: Considering the implementation of above mentioned mitigation measures, the residual impact on noise quality is assessed to be **moderate** (*Refer* ***Table 4.7*** *Impact Significance Matrix with mitigation*).

4.2.7 Potential Impact on Road & Traffic

Source of Impact: The source of impact is additional traffic load during:

- Predrilling Phase, Production facilities and laying of pipeline
  - Transportation of construction materials and manpower;
  - Transportation of drilling rig and machineries;
- Drilling phase
  - Transportation of drilling chemical and fuel
  - Transportation of manpower
- Decommissioning phase
  - Transportation of drilling rigs and machineries.

Assessment of Impact: Approximately, 100 trucks/trailers load materials will be transported to drill site during predrilling phase. During drilling activity 5-7 trucks/trailers load materials will be transported to drill site; additionally, 10 to 15 vehicles will be required for transport of site workers.

Based on the traffic survey conducted (***Refer Section 3.3.11***), it is noted that NH 37 Road, Naharkatia-Moran roads will be the main roads for transportation of construction material and drilling rig and machineries.

The increase of traffic during construction phase will cause perceptible changes in the existing road traffic. This may cause damage of existing infrastructure. The increase of traffic may cause community health and safety of the nearby villagers and sensitive man-made habitat like schools. Impact on community health & safety discussed in following section.

During operation phase traffic movement would be primarily for the movement of manpower to the sites.

The scale of impact of traffic movement due to the proposed project is considered to be **medium** as the increase of traffic during construction phase will cause perceptible changes in the existing road traffic (however, no perceptible change to the existing traffic load is expected during operation phase). The extent of impact is considered as **local** as impact would be on the access and approach roads to the site. The duration of impact is also considered as **medium-term** spread across several phases of the project lifecycle. The magnitude of impact assessed to be **medium**. The sensitivity of the receptors is **medium** as human receptors are present adjacent the access routes and likely to be affected by the project. The potential impact on road and traffic due to operational traffic is assessed to be **moderate** (*Ref. **Table 4.6:** Impact Significance Matrix without mitigation*).

Mitigation Measures: Precautions as mentioned will be taken to minimize impact on road and traffic:

- Avoid the traffic movement during school hours and market times;
- Regular maintenance of the access roads;
- Deploying traffic supervisors at important road junctions and near sensitive receptors (eg. schools) for maintenance of project traffic.

Residual Impact: Considering the implementation of above mentioned mitigation measures, the residual impact disturbance/ discomfort to local people due to increase of traffic is assessed to be **minor** (*Refer **Table 4.7** Impact Significance Matrix with mitigation*).

4.2.8 Potential Impact on Surface Water Quality

Source of Impact: Potential impact on surface water quality could arise due to the following activities;

- Predrilling phase, construction of production facilities and laying of pipeline:
    - Surface runoff from construction site, spill area;
    - Generation and disposal of domestic waste water from construction camp.

- Drilling phase:
    - Discharge of drilling wash water;
    - Generation and disposal of domestic waste water from drill sites;
    - Surface runoff from drill sites;
    - Accidental discharge from waste pit.
- Decommissioning phase:
    - Surface runoff from site.
- Operation of OCS, FGGS
    - Discharge of produced water
    - Surface runoff

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

- Septic tanks and soak pits have been considered in the design of the OIL's camps for treatment of the domestic black water;
- Process wastewater would be treated in Effluent Treatment Plant (ETP) at drill sites.

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

Surface run-off from the site: The site development activity *viz*. site clearance and stripping of top soil during site construction may result in increase in soil erosion that might lead to an increased silt load in the surface run-off. The surface run off from drilling waste (cuttings and drilling mud) storage areas, hazardous waste (waste oil, used oil, etc.) storage areas and chemical storage areas is likely to be contaminated. To prevent these run-offs, waste pits (dimensions given in *Section 2.8.3*), storm water drains and tankers (that will regularly carry the treated water) will be provided during drilling phase. Further, the boundaries of the waste pits will be raised to prevent any runoff. There few wells located in close proximity to drainage channels (within 100 m). Similarly, few production installations area also within 100 m of drainage channels. Any accidental runoff from drill sites and production facilities will create an adverse impact upon the receiving surface water body, river or ponds. This situation is likely to be more pronounced considering high rainfall received in these areas. The surface run offs may contain high sediment load, oil residues, organic wastes, etc. The higher value of suspended solid and organic rich sediment load may affect the lowering of DO levels and affect the aquatic ecology. Impact on aquatic ecology discussed in ecological impact assessment *Section 4.2.12*.

Discharge of drilling wastewater and domestic wastewater: The process wastewater and formation water will be generated during drilling activity. The process wastewater treated through ETP would meet the CPCB discharge standards before it is discharged into the local stream. The discharge of treated effluent in the local stream is not expected to cause significant change in the surface

water quality. However, accidental discharge of untreated process effluent will adversely affect the surface water quality.

The domestic wastewater will be generated during all the phases of the project. The domestic wastewater will be treated in septic tank and soak pits.

Discharge of Produced Water from OCS/FGGS: Produced water will be treated in ETP to comply with the CPCB discharge standards before discharging to local streams. The discharge of treated water in the local streams is not expected to cause significant change in the surface water quality. However, accidental discharge of untreated water will adversely affect the surface water quality.

The Brahmaputra River, Dinjan River, Dangori River etc. are ecological sensitive area in terms of fish habitat, breeding and nursing ground for fishes. The water quality of the river is fit the use of outdoor bathing and for propagation of wildlife (CPCB Use Class category B and D) and also no major contamination was recorded (*Refer Section 3.3.8*).

Discharge of surface run-off, treated wastewater can cause reversible damage to water quality but likely to easily revert to earlier stage with mitigation, hence, scale of impact is ***medium***. The duration of impact will be **short term**; i.e. surface runoff may get discharged at the time of rainfall and formation water may get discharged accidentally. The extent of impact is ***regional*** as treated wastewater and surface run-off may reach beyond 0.5 km from the drill sites**.** The impact magnitude is assessed to be **small.**

Brahmaputra River, Dinjan River, Dangori River etc. provides habitat to wide variety of fishes and water birds. Hence the sensitivity of the habitat is assessed to be **medium.**

The potential impact on surface water quality is assessed to be ***minor*** (*Ref.* ***Table 4.6:*** *Impact Significance Matrix without mitigation*).

Mitigation Measures: The mitigation measures are as follows:

- Construction activities *viz*. stripping, excavation etc., during monsoon season will be restricted to the extent possible;
- Channelize all surface runoff from the construction site through storm water drainage system and provide adequate size double chambered sedimentation tank;
- Proper treatment of all wastewater and produced water discharges will be made to ensure that they comply with criteria set by the regulatory body (MoEFCC and SPCB);
- All chemical and fuel storage areas, process areas will have proper bunds so that contaminated run-off cannot escape into the storm-water drainage system;
- An oil-water separator will be provided at the storm water drainage outlet, to prevent discharge of contaminated run-off;
- Spill kits to be used for removal of any oil or chemical spillage on site;

- Additional storage area to be provided to store formation water within the drill site.

Residual Impact: Considering the implementation of above mentioned mitigation measures, the residual impact on surface water quality due to above mentioned activity is still assessed to be **minor** (*Refer **Table 4.7** Impact Significance Matrix with mitigation*).

4.2.9 Potential Impact on Ground Water Resources

Source of Impacts: Potential impact on ground water resource could arise due to:

- Predrilling phase, Construction of drill sites and pipeline laying
  - Approx. 8 m^3/day (5 m^3/day for construction activity and 3 m^3/day for domestic use) for a period one month.
- Drilling phase
  - Approximately 60 m^3/day per well will be required for a period of 45-60 days,
  - Generation of produce water during drilling activity.
- Operation of Production facilities
  - Approximately 20 m^3/day per well will be required for a period of 45-60 days,

Embedded Controls

- Proper engineering controls for the drilling and cementing operations

Assessment of Impact: The potential impact on groundwater resource has been discussed in following section.

Abstraction of ground water: The required water for drilling activities will be sourced from ground water. As per CGWB ground water resource estimation, the stage of ground water development was only 15% for Dibrugarh district and 12% for Tinsukia district and the districts are reported under "safe" category.

Drilling is a temporary activity (approx 45-60 days) hence; impact on ground water resource will be low if OIL abstains from drawing water from the groundwater aquifers from which local people draw water. Additionally, OIL was also seek for alternate surface water sources, where available to reduce the requirement of groundwater.

Ground water cutting during drilling activity: The estimated depth of the drilling is 3950 m. During drilling activity, different aquifer will be intersected. The intersected ground water (formation water) will come out to surface with drill cuttings and mud. However, the well will be immediately protected by providing casing and cementing. This will prevent the ground water from being discharged from the aquifer. It is estimated that 7-10 m^3/day of formation water may be discharged during the drilling activity.

This quantity of formation water and abstracted water is very low compared to likely potential yields of aquifers hence the scale of impact is **low**. The geographical extent of potential impact due to withdrawal of water is anticipated to be **regional**, impact duration is expected to be **medium term i.e.** across some phases during the entire duration of the project. The sensitivity is **low**, as the water resource is categorized as safe by CGWB. The impact on ground water resources is assessed to be **minor** (*Ref.* ***Table 4.6:*** *Impact Significance Matrix without mitigation*).

4.2.10 Potential Impact on Ground Water Quality

Source of Impact: Potential impact on ground water quality could arise due to contamination from fuel & chemical storage, hazardous waste storage, cutting and waste mud storage.

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

- The drill cutting along with spent mud will be stored in HDPE lined pit.
- After the drilling activity, this waste pit will be capped by HDPE liner and soil will be put over it.
- Impervious storage area to be provided especially for fuel & lubricant, chemical, hazardous waste etc.

Impact Assessment: The potential impact on groundwater quality is discussed below:

Contamination from fuel, lubricant & chemical storage areas, drill cutting & waste mud storage and disposal area: Fuels, chemical lubricant etc., would be stored at a designated paved area within drill site. Thus, contamination of groundwater can happen due to accidental spillage of fuel, lubricants and chemicals from storage areas and during the transfer of fuels and chemicals.

The drill cutting and the spent mud would be stored in HDPE lined pits at site. Improper lining system or any puncture in the liner system can lead to the potential leakage of chemical like cadmium, mercury, etc. (present of mud chemical) and has potential to contaminate soil and subsequently ground water. Leachate will be generated, if the rainwater percolates into waste disposal area. This leachate can pass through the any puncture in the liner system and will have potential to contaminate the ground water.

Contamination during drilling of wells: The other impact on the groundwater quality will be due to the drilling activity. Water based mud will only be used as discussed in Section 2.6. Eco-friendly polymer mud system may also be used if required for deeper sections after providing intimation to the Pollution Control Board. Possibility of contamination of subsurface and unconfined aquifers may also exist if the casing and cementing of the well is not carried out properly leading to infiltration or seeping of drilling chemicals or mud into porous aquifer region.

Considering project embedded control measures, the scale of impact is considered to be ***low***. The geographical extent of potential impact due to above activity is anticipated is ***local;*** however, impact duration of impact is considered to be ***long-term-*** contamination may spread beyond lifecycle of the project. The impact magnitude is assessed to be **low**. The sensitivity is **high**, as the water is unpolluted and provides services as drinking water, domestic uses and irrigation for the area. The impact on ground water quality assessed to be **moderate.** (*Ref. **Table 4.6:** Impact Significance Matrix without mitigation*).

Mitigation Measures: The proposed mitigation measures are as follows:

- Prevent & mitigate spill of paint/fuel within the construction site;
- Conduct all the fuel transfer operations in paved areas;
- Regularly monitoring the ground water quality in the vicinity of the well sites.

Residual Impact: Considering the implementation of above mentioned mitigation measures, impact on ground water quality is assessed to be **minor** (*Refer **Table 4.7** Impact Significance Matrix with mitigation*).

4.2.11 Potential Impact Terrestrial Ecology

Potential Impact on Terrestrial Flora

Source of Impact: The potential impacts on terrestrial ecology may arise due to:

- Vegetation clearance;
- Fugitive dust emission and deposition on vegetation.

Embedded Control Measures: The control measures are as follows:

- Water sprinkling for dust suppression;
- Engineering control measures to minimise the noise level from construction machineries and equipment.

Impact Assessment: The potential impact on terrestrial ecology is discussed below:

Vegetation Clearance: The existing vegetation at the proposed drill sites, production installations, approach roads and RoU of the pipeline will be felled for site development.

The ecological survey in the study area reveals that the vegetation species composition in the non-forest areas (agricultural lands, homestead plantation and tea garden areas) comprise of planted species are common in the area. The cleared vegetation can be brought back to near original condition with plantation programme. The scale of impact can be considered as ***low***. No

facility is planned with forest area. Hence, for felling of trees the scale of impact would be ***low***.

Clearance of vegetation would happen in small area (approximately 3 ha. For each well, 4 to 7 ha for associated facilities and 10 m RoU for interconnected pipelines). Extent of impact will be within the project site; hence, extent of impact will be ***local***.

The clearance of vegetation and change of land use hence, duration of impact is ***long term***. Impact magnitude will be **small**.

The vegetation in the non-forest areas where the proposed facilities are planned comprise of planted species and the habitat cannot be considered as sensitive hence, the resource sensitivity would be **low**.

Overall impact significance would be **minor**.

Fugitive Emission: The fugitive emissions are likely to be generated during site construction and decommissioning phases. Due to relatively large particulate matter sizes associated with the fugitive emission from construction site and the relatively short release height of the pollutants, such negative impacts are usually confined in relatively small areas; estimated to be 100 to 200 m from the construction site. The deposited particulate matter may Khagorijan Filed the plant leaf stomata hence inhibiting gas exchange, or smother the plant leaf surfaces reducing photosynthesis levels. In the non-forest areas within the 200 m from the proposed project sites, there is no natural vegetation; the major vegetated area is the homestead plantations, tea garden and agricultural land.

Air Emission: The major pollutant from the operation of DG sets and flare stacks is NOx.

Nitrogen-containing air pollutants can affect vegetation indirectly, via. chemical reactions in the atmosphere, or directly after being deposited on vegetation, soil or water. The critical level is the concentration in the atmosphere above which these is direct adverse effects on receptors, such as plants, ecosystems. The Critical Levels for NO_2 is cited in 'Effects of nitrogen containing air pollutants: critical levels; Air Quality Guidelines – Second Edition[1]'.

Table 4.5 Critical Levels for NO_2

Concentration (µg/m³)	Exposure Time	Remarks
95	4 hours	The incremental value of NO_2 in ambient air during the current drilling programme clearly indicates that concentration will be below critical level.
30	Annual mean	
800	1 hour	
60	Growing season	
40	Winter	

[1] http://www.euro.who.int/__data/assets/pdf_file/0005/123098/AQG2ndEd_11no2level.pdf?ua=1

Source: WHO. 2000. Effects of nitrogen containing air pollutants: critical levels; Air Quality Guidelines – Second Edition

With respect to critical level value, the NO_2 levels in ambient air during the current drilling and production activities are expected to be low. Hence, the proposed drilling and production activities is not envisaged to cause damage to the vegetation in the area and the scale of impact will be ***low***. Duration of impact will be ***medium*** i.e. during the entire drilling phase and in some phases of the production operations and extent of impact will be ***regional*** as emission from DG/GG sets may reach a distance of 2-3 km (refer ***Table 4.3***). The impact magnitude is assessed to be **medium**.

The tree species present in the non –forest and forest area in proximity to the well sites and production facilities are common and does not represent any ecosensitive habitat hence the resource sensitivity would be **low**. Overall impact on terrestrial flora is assessed to be **minor** (*Ref. **Table 4.6:** Impact Significance Matrix without mitigation*).

Mitigation Measures

A range of measures will be adopted during drilling/production activities to mitigate potential impacts on the terrestrial flora including the following.

- The working area which has to be disturbed will be kept minimum at all times;
- Sourcing of timber and fuel wood from forest area will be prohibited;
- Regular maintenance of vehicles and machineries to control noise and air pollutant emission;
- All diesel-powered equipment will be regularly maintained and idling time reduced to minimise emissions;
- Low sulphur diesel (S<0.5%) 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 will be serviced/ replaced;
- Fugitive dust will be suppressed with periodic water sprinkling.

Residual Impact: Considering the above mentioned mitigation measures, the residual impact on terrestrial flora is assessed to be **minor** (*Refer **Table 4.7** Impact Significance Matrix with mitigation*).

Potential Impact on Terrestrial Fauna

Source of Impact: The potential impacts on terrestrial fauna may arise due to:

- Vegetation clearance;
- Illumination from site;
- Noise & vibration.

Embedded Control Measures: The control measures are as follows:

- Water sprinkling for dust suppression;
- Engineering control measures to minimise the noise level from construction machineries and equipment.

Impact Assessment: The potential impact on terrestrial fauna is discussed below:

Vegetation Clearance: Vegetation clearance from the drill sites, production facilities, access roads and pipeline RoU will cause loss of habitat for the terrestrial fauna. In the non-forest areas 9 wells & 1 production installation are located in agriculture areas, 8 wells in homestead plantation areas and 26 wells in tea garden areas, with very low/scattered vegetation hence vegetation clearance is not expected to cause habitat fragmentation for the faunal species. Moreover, only IUCN threatened species found particularly at the non- forest area is Common Leopard which is reported from the tea garden areas.

Clearance of vegetation would not disturb the species composition of the area and clearance would happen in small area (approximately 3 ha. for each well, 4-7 ha. for production installation and 10 m RoU for pipelines). The scale of impact can be considered as ***small***.

Extent of impact will be within the project site; hence, extent of impact will be ***local***. The clearance of vegetation will present ***long term*** impact as the vegetation could not be recovered easily. Impact magnitude will be **small**.

The sensitivity of species at the non-forest area would be **medium** as few Schedule I species and IUCN threatened species Common Leopard may experience the impact.

Overall impact significance on terrestrial fauna would be **minor** (*Ref.* ***Table 4.6:*** *Impact Significance Matrix without mitigation*).

Noise Emission & Illumination: The proposed drill sites and production installations will be located in rural settings and tea garden areas. Noise generated from various operational activities from the proposed locations during the drilling phase in presence of fence line barrier (*refer Potential Impact on Noise Quality Section 4.2.6*) is expected to get attenuated to baseline levels within 200-300 m from the locations. As there is no natural wildlife habitat within 300 m of proposed drill sites and production facilities the incremental noise levels is not expected to cause significant disturbance to faunal species.

The drill site would be illuminated with artificial lighting as drilling is conducted continuously for 24 hours and thus may cause significant alternation of existing illumination levels in the area and it may cause disturbance to the faunal species.

Podumoni section of the BBPWLS and DSNP is located at a minimum distance of 1.3 km and 1.6 km respectively from the nearest well sites. Hence impact due to noise and illumination from the drill sites is not expected to cause any disturbance to the terrestrial fauna at the abovementioned ecologically protected areas.

Ecological baseline study reveals that, few Schedule I and IUCN threatened species are likely to be present within the non-forest areas hence, the sensitivity of ecological habitat is considered as **medium**.

The scale of impact is considered to be **medium** as disturbance to fauna may occur due to noise, vibration and illumination from the drill site may affect the faunal species within the Khagorijan Field; and noise may affect the fauna within 200-300 m of the drill sites and production facilities.

The extent of impact is considered to be **regional** i.e. within 5 km of the proposed drill sites and production facilities. The duration of impact will be **medium-term** during the entire drilling phase. The magnitude of the ecological impact would be **medium**.

The impact significance on terrestrial fauna is thus assessed to be **moderate.**

Mitigation Measures

A range of measures will be adopted during construction and drilling and production activities to mitigate potential impacts on the terrestrial fauna, including the following.

- OIL will obtain clearance from the Standing Committee of the National Board of Wildlife for the wells and production facility located within 10 km of DSNP and BBPWLS prior to site developmental activities.
- The working area which has to be disturbed will be kept minimum at all times;
- Sourcing of timber and fuel wood from natural vegetated area will be prohibited;
- Regular maintenance of vehicles and machineries to control noise and air pollutant emission;
- All diesel-powered equipment will be regularly maintained and idling time reduced to minimise emissions;
- Restrict all noise generating operations, except drilling, to daytime;
- Fugitive dust will be suppressed with periodic water sprinkling;
- Provide noise barrier in sensitive locations;
- Appropriate shading of lights to prevent scattering;
- The movement of construction vehicles will be minimised and a speed of 20 km/hr will be enforced along the access and approach roads.

<u>*Residual Impact*</u>: Considering the above mentioned mitigation measures, the residual impact on terrestrial fauna would be **minor** (*Refer **Table 4.7** Impact Significance Matrix with mitigation*).

4.2.12 Impact on Aquatic Ecology

Source of Impact: Impacts to the aquatic habitat during construction phase may happen due to:

- Discharge of untreated surface runoff;
- Discharge of wastewater from (wash water from machineries & equipment; drilling wash water) drill site;
- Discharge of domestic water.

Embedded Control Measures: The control measures are as follows:

- Treatment of domestic waste water through septic tank and soak pit;
- Storage of diesel, lubricant and waste oil in paved surface with secondary containment;
- Treatment of process effluent and re-use in the process.

Impact Assessment:

Surface Runoff: Surface runoff from the drill sites contaminated with sediment, site may reach Brahmaputra River, Dangori River, Dinjan River etc. through small drainage channels and increase the suspended solids load of the river water. Increase of suspended solid will increase the turbidity of river water that ultimately will adversely affect the Dissolved Oxygen (DO) level in the water. The turbid water and lower DO will affect the primary productivity of the impacted areas of the rivers.

During site development and drilling activities, production activities operation of machineries and vehicles will take place at site. For the operation of construction machineries and vehicle, oil (diesel) and lubricant will be utilised; accidental spillage and leakage of oil and lubricant is likely to be mixed up with surface runoff. The discharge of oil and grease contaminated runoff water without treatment has the potential to impact water quality of the receiving waterbody. The degradation of water quality will affect the primary productivity of the river.

Discharge of Effluent/Drilling Wastewater/Formation water: The process effluent will be adequately treated in the ETP to meet the industrial effluent discharge standards. The discharge of treated effluent is not expected to cause perceptible changes in the water quality of the river.

Accidental discharge of formation water to the local small channels may reach Brahmaputra River, Dangori River, Dinjan River etc. and have the potential to affect the river water quality.

Discharge of Domestic Wastewater: The domestic wastewater will be treated through septic tank and soak pit; hence, water pollution due to domestic wastewater is envisaged.

The extent of impact will be **regional** as surface run-off, discharge of treated wastewater and formation water from the drill sites may reach Brahmaputra River, Dangori River, Dinjan River etc. through small streams. The duration of impact will be **short term**; i.e. only during monsoon season. The discharge of pollutants if reaches the river water may cause affect and affect the productivity; however, the system could revert to its original condition after the settling of the suspended solids. Oil and chemicals present in the surface runoff will be lower in volume and diluted after reaching the large waterbodies *viz.* Brahmaputra River, Dangori River, Dinjan River etc. Oil and chemical may be deposited at the benthic ecosystem of the rivers hence the scale of the impact would be **medium**. The impact magnitude is assessed to be **small**.

The rivers mentioned above provides habitat to fish. Discharge of surface runoff, formation water from the well site may reach the rivers and affect the sediment load, productivity of the river water and cause habitat disturbance to the aquatic species. The IUCN Endangered species Gangetic Dolphin is reported in Brahmaputra River and its tributaries. Discharge of surface runoff, formation water from the well site may reach the rivers and affect the sediment load, productivity of the river water and cause habitat disturbance to the aquatic species. Hence the sensitivity of the habitat is assessed to be **high.**

The potential impact on aquatic ecology due to abovementioned activity is assessed to be **moderate**.

Mitigation Measures

A range of measures will be adopted to mitigate potential impacts on the ecology and biodiversity, including the following:

- Earth works and other construction activities during heavy rains to be avoided;
- All accidental discharges would be controlled before it reaches any surface water body through sedimentation tank and oil-water separator;
- Spill kits to be used for removal of any oil or chemical spillage on site;
- All process and domestic wastewater would be adequately treated before discharge;
- Additional storage area to be provided to store formation water within the drill site;
- Proper monitoring of indicator species will be carried out and compared to baseline conditions to understand any negative impacts.

Residual Impact: The residual impact on aquatic ecology and biodiversity is still considered to be **moderate** (*Refer **Table 4.7** Impact Significance Matrix with mitigation*).

4.2.13 Potential Impact on Socio-economic Environment

A socio economic assessment of the positive and negative impacts on the people likely to be directly and indirectly affected by the project was conducted 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 OIL's commitment towards the Corporate Social Responsibility (CSR) initiatives.

The assessment of socio-economic impacts due to the proposed drilling and production activity have considered the following context and project activities:

- New land will be purchase for the proposed drilling activity, construction of production facility and road infrastructure for transport of plant and machineries however, no physical displacement due to land purchase is envisaged;
- There will be incremental change in the workforce during construction and operations phase. A majority of the workforce is likely to be from the local areas.

Source of Impact

- Loss of livelihood/Income due to land purchase
- Conflict with Local People

Embedded Control Measures

- OIL follow the compensation calculation procedure of Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013 (LARR Act of 2013) and that is highest land value they offer to the land owner;
- For the assets over the land OIL, provide surface compensation to the landowner as per the Assets Rate List of concerned district authority;
- They also provide a land seller certificate to Land Owner that helps land owner and his family member to get job in OIL in the future under land seller quota;
- If any landowner is not agreeing to sell to land to OIL and this land is extremely important to OIL then they acquire this land through govt. land acquisition process;
- OIL organize continuous consultation with the local people and also timely disclosure of project activities;

- OIL has established grievance redressal process to deal with conflict with local communities.

Assessment of Impacts

Loss of livelihood /income: As discussed in *Section 4.2.1*; 54 wells will be drilled and 2 production facilities and with associated road infrastructure will be constructed in different location within Dibrugarh and Tinsukia districts. Approximately 3 ha. land would required for drilling and 4-7 ha for production facilities which will be purchased from local communities. Discussion with OIL officials reveals that mostly agricultural, tea garden and homestead plantation land will be selected and no physical displacement during land procurement is anticipated. Affected landowners will be adequately compensated for the land parcels, any assets over the land and for the standing crop.

Community consultation reveals that the dependency of the landowner in case of generation of livelihood is limited as most of the agricultural land in this region is classified as monocropped agricultural land hence the resource sensitivity is ***medium***. As discussed, only 3 ha land for a drill site and 4to 7 ha. land for a production facility will be procured from different location within the Dibrugarh and Tinsukia districts hence extent of impact would be ***local***. Land procurement will cause permanent change of land use hence the scale of impact would be ***high*** and duration would be ***permanent***. Impact magnitude is assessed to be **medium.** The impact significance would be **moderate**. However, adequate compensation will be provided for land parcels, the significance of the impact will be reduced to **minor**

Conflict with Local People: Consultations in the neighbouring villages indicate that the people in the area look forward to new employment to be generated by the project. Even though OIL/its contractors would endeavour to provide maximum employment to the local people, there would be constraints due to the lack of required technical skills and expertise in the local population. So, certain percentage of semi-skilled and highly skilled migrant labour would be used by contractors for manning these activities. It is anticipated that occasional conflicts would arise with the local community over the recruitment of migrant workers.

Conflict with local people may also arise due to different project activities *viz*. movement of vehicles, generation of dust and noise due to project activities, surface water discharge to nearby agricultural fields, use and damage of common property resources etc. The receptor significance would be **high** as drill site and access road is located in close proximity to habitated area. The scale of the impact would be ***medium*** as people in this region are familiar with the oil and gas-drilling activities. Apart from that, OIL also has structured grievance redressal procedure to deal with the community conflicts. The extent of the impact would be ***local*** as it would be limited to immediate vicinity of the sites selected for drilling activity and production facility and

access roads. The duration of the impact would be ***short term*** as conflict may arise at any point of time during the project activity; however, the same is expected to be addressed through active grievance redressal system of OIL. The magnitude of impact is assessed to be **small**. The significance of impact would be **moderate** (*Refer **Table 4.6** Impact Significance Matrix without mitigation*).

Mitigation Measures

- Communication in the nearby villagers during the construction phase and the installation of an effective grievance redressal mechanism;
- Migrant labours would be provided training on local culture and traditions;
- Labours to be provided with proper sanitation facilities.

Residual Impact: Considering the above-mentioned mitigation measures the residual impact will remain same, i.e. **moderate** (*Refer **Table 4.7** Impact Significance Matrix with mitigation*).

Loss of Livelihood and Fragmentation of Land Due to Pipeline Laying

Maximum 10 meter RoU will be required for laying of oil pipeline and as per planning majority of the pipeline will be routed through agricultural land and tea garden areas. However, the land required for RoU of the pipeline will not be purchased and it will remain with the land owner for future agricultural use. The land will also be compensated for the standing crop on the land hence the resource sensitivity will be ***low***.

Parcels of land along the proposed RoU for laying of oil pipeline may get fragmented due to the linear nature of the oil/gas pipeline. This may either lead to partial loss of cultivable land or even creation of orphan lands which may be rendered too small or unviable for cultivation for agriculture. However, all the agricultural land in this area are mono cropped in nature i.e. the agricultural activity is limited to three to four month in a year. Moreover, laying of pipeline would take 3-4 months only and land could be used for agriculture after the laying of the pipeline. Hence, the receptor sensitivity will be ***low***.

As this impact is limited to the oil pipeline laying site hence the impact extent will be ***local*** and duration will be ***short term*** as it is limited to construction period. It is understood that land owner can use this land for agriculture purpose once the construction activity will be over hence the scale of the impact will be ***low*** and the magnitude and significance of the impact will be ***negligible.***

Benefit to Local Enterprises

The project is likely to influence development of entrepreneurs in the area. The local enterprises, particularly involved in production and sale of

construction materials are expected to be potential benefactors of the civil works to be undertaken for the project. Similarly, local transporters of construction materials will also benefit from the project.

Employment Generation

The construction phase of the project is likely to generate both direct and indirect opportunities for employment. The estimated direct employment would be approximately 50 un-skilled workers during the peak construction phase that will primarily sourced from nearby villages. Indirect employment would be primarily in the supply chain as vendors, which are anticipated to be set up to support the construction. The local people are expected to be having options for such indirect employment, even if they are not directly involved as construction labour. Overall construction activity would have positive impact on the socio-economic conditions in general and employment scenario in particular in the study area.

4.2.14 Potential Impact on Occupational Health & Safety

Construction Phase

Source of Impact Occupational health and safety impacts during construction 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 machineries/equipment and fugitive dust generated from material stockpiles, earth works and vehicular emission. It is estimated that about 50-60 workers will be deployed by the contractor at each drill site and 10-20 workers in the production facility. The outstation project workforce will 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 is limited to the well site and production facility only hence the impact will be ***local***. Also considering the temporary nature of the construction phase activities, intermittent operation of machineries/equipment duration will be ***short term*** and with provision of

proper PPEs and training for the workers scale of the impact will be ***low***. Hence, the impact magnitude for occupation health and safety due to above mentioned construction activities is assessed to be ***medium and*** significance would be ***moderate*** (*Refer* ***Table 4.6*** *Impact Significance Matrix without mitigation*).

Mitigation Measures

The mitigation measures are as follows:

- Provision of healthy living conditions will be ensured in the contractor labour camp as per National Policy on Safety, Health & Environment at Work Place;
- Exposure of workers operating near high noise generating sources will be reduced to the extent possible;
- Health surveillance of contractor workforce will be conducted;
- Occupational health and safety of contractor workforce will be assured through the formulation of an "Occupational Health & Safety Management Plan".

Residual Impact: Considering the implementation of above mentioned mitigation measures, impact on occupational health and safety is assessed to be **minor** (*Refer* ***Table 4.7*** *Impact Significance Matrix with mitigation*).

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 will be identified;
- Permit to work system to be in place;
- Provision of PPE's to all workers.

Assessment of Impact:

Major occupational health risks encountered in proposed drilling activity include noise from drilling activity, operation of heavy vehicles and machinery, handing 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 is limited to the well site only hence the impact will be ***local***. As the drilling

activity will be continues maximum up to 3 months and intermittent operation of machineries/equipment duration will be ***short term*** and with provision of proper PPEs and training of the workers scale of the impact will 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*** (*Refer* ***Table 4.6*** *Impact Significance Matrix without mitigation*).

Production Facility

Main impact on occupational health safety in production facility will 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 upto 10 persons and it is understood that they will be trained. Hence, the resource sensitivity will be ***medium***. As all the activity of production facility will be carried out within secure premise extent of impact will be ***local***. The production installation will be **permanent** in nature and continues its operation up to 20 years hence the impact will be permanent in nature. As the risk level of a production facility is high as it is handling highly inflammable hydrocodone embedded control of any production facility is very strong so the scale of the impact will be ***medium***. Hence, the magnitude of the impact will be ***medium*** and significant of the impact is assessed to be ***moderate*** (*Refer* ***Table 4.6*** *Impact Significance Matrix without mitigation*).

Mitigation measures: The mitigation measures are as follows:

- Regular onsite surveillance to be conducted so that the workers use the designated PPEs all the time;
- Health surveillance will be conducted of personnel working in the aforesaid areas;
- Regular health and safety training to be provided to workers.

Residual Impact: Considering the implementation of above mentioned mitigation measures, impact on occupational health and safety is assessed to be **minor** (*Refer* ***Table 4.7*** *Impact Significance Matrix with mitigation*).

4.2.15 Potential Impact on Community Health and Safety

Source of Impact: The community health and safety impacts may arise due to:

- Changes in environmental quality;
- Influx of non-resident workers to the area;
- Movement of project traffic.

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

- Engineering control measures to minimize the noise level from construction machineries;
- Dust suppression measures.

Dust and Noise Discomfort

Several rural settlements are present in proximity to the well sites and production facilities. Inhabitants residing close to site and access roads will get affected due to noise and dust generated from vehicular movements, site preparation operation of machineries, construction activities etc. The construction noise level will be attenuated within 200 m from the construction site. Incremental noise level will remain within the ambient noise quality standard for residential area. The scale of impact is assessed to be **low.**

Influx of non-residential workers

Approximate 50 workers will be employed during the construction phase of the project and it is anticipated that about 50% of the workers would be non-locals. The influx of workers to the community may cause impacts to public health, especially an increase in prevalence of diseases. Influx of migrant labours during construction can cause mixing of the migrant workforce with the local people. This mixing of the groups may cause some adverse impacts to public health in the neighbouring villages with the potential for spread of infectious diseases.

Improper sanitation facilities and disposal of municipal solid waste from the construction labour camps can also trigger vector borne diseases. Measures such as proper collection, storage and disposal of wastes, construction of septic tanks to prevent contamination of water resources from sanitary effluents generated from labour camps will be implemented. Taking these measures into account, the scale of impact is assessed to be **low**.

Traffic Movement in site approach road

An increase in traffic during the peak construction activities and may create public safety issues for local residents. Potential impacts may include blocking access, congestion and traffic accidents along the approach road. With mitigation measures as speed control in place the scale of impact to communities from heavy vehicular movement is assessed to be **low.**

As mentioned above that most of the well site, production facility and access road will be located adjacent to the habitation area hence the receptor sensitivity will be ***high***. However all the drill site and production facility will be stand alone and any impact arises from the facility will be affect the nearby area of the drill site hence the extent of the impact will be **local**. It is understood that all the impact will be limited to the construction phase and affect will be over after completion of the construction hence the duration of the impact will be ***short term***. It can also be anticipated that with proper embedded controls, the impact will be very limited hence, the scale of the impact will be ***medium***. Then the impact magnitude on community health and safety due to above mentioned activities is assessed to be ***medium*** and significance of impact will be ***moderate*** (*Refer* ***Table 4.6*** *Impact Significance Matrix without mitigation*).

Mitigation Measures

The following mitigation measures will be put in place to reduce impacts to community to as low as reasonably practicable:

- Emphasizing safety aspects among drivers, particularly with regard to safe driving speeds;
- Ensuring that only licensed drivers are employed by the project;
- Avoiding peak hours for heavy vehicles movement where possible;
- Regular maintenance of vehicles and use of manufacturer approved parts to minimize potentially serious accidents caused by equipment malfunction or premature failure;
- Collaboration with local communities and responsible authorities to improve signage, visibility and awareness of traffic and pedestrian safety.

Residual Impact: Considering the above mentioned mitigation measures, the residual impact on community health and safety is assessed to be ***minor*** (*Refer* ***Table 4.7*** *Impact Significance Matrix with mitigation*).

Table 4.6 Impact Significance Matrix without Mitigation Measures

Impact	Nature			Type			Duration			Extent			Scale			Magnitude						Sensitivity			Significance			
	Negative	Positive	Neutral	Direct	Indirect	Induced	Shor term	Medium term	Long term	Local	Regional	National	Low	Medium	High	Positive	Negligible	Small	Medium	Large	Low	Medium	High	Negligible	Minor	Moderate	Major
Aesthetic & visual	■			■			■		■	■				■					■			■				■	
Land Use	■			■					■	■			■					■			■			■			
Soil Quality	■			■				■		■				■					■			■				■	
Air Quality	■			■				■			■			■					■			■				■	
Noise Quality	■			■				■		■					■				■				■				■
Road & Traffic	■			■				■			■			■					■			■				■	
Surface Water Quality	■			■			■				■			■				■					■		■		
Ground water resource	■			■				■			■		■					■			■				■		
Ground Water Quality	■			■				■			■			■					■			■				■	
Terrestrial Flora	■			■				■		■	■		■	■				■	■		■			■	■		
Terrestrial Fauna	■			■				■		■	■		■	■				■	■			■		■		■	
Aquatic Ecology	■			■	■		■				■			■				■					■			■	
Livelihood & Income generation	■			■	■				■	■					■				■			■				■	
Conflict with local people	■			■	■			■		■				■				■					■			■	
Benefit to Local Enterprises		■		■	■				■		■					■											
Employment Generation		■		■	■		■				■					■											
Occupationa l health & safety	■			■				■		■				■				■				■			■		
Community health & safety	■			■	■			■			■			■					■			■				■	

Table 4.7 Impact Significance Matrix with Mitigation Measures

Impact	Nature			Type			Duration			Extent			Scale			Magnitude				Sensitivity			Significance			
	Negative	Positive	Neutral	Direct	Indirect	Induced	Shor term	Medium term	Long term	Local	Regional	National	Low	Medium	High	Positive	Negligible	Small	Medium	Large	Low	Medium	High	Negligible	Minor	Moderate	Major
Aesthetic & visual	■			■			■			■			■					■				■			■		
Land Use	■			■					■	■			■					■			■			■			
Soil Quality	■			■				■		■			■					■				■			■		
Air Quality	■			■				■			■		■					■				■			■		
Noise Quality	■			■				■		■			■					■					■			■	
Road & Traffic	■			■			■				■		■					■				■			■		
Surface Water Quality	■			■			■				■		■					■					■		■		
Ground water resource	■			■				■			■		■					■			■				■		
Ground Water Quality	■			■				■			■		■									■			■		
Terrestrial Flora	■			■				■			■		■					■			■		■		■		
Terrestrial Fauna	■			■				■			■		■					■			■		■		■		
Aquatic Ecology	■			■	■		■				■		■					■					■			■	
Livelihood & Income generation	■			■	■				■					■					■			■				■	
Conflict with local people	■			■	■			■		■			■					■					■			■	
Benefit to Local Enterprises		■		■	■				■		■																
Employment Generation		■		■	■		■				■																
Occupational health & safety	■			■				■		■				■				■				■					
Community health & safety	■			■	■			■			■		■					■				■					

5 ANALYSIS OF ALTERNATIVES

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 analysed to understand what would be reasonably expected to occur in the near future if the proposed drilling and production of hydrocarbons 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 and indirect economic benefits that such a project can provide.

Oil and gas exploration activities will lead to discovery of new hydrocarbon reserves in the country leading to energy security for the country; provision of more royalty to Assam Government and Government of India; increase in employment and business opportunity for the local people; development of infrastructure (roads, culverts, bridges, schools etc.) in the area.

In case of no project scenario, there would not be any production of the untapped hydrocarbon reserves of Khagorijan Field. There would also be no opportunity of employment and induced development associated with the drilling and production activities in the area. Thus, the proposed project scenario involving the drilling and production of hydrocarbons is considered to be a preferred scenario compared to no project scenario.

6 ENVIRONMENTAL MONITORING PROGRAMME

Monitoring is one of the most important components of a management system. Continuous monitoring needs to be carried out for regulatory requirements, to monitor the environmental quality and to determine performance of proposed mitigation measures. Monitoring indicators have been developed for each of the activity considering the mitigation measures proposed. Indicators have been developed for ascertaining the environmental quality and performance of the EMP implementation through Environmental Quality Indicators (EQI's) and Environmental Performance Indicators (EPI's) respectively which focus not only on quantifying or indexing activity-environment interactions that may potentially impact the environment but at the same time also help in comparing different components of environmental quality against previously established baseline values. Monitoring results will be documented, analyzed and reported internally to GM – Safety & Environment of Safety and Environment (S&E) department of OIL. 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 Monitoring Program for Drilling of Well, Production facilities and Pipelines

A) Environmental Performance Monitoring

EPI No.	Environmental Performance Indicator (EPI)	Monitoring Parameter	Location	Period & Frequency	Responsibility
A.	**Design & Planning**				
A.1	Proximity of sensitive environmental habitat	Distance between the drill site and sensitive environmental habitat	Site	Once in project lifecycle	OIL/Contractor
A.2	Proximity of nearest habitation	Distance between the drill site and nearest habitation	Site	Once in project lifecycle	OIL/Contractor
A.3	Flood History	HFL at site Return period of major floods	Site	Once in project lifecycle	OIL/Contractor
A.4	Location and land required	Number of land owners affected Total area procured for drill site (Ha)	Site	Once in project lifecycle	OIL/Contractor
A.5	Approval / Authorization of quarries	Validity of the Approval / Authorization	Quarry	Once in project lifecycle	OIL/Contractor
A.6	Land use	Land use type	Quarry/ Borrow Area	Once in project lifecycle	OIL/Contractor.
A.7	Haul Routes	Distance of quarry / borrow area from project site Condition of haul road	Quarry / Borrow Area	Once in project lifecycle	OIL/Contractor
B.	**Site Development**				
B.1	Topsoil stripping and storage	Area occupied for topsoil storage/ Area planned for topsoil storage	Site	Once during each site preparation	OIL/Contractor
B.2	Local drainage pattern	Number of Cross Drainage structures constructed to actual number of cross drainage structures designed	Site	Once in project lifecycle	OIL/Contractor
B.3	Fugitive emission of dust during site preparation	Visual observation of dust in air by haziness	Site & approach roads	Daily during site preparation	OIL/Contractor
B.4	Air emissions from vehicles and machinery	$PM_{2.5}$, PM_{10}, NOx, SO_2, CO, HC, VOC based on emission factors Visual observation of emissions (black signifying more pollution) % of vehicles possessing valid PUC Certificates	Exhausts	Once in project lifecycle Daily Once in project life cycle	OIL through Contractors operating vehicles
B.5	Noise emissions from vehicles and machinery	Noise pressure level in dB(A) near noise sources (5m)	Site & approach road	Daily during site preparation	OIL/Contractor

EPI No.	Environmental Performance Indicator (EPI)	Monitoring Parameter	Location	Period & Frequency	Responsibility
B.6	Accident reporting	Number of casualties / Number of fatalities	Site & Haul Routes	During life cycle of project	OIL/Contractor
B.7	Fugitive emission of dust during material handling and storage	Visual observation of dust in air by haziness	Near stockpiles and storages	Daily during the entire project life-cycle	OIL/Contractor
C.	**Drilling & Testing**				
C.1	Gaseous pollutant emissions from DG Set	Pollutant concentrations in gaseous emissions and maintenance parameters (air, fuel filters & air-fuel ratio) of DG sets influencing air emissions Visual observation of exhaust smoke characteristics	DG Stack	Monthly during drilling & testing Daily during drilling & testing	OIL/Contractor
C.2	Noise emission from DG Sets	Noise pressure level in dB(A)	Near noise sources (5m)	Monthly during the entire project life-cycle	OIL/Contractor
C.3	Noise emission from rig	Noise pressure level in dB(A) Number of cases of workers not using PPE	On the rig floor Near noise sources (5m) Site	Monthly during drilling Monthly during drilling	OIL/Contractor
C.4	Accident reporting	Number of casualties / Number of fatalities	Site	As and when accident occurs	OIL/Contractor
C.5	Spilled Chemicals/Oil	Area of Spill / Quantity Spilled / Severity of Spill / Characterization of Spilled Substances for Contaminants (Heavy Metals, Toxics, etc.)	Site	As and when spills occur	OIL/Contractor
C.6	Fugitive emission of cement dust during handling and storage	Visual observation of cement dust in air by haziness	Near stockpiles and storages	Daily during the entire project life-cycle	OIL/Contractor
C.7	Runoff from temporary storage areas	Supervision of functioning of conduits / drains, channels	Site	Fortnightly during drilling phase	OIL/Contractor
C.8	Emissions from Flaring	Total CO, total hydrocarbon, Non-Methane Hydrocarbons, NOx emission estimates based on emission factors	Flare Stack	As and when flaring occurs	OIL
C.9	Wastewater quantity & quality (Process water viz. rig wash, formation water etc.)	Volume estimate CPCB General discharge parameters and Oil & Gas Extraction Industry Standards	At discharge point	Weekly during drilling Quarterly during drilling	OIL/Contractor

EPI No.	Environmental Performance Indicator (EPI)	Monitoring Parameter	Location	Period & Frequency	Responsibility
C.10	Storm water/wash down water discharge	CPCB General discharge parameters and Oil & Gas Extraction Industry Standards	At discharge point	Depending on generation particularly during monsoon	OIL/Contractor
C.11	Drill cutting storage and disposal	Total volume generated Concentration of hazardous constituents as per Hazardous Waste Management and Handling Rules CPCB Onshore discharge standards for Oil & Gas Extraction Industry	At storage location	Once during drilling period	OIL/Contractor
D.	**Decommissioning/ Site Closure**				
D.1	Noise pressure level in dB(A)	Near noise sources (5m)	Site & Approach road	Once per site	OIL/Contractor
D.2	Air emissions from vehicles	Standards of vehicular emission Visual observation of emissions (black signifying more pollution)	Exhausts	Once in project lifecycle Daily	OIL/Contractor
D.3	Fugitive emission of dust during transport of drilling facilities	Visual observation of dust in air by haziness	Near stockpiles and storages	Daily during the entire activity	OIL/Contractor
E.	**Operation of Production facilities**				
E.1	Any discharge of effluent	CPCB General discharge parameters and Oil & Gas Extraction Industry Standards	At discharge point	Depending on generation particularly during monsoon	OIL/Contractor
E2	Gaseous pollutant emissions from GG Set	Pollutant concentrations in gaseous emissions of GG sets	GG Stack	Once per six months	OIL/Contractor
E.2	Noise Emission	Noise pressure level in dB(A)	High noise generating equipment	Once per six months	OIL/Contractor

B) Environmental Quality Monitoring

EQI No.	Environmental Performance Indicator (EQI)	Monitoring Parameter	Location	Period & Frequency	Responsibility
A.	**Site Development for Wells, Production facilities and Pipelines**				
A1	Soil Fertility	Fertility parameters like pH, NPK ratio, Total Carbon, etc.	Site & adjacent areas- three locations	Once before site preparation	OIL/Contractor
A2	Quality of water	Analysis of Parameters as per CPCB Use-class	Natural drainage channel receiving run-off discharges; 1-2 location, based on availability	Once during site works	OIL/Contractor
A4	Ambient Air Quality	Measurement of PM_{10}, $PM_{2.5}$, NOx, SO_2, CO, HC using ambient air sampler	At Surrounding receptor points; three	Once during site works	OIL/Contractor
A5	Ambient noise quality	Hearing / perception Measurement of Noise Pressure Level in dB(A)	At surrounding receptor points – three locations	Once during site works	OIL/Contractor
A6	Soil Contamination	Analysis for suite of contaminants (heavy metals, TPH, organics, pesticides).	Site, adjacent areas and Waste disposal site	In event of spills over an area of 10 sq.m	OIL/Contractor
B.	**Drilling & Testing**				
B1	Ambient Air Quality	Measurement of PM_{10}, $PM_{2.5}$, NOx, SO_2, CO, HC using ambient air sampler	At Surrounding receptor points– three locations	Twice during drilling and testing	OIL/Contractor
B2	Stack Emission Monitoring	Measurement of PM_{10}, $PM_{2.5}$, NOx, SO_2, CO, HC	At three DG sets within drill site	Once during drilling	OIL/Contractor
B3	Ambient noise quality	Hearing / perception Measurement of Noise Pressure Level in dB(A)	At surrounding receptor points- three locations	Twice during drilling and testing	OIL/Contractor
B4	Workplace Noise Monitoring	Hearing / perception Measurement of Noise Pressure Level in dB(A)	5 locations within drill site	Twice during drilling and testing	OIL/Contractor
B5	Soil Contamination	Analysis for suite of contaminants (heavy metals, TPH, organics, pesticides).	Site, adjacent areas and Waste disposal site	In event of spills over an area of 10 sq.m; once after drilling	OIL/Contractor
B5	Quality of water	Analysis of Parameters as per CPCB Use-class	Natural drainage channel receiving run-off discharges – 3 locations	Once during drilling & testing	OIL/Contractor

EQI No.	Environmental Performance Indicator (EQI)	Monitoring Parameter	Location	Period & Frequency	Responsibility
B6	Treated water quality	Analysis of Parameters as per CPCB Discharge Standards for Oil and Gas Industry	Two from ETP and one from oil water separator	Once during drilling & testing	OIL/Contractor
B7	Groundwater Quality	Analysis of Parameters as per IS:10500, 2012	At surrounding receptor points- three locations	Once during drilling & testing	OIL/Contractor
C.	**Decommissioning / Closure**				
C1	Ambient noise quality	Hearing / perception Measurement of Noise Pressure Level in dB(A)	At surrounding receptor points- three locations	Once during decommissioning	OIL/Contractor
C2	Quality of water	Analysis of Parameters as per CPCB Use-class	Natural drainage channel receiving run-off discharges	Once after decommissioning	OIL/Contractor
C3	Ambient Air Quality	Measurement of PM_{10}, $PM_{2.5}$, NOx, SO_2, CO, HC , using ambient air sampler	At Surrounding receptor points– three locations	Once during decommissioning	OIL/Contractor
C4	Soil Fertility	Fertility parameters like pH, NPK ratio, Total Carbon, etc.	Site & adjacent areas- three locations	Once after site restoration	OIL/Contractor
D.	**Operation of Production facilities**				
D.1	Ambient noise quality	Hearing / perception Measurement of Noise Pressure Level in dB(A)	At surrounding receptor points within 1 km- three locations	Once every six months	OIL/Contractor
D.2	Workplace Noise Monitoring	Hearing / perception Measurement of Noise Pressure Level in dB(A)	5 locations within drill site	Once every six months	OIL/Contractor
D.3	Ambient Air Quality	Measurement of PM_{10}, $PM_{2.5}$, NOx, SO_2, CO, HC , using ambient air sampler	At Surrounding receptor points– three locations	Once every six months	OIL/Contractor
D.4	Quality of water	Analysis of Parameters as per CPCB Use-class	Natural drainage channel receiving run-off discharges	Once every six months	OIL/Contractor
D.5	Groundwater Quality	Analysis of Parameters as per IS:10500, 2012	At surrounding receptor points- three locations	Once every six months	OIL/Contractor
D.6	Soil Fertility	Fertility parameters like pH, NPK ratio, Total Carbon, etc.	Site & adjacent areas- three locations	Once every six months	OIL/Contractor

EQI No.	Environmental Performance Indicator (EQI)	Monitoring Parameter	Location	Period & Frequency	Responsibility
D.7	Treated water quality	Analysis of Parameters as per CPCB Discharge Standards for Oil and Gas Industry	Two from ETP and one from oil water separator	Once every six months	OIL/Contractor

7 ADDITIONAL STUDIES

7.1 QUANTITATIVE RISK ASSESSMENT

This section on Quantitative Risk Assessment (QRA) aims to provide a systematic analysis of the major risks that may arise from 54 onshore well drilling and laying of oil and gas pipeline in Khagorijan Block. The QRA process outlines rational evaluations of the identified risks based on their significance and provides the outline for appropriate preventive and risk mitigation measures. Results of the QRA provides valuable inputs into the overall project planning and the decision making process for effectively addressing the identified risks. This will ensure that the project risks stay below As Low As Reasonably Practicable (ALARP) levels at all times during project implementation. In addition, the QRA will also help in assessing risks arising from potential emergency situations like a blow out and develop a structured Emergency Response Plan (ERP) to restrict damage to personnel, infrastructure and the environment.

The risk study for the onshore drilling and testing activities has considered all aspects of operation of the drilling rig and other associated activities during the development phase. Loss of well control / blow-out and process/pipeline leaks constitute the major potential hazards that may be associated with the proposed onshore development and production of oil and natural gas at the identified well locations within the Khagorijan Field.

The following section describes objectives, methodology of the risk assessment study and then presents the assessment for each of the potential risk separately. This includes identification of major hazards, hazard screening and ranking, frequency and consequence analysis for major hazards. The hazards have subsequently been quantitatively evaluated through a criteria based risk evaluation matrix. Risk mitigation measures to reduce significant risks to acceptable levels have also been recommended as a part of the risk assessment study.

7.2 OBJECTIVE OF THE QRA STUDY

The overall objective of this QRA with respect to the proposed project involves identification and evaluation of major risks, prioritizing risks identified based on their hazard consequences and formulating suitable risk reduction/mitigation measures in line with the ALARP principle. Hence in order to ensure effective management of any emergency situations (with potential individual and societal risks) that may arise during the development drilling activities, following specific objectives need to be achieved.

- Identify potential risk scenarios that may arise out of proposed development well drilling, operations of assorted oil and gas pipelines and associated equipment's, mud chemicals storage and handling etc.

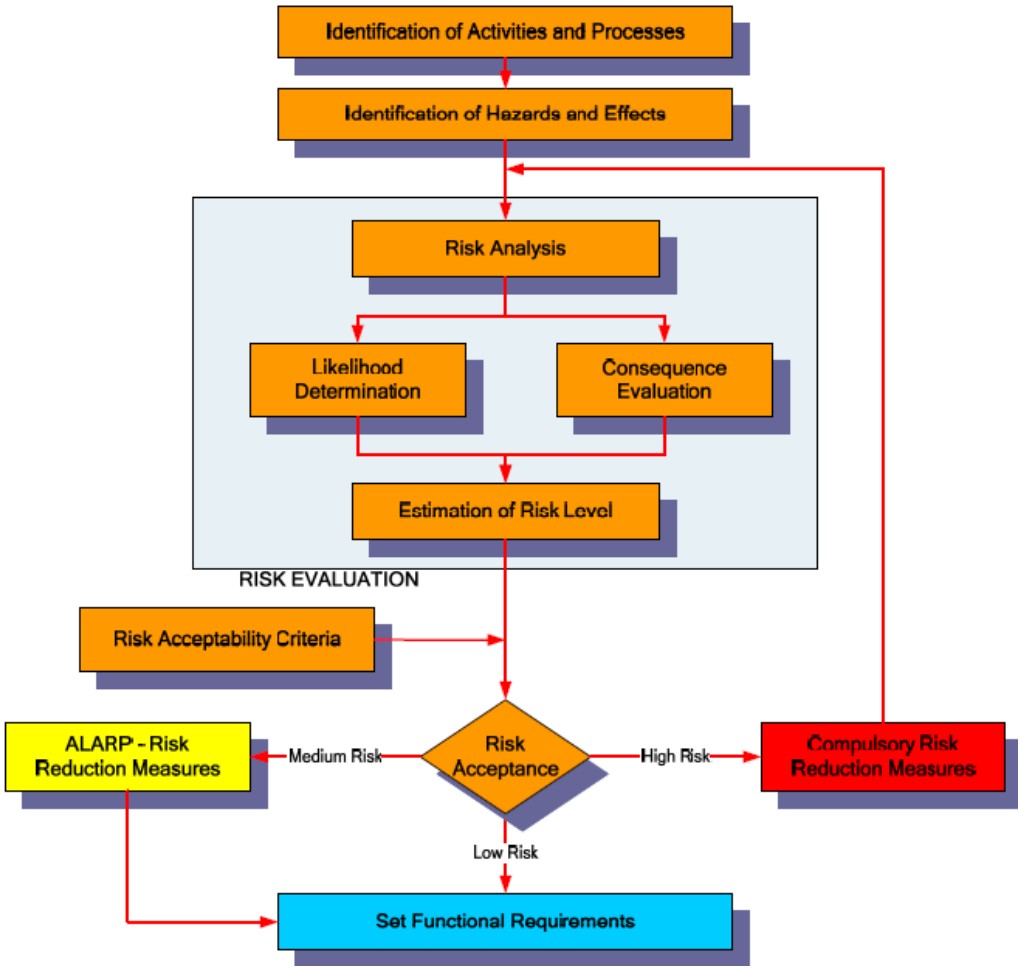
- Analyse the possible likelihood and frequency of such risk scenarios by reviewing historical accident related data for onshore oil and gas industries.
- Predict the consequences of such potential risk scenarios and if consequences are high, establish the same by through application of quantitative simulations.
- Recommend feasible preventive and risk mitigation measures as well as provide inputs for drawing up of Emergency Management Plan (EMP) for the Project.

7.3 RISK ASSESSMENT METHODOLOGY

The risk assessment process is primarily based on likelihood of occurrence of the risks identified and their possible hazard consequences particularly being evaluated through hypothetical accident scenarios. With respect to the proposed Project, major risks viz. blow outs, pipeline and process leaks, non-process fires etc. have been assessed and evaluated through a risk matrix generated to combine the risk severity and likelihood factor. Risk associated with the well development activities have been determined semi-quantitatively as the product of likelihood/probability and severity/consequence by using order of magnitude data (risk ranking = severity/consequence factor X likelihood/probability factor). Significance of such project related risks was then established through their classification as high, medium, low, very low depending upon risk ranking.

The risk matrix is a widely accepted as standardized method of quantitative risk assessment and is preferred over purely quantitative methods, given that its inherent limitations to define a risk event is certain. Application of this tool has resulted in the prioritization of the potential risks events for the drilling activity thus providing the basis for drawing up risk mitigation measures and leading to formulation of plans for risk and emergency management. The overall approach is summarized in the ***Figure 7.1***.

Figure 7.1 Risk Assessment Methodology



7.3.1 Hazard Identification

Hazard identification for the purposes of this QRA comprised of a review of the Project and associated activity related information provided by OIL. In addition, guidance provided by knowledge platforms/portals of the upstream oil & gas industry including International Association of Oil & Gas Producers (OGP), International Tanker Owners Pollution Federation Limited (ITOPF), European Gas Pipeline Incident Data Group (EGIG) and Det Norske Veritas (DNV), Norwegian Petroleum Directorate etc. are used to identify potential hazards that can arise out of proposed Project activities. Taking into account the applicability of different risk aspects in context of the development drilling operations to be undertaken in the identified well locations, there are three major categories of hazards that can be associated with proposed Project which has been dealt with in detail. This includes:

- Blowouts leading to uncontrolled well flow, jet fires, pool fires;
- Non-process fires / explosions, the release of a dangerous substance or any other event resulting from a work activity which could result in death or serious injury to people within the site;
- Leaks from interconnecting pipeline network pipeline leading to jet fire; and

- Any event which may result in major damage to the structure of the rig

Well control incident covers a range of events which have the potential of leading to blow-outs but are generally controlled by necessary technological interventions. Hence, such incidents are considered of minor consequences and as a result not well documented. Other possible hazard scenarios like mud chemical spills, falls, etc. has also not been considered for detailed assessment as preliminary evaluation has indicated that the overall risk that may arise out of them would be low. In addition, it is understood that, causative factors and mitigation measures for such events can be adequately taken care of through exiting safety management procedures and practices of OIL.

It must also be noted here that many hazards identified are sometimes interrelated with one hazard often having the ability to trigger off another hazard through a domino effect. For example, a large oil spill in most instances is caused by another hazardous incident like a blowout or process leak. This aspect has been considered while drawing up hazard mitigation measures and such linkages (between hazards) has also been given due importance for managing hazards and associated risks in a composite manner through OIL's Health, Safety & Environmental Management System (HSEMS) and through the Emergency Management Plan, if a contingency situation so arises.

7.3.2 Frequency Analysis

Frequency analysis involves estimating the likelihood of each of the failure cases identified during the hazard identification stage. The analysis of frequencies of occurrences for the key hazards that has been listed out is important to assess the likelihood of such hazards to actually unfold during the lifecycle of the project. The frequency analysis approach for the proposed Project is based primarily on historical accident frequency data, event tree analysis and judgmental evaluation. Major oil and gas industry information sources viz. statistical data, historical records and global industry experience were considered during the frequency analysis of the major identified risks[1].

For QRA for the proposed Project, various accident statistics and published oil industry databases have been consulted for arriving at probable frequencies of identified hazards. However, taking into account the absence of representative historical data/statistics with respect to onshore operations[2], relevant offshore accident databases have been considered in the frequency analysis of identified hazards. The same has been recommended in the "*Risk Assessment Data Directory" published by the International Association of Oil & Gas Producers (OGP). Key databases/reports referred as part of the QRA study includes Worldwide*

[1]It is to be noted that the frequency of occurrences are usually obtained by a combination of component probabilities derived on basis of reliability data and /or statistical analysis of historical data.
[2]Although Alberta Energy & Utilities Board (EUB) maintains a database for onshore incidents for the period 1975-1990 the same has not been considered in the context of the present study as the Alberta wells are believed to be sour with precaution being taken accordingly to minimize the likelihood of release

Offshore Accident Databank (WOAD), Outer Continental Shelf (OCS) Reports, Norwegian Petroleum Directorate Directives, Offshore Reliability Data (OREDA) Handbook, HSE Offshore Incident Database, SINTEF Offshore Blowout Database etc.

Based on the range of probabilities arrived at for different potential hazards that may be encountered during the proposed well development activities, following criteria for likelihood rankings have been drawn up as presented in the ***Table 7.1***.

Table 7.1 Frequency Categories and Criteria

Likelihood Ranking	Criteria Ranking (cases/year)	Frequency Class
5	>1.0	Frequent
4	$>10^{-1}$ to <1.0	Probable
3	$>10^{-3}$ to $<10^{-1}$	Occasional/Rare
2	$>10^{-5}$ to $<10^{-3}$	Not Likely
1	$>10^{-6}$ to $<10^{-5}$	Improbable

7.3.3 Consequence Analysis

In parallel to frequency analysis, hazard prediction / consequence analysis exercise assesses resulting effects in instances when accidents occur and their likely impact on project personnel, infrastructure and environment. In relation to the proposed Project, estimation of consequences for each possible event has been based either on accident experience, consequence modelling or professional judgment, as appropriate.

Given the high risk perception associated with blow outs in context of onshore drilling operation, a detailed analysis of consequences has been undertaken for blow outs taking into account physical factors and technological interventions. Consequences of such accidental events on the physical, biological and socio-economic environment have been studied to evaluate the potential of the identified risks/hazards. In all, the consequence analysis takes into account the following aspects:

- Nature of impact on environment and community;
- Occupational health and safety;
- Asset and property damage;
- Corporate image
- Timeline for restoration of environmental and property damage
- Restoration cost for environmental and property damage

The following criterion for consequence rankings (***Table 7.2***) is drawn up in context of the possible consequences of risk events that may occur during proposed well development activities:

Table 7.2 Severity Categories and Criteria

Consequence	Ranking	Criteria Definition
Catastrophic	5	• Multiple fatalities/Permanent total disability to more than 50 persons • Severe violations of national limits for environmental emission • More than 5 years for natural recovery • Net negative financial impact of >10 crores • Long term impact on ecologically sensitive areas • International media coverage • National stakeholder concern and media coverage
Major	4	• Single fatality/permanent total disability to one or more persons • Major violations of national limits for environmental emissions • 2-5 years for natural recovery • Net negative financial impact of 5 -10 crores • Significant impact on endangered and threatened floral and faunal species • Loss of corporate image and reputation
Moderate	3	• Short term hospitalization & rehabilitation leading to recovery • Short term violations of national limits for environmental emissions • 1-2 years for natural recovery • Net negative financial impact of 1-5 crores • Short term impact on protected natural habitats • State wide media coverage
Minor	2	• Medical treatment injuries • 1 year for natural recovery • Net negative financial impact of 0.5 - 1 crore • Temporary environmental impacts which can be mitigated • Local stakeholder concern and public attention
Insignificant	1	• First Aid treatment with no Lost Time Incidents (LTIs) • Natural recovery < 1year • Net negative financial impact of <0.5 crores. • No significant impact on environmental components • No media coverage

7.3.4 Risk Evaluation

Based on ranking of likelihood and frequencies, each identified hazard has been evaluated based on the likelihood of occurrence and the magnitude of consequences. Significance of risks is expressed as the product of likelihood and consequence of the risk event, expressed as follows:

Significance = Likelihood X Consequence

The ***Table 7.3*** below illustrates all possible product results for five likelihood and consequence categories while the ***Table 7.4*** assigns risk significance criteria in four regions that identify the limit of risk acceptability. Depending on the position of intersection of a column with a row in the risk matrix,

hazard prone activities have been classified as low, medium and high thereby qualifying a set of risk reduction / mitigation strategies.

Table 7.3 Risk Matrix

Consequence →			Likelihood → Frequent	Probable	Remote	Not Likely	Improbable
			5	4	3	2	1
	Catastrophic	5	25	20	15	10	5
	Major	4	20	16	12	8	4
	Moderate	3	15	12	9	6	3
	Minor	2	10	8	6	4	2
	Insignificant	1	5	4	3	2	1

Table 7.4 Risk Criteria and Action Requirements

Risk Significance	Criteria Definition & Action Requirements
High (16 - 25)	**"Risk requires attention"** – Project HSE Management need to ensure that necessary mitigation are adopted to ensure that possible risk remains within acceptable limits
Medium (10 – 15)	**"Risk is tolerable"** – Project HSE Management needs to adopt necessary measures to prevent any change/modification of existing risk controls and ensure implementation of all practicable controls.
Low (5 – 9)	**"Risk is acceptable" –** Project related risks are managed by well-established controls and routine processes/procedures. Implementation of additional controls can be considered.
Very Low (1 – 4)	**"Risk is acceptable" –** All risks are managed by well-established controls and routine processes/procedures. Additional risk controls need not to be considered

7.4 RISK ASSESSMENT OF IDENTIFIED PROJECT HAZARDS

As already discussed in the previous section, three major categories risk have identified in relation to proposed development drilling activities. A comprehensive risk assessment study has been undertaken to assess and evaluate significance of identified risks in terms of severity of consequences and likelihood of occurrence. Risk assessment study details have been summarized in the subsequent sections below:

7.4.1 Blow Outs/Loss of Well Control

Blow out is an uncontrolled release of well fluid (primarily hydrocarbons viz. oil and/or gas and may also include drilling mud, completion fluid, water etc.) from an exploratory or development well. Blow outs are the result of failure to control a kick and regain pressure control and are typically caused by equipment failure or human error. The possible blow out cause events occurring in isolation or in combination have been listed below:

- Formation fluid entry into well bore;
- Loss of containment due to malfunction (viz. wire lining);
- Well head damage (e.g. by fires, storms, dropped object etc.); and
- Rig forced off station (e.g. by anchor failure) damaging Blow Out Preventer (BOP) or wellhead.

The most common cause of blow out can be associated with the sudden/unexpected entry/release of formation fluid into well bore that may arise as a result of the following events as discussed in the ***Box 7.1*** below:

Box 7.1 Primary Causes of Blow Outs

Shallow gas
In shallow formations there may be pockets of shallow gas. In these instances there is often insufficient mud density in the well and no BOP is in place. If the hole strikes shallow gas the gas may be released on the drilling rig very rapidly. Typical geological features which suggest the presence of shallow gas can then be detected. Historically, striking of shallow gas has been one of the most frequent causes of blowouts in drilling.

Swabbing
As the drill pipe is pulled upwards during trips out of the hole or upward movement of the drill string, the pressure in the hole beneath the drill bit is reduced, creating a suction effect. Sufficient drilling mud must be pumped down-hole to compensate for this effect or well fluids may enter the bore. Swabbing is also a frequent cause of drilling blowouts.

High formation pressure
Drilling into an unexpected zone of high pressure may allow formation fluids to enter the well before mud weight can be increased to prevent it.

Insufficient mud weight
The primary method of well control is the use of drilling mud; in correct operation, the hydrostatic pressure exerted by the mud prevents well fluids from entering the well bore. A high mud weight provides safety against well fluids in-flows. However, a high mud weight reduces drilling speed, therefore, mud weight is calculated to establish weight most suitable to safely control anticipated formation pressures and allows optimum rates of penetration. If the required mud weight is incorrectly calculated then well fluid may be able to enter the bore.

Lost Circulation
Drilling mud circulation can be lost if mud enters a permeable formation instead of returning to the rig. This reduces the hydrostatic pressures exerted by the mud throughout the well bore, and may allow well fluids from another formation to enter the bore.

Gas cut mud
Drilling fluids are denser than well fluids; this density is required to provide the hydrostatic pressure which prevents well fluids from entering the bore. If well fluids mix with the mud then its density will be reduced. As mud is circulated back to surface, hydrostatic pressure exerted by the mud column is reduced. Once gas reaches surface it is released into the atmosphere.

Source: A Guide to Quantitative Risk Assessment for Offshore Installations; John Spouge – DNV Technical Publication 99/100a

For better understanding, causes of blow outs have been systematically defined in terms of loss of pressure control (failure of primary barrier), uncontrolled flow of fluid or failure of secondary barrier (BOP). The blow out incidents resulting from primary and secondary failures for proposed operations as obtained through comprehensive root cause analysis of the Gulf Coast (Texas, OCS and US Gulf of Mexico) Blow Outs[1] during 1960-1996 have been presented in the ***Table 7.5*** below.

Table 7.5 Blow Out Cause Distribution for Failures during Drilling Operations

Sl. No.	Causal Factors	Blow Out Incidents (Nos.)
A.	**Primary Barrier**	
1	Swabbing	77
2	Drilling Break	52
3	Formation breakdown	38
4	Trapped/expanding gas	09
5	Gas cut mud	26
6	Low mud weight	17
7	Wellhead failure	05
8	Cement setting	05
B.	**Secondary Barrier**	
1	Failure to close BOP	07
2	Failure of BOP after closure	13
3	BOP not in place	10
4	Fracture at casing shoe	03
5	Failure to stab string valve	09
6	Casing leakage	06

Thus, underlying blowout causes as discussed in the above table can be primarily attributed to swabbing as the primary barrier failure which is indicative of insufficient attention given to trip margin and controlling pipe movement speed. Also, it is evident from the above table that lack of proper maintenance, operational failures and absence of BOPs as secondary barrier contributed to majority of blowout incidents (approx. 30 nos.) is recorded.

Blowout Frequency Analysis

Blow out frequency estimates is obtained from a combination of incident experience and associated exposure in a given area over a given period. For the purpose of calculation of blow out frequency analysis in context of the present study involving developmental drilling, blow out frequencies per well drilled have been considered.

The blowout frequencies presented in this report are extracted from the latest revision of the Scandpower[2] report and are presented in ***Table 7.6*** below. The blowout probability is determined from blowouts in the North Sea. (I.e. British, Dutch and Norwegian sectors) given comparable data for onshore operations are not readily available.

[1] "Trends extracted from 1200 Gulf Coast blowouts during 1960-1996" – Pal Skalle and A.L Podio
[2] "Blowout and Well Release Frequencies" - Based on SINTEF Offshore Blowout Database 2010, Report, Scandpower Risk Management. Report no. 19.101.001-3009/2011/R3, 05.04.2011.

Table 7.6 Blow Out Frequencies Recommended per Drilled Well

Drilling Operation	Well Category	Frequency, gas well	Frequency, oil well
Exploration	Normal	1.12E-04	1.23E-04
Wild Cat	Normal	9.70E-05	1.17E-04
Appraisal	Normal	1.07E-04	1.30E-04
Development	Normal	2.16E-05	2.62E-05

Based on the aforesaid frequency and information provided by OIL the blow out frequency for the proposed project has been computed as follows:

No of wells to be drilled per year = 11 (A)

Blow out frequency for development drilling (oil) = 2.62×10^{-5} per well drilled (B)

Blow out frequency for development drilling (gas) = 2.16×10^{-5} per well drilled (C)

Frequency of blow out occurrence for the proposed project (oil) = (A X B) = $11 \times 2.62 \times 10^{-5}$ = 2.82×10^{-4} per well drilled

Frequency of blow out occurrence for the proposed project (gas) = (A X C) = $11 \times 2.16 \times 10^{-5}$ = 2.37×10^{-4} per well drilled

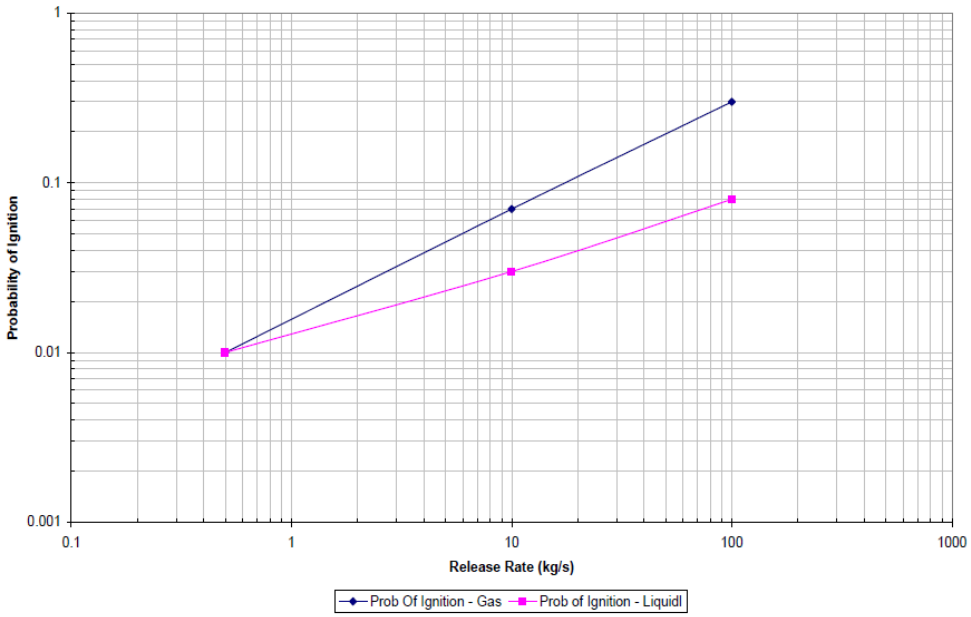
Thus, the blow out frequency for the proposed project for oil and gas wells have been at **2.82×10^{-4} and 2.37×10^{-4} per well drilled per year respectively i.e. the likelihood of its occurrence is identified to be as "Not Likely**"

Blowout Ignition Probability

Review of SINTEF database indicates that a rounded ignition probability of 0.3 has been widely used for the purpose of quantitative risk analysis arising from blow outs. As per this database generally ignition occurred within first 5 minutes in approximately 40% of the blowouts leading to either pool and/or jet fire. Blow out leading to flammable gas release has a greater probability of ignition compared to liquid releases[1] (***Figure 7.2***).

[1]Fire and Explosion – Fire Risk Analysis by Daejun Change, Division of Ocean System and Engineering

Figure 7.2 Ignition Probability Vs Release Rate



An alternative to the blowout ignition probabilities given by the UKOOA look-up correlations can be obtained from Scandpowers's interpretation of the blowout data provided by SINTEF 2. The most significant category is that for deep blowouts which indicates an early ignition probability of 0.09. For the purpose of the QRA study this can be taken as occurring immediately on release and calculation provided below:

No of wells to be drilled per year = 11 (A)

Blow out frequency for development drilling (oil) = 2.62 X 10^{-5} per well drilled (B)

Blow out frequency for development drilling (gas) = 2.16 X 10^{-5} per well drilled (C)

Blow out ignition probability = 0.09 (D)

Probability of Blow out ignition for the proposed project (oil) = (A X B X D) = 11 X 2.62 X 10^{-5} X 0.09

= 2.82X 10^{-4} = ~ 0.002%

Probability of Blow out ignition for the proposed project (gas) = (A X C X D) = 11 X 2.16 X 10^{-5} X 0.09

= 2.37 X 10^{-4} = ~ 0.002%

Hence based on the aforesaid calculation the probability of ignition of blow out releases of hydrocarbons for the proposed development project for both oil and gas is computed to be around ~0.002% and can be considered to be as negligible.

Blowout Consequence Analysis

Blow out from a hydrocarbon development wells may lead to the following possible risk consequences:

a. Jet fires resulting from ignited gas blow outs; and
b. Oil slicks resulting from un-ignited oil pools.

Pool fire

A pool fire is a turbulent diffusion fire burning above a pool of vapourizing hydrocarbon fuel where the fuel vapour has negligible initial momentum. The probability of occurrence of pool fires for oil and gas exploration is high due to continuous handling of heavy hydrocarbons. The evaporation of hydrocarbons from a pool forms a cloud of vapour above the pool surface which, on ignition, leads to generation of pool fire.

For the purpose of consequence modeling for pool fires resulting from blow outs, following hypothetical scenarios in terms of hydrocarbon (particularly crude oil) release rates (***Table 7.7***) have been considered based on DNV Technica's FLARE program.

Table 7.7 Pool Fire Modelling Scenario

Scenario	Release Rate (kg/s)	Release Type
Scenario - I	1	Small
Scenario - II	10	Medium
Scenario – III (Worst Case)	50	Large

The release rates as specified for the aforesaid scenarios have been utilized in the computing the pool fire diameter utilizing the following equation and input parameters:

$D = \sqrt{4Q/\pi b}$
Where D = pool diameter (m)
Q = release rate (kg/s)
b = burning rate (kg/m^2s)

The mass burning rate for crude oil has been considered to be 0.05 kg/m^2s
Based on above equation, the pool fire diameter and the steady study burning areas computed for various release types have been presented in the **Table 7.8** below.

Table 7.8 Pool Fire Diameter & Steady State Burning Scenario

Scenario	Release Rate (kg/s)	Release Type	Pool fire diameter (m)	Steady State Burning Area (m^2)
Scenario - I	1	Small	5.05	6.37
Scenario - II	10	Medium	15.96	63.69
Scenario - III	50	Large	35.69	318.47

The impact zone for long duration fires is conveniently described by thermal radiation contours and its effects on the people who are exposed to such radiation levels for one minute (60sec). The thermal radiation threshold values

(measured in kilowatts per square meter) defined for crude oil pool fire consequence modelling is provided in **Table 7.9** below:

Table 7.9 Thermal Radiation Intensity Threshold Values Impact Criterion

Threshold Radiation Intensity	Threat Zone	Impact Criterion
5.0 kW/m²	**Green**	• Escape actions within one minute. • Cause second degree burns within 60 sec.
12.5 kW/m²	**Blue**	• Escape actions lasting for few seconds. • Cause second degree burns within 40 sec.
37.5 kW/m²	**Red**	• Results in immediate fatality. • Pain threshold is instantaneous leading to second degree burns within 8 sec.

For estimating the distance to a pool fire heat radiation level that could cause second degree burns and fatality for a maximum exposure of 60 sec the following EPA equation and input parameters are utilized.

$$X = H_c \sqrt{\frac{0.0001\ A}{5000\ \Pi\ (H_V + C_p\ (T_B - T_A))}}$$

Where:

X = distance to the heat radiation level (m)
HC = heat of combustion of the flammable liquid (joules/kg)
HV = heat of vapourization of the flammable liquid (joules/kg)
A = pool area (m^2)
CP = liquid heat capacity (joules/kg-^oK)
TB = boiling temperature of the liquid (^oK)
TA = ambient temperature (^oK)

For crude oil **HC = 42600000 joules/kg; HV = 957144 joules/kg; CP = 1892 joules/kg-°K; TB = 633 °K** and **TA = 300 °K.** The following input parameter along with pool area (m^2) computed for blow out risk scenarios provided the distance to the threshold heat radiation levels for the threat zones and have been presented in **Table 7.9** below

Table 7.10 Distance to Thermal Radiation Threshold Levels

Release Type	Pool fire diameter (m)	Pool fire area (m^2)	Distance to 5.0 kW/m^2 (m)	Distance to 12.5 kW/m^2 (m)	Distance to 37.5 kW/m^2 (m)
Small	5.05	6.37	6.81	4.31	2.49
Medium	15.96	63.69	21.54	13.62	7.86
Large	35.69	318.47	48.16	30.46	17.59

The worst hazard for release and ignition of crude oil at a rate of **50kg/s** for a thermal radiation intensity of **37.5 kW/m²** is likely to be experienced to a maximum distance of **17.59m** from the source with potential lethal effects experienced within 8 sec.

Risk Ranking – Blowout Pool Fire (Worst Case Scenario)

Likelihood ranking	**3**	**Consequence ranking**	**4**
Risk Ranking & Significance = 12 i.e. "Medium" i.e. Risk is Tolerable and can be managed through adoption of necessary controls.			

Ignition of Flammable Gas Release leading to Jet Fire

Jet fires are burning jet of gas or sprays of atomized liquids resulting from gas and condensate release from high pressure equipment and blow outs. Jet fires may also result in the release of high pressure liquid containing dissolved gas due to gas flashing off and turning the liquid into a spray of small droplets. In context of the present study, formation of jet fires can be attributed by the high pressure release and ignition of natural gas if encountered during exploration of block hydrocarbon reserves.

Natural gas as recovered from underground deposits primarily contains methane (CH_4) as a flammable component, but it also contains heavier gaseous hydrocarbons such as ethane (C_2H_6), propane (C_3H_8) and butane (C_4H_{10}). Other gases such as CO_2, nitrogen and hydrogen sulfide (H_2S) are also often present. Methane is typically 90 percent, ethane 5-15 percent, propane and butane, up to 5 percent. Thus, considering higher percentage of methane in natural gas, the thermo-chemical properties of the same has been utilized in the jet fire blow out consequence modelling. The following risk scenarios (***Table 7.11***) have been considered for nature gas release consequence modelling:

Table 7.11 Natural Gas Release Modelling Scenario

Scenario	Release Rate (kg/s)	Release Type
Scenario - I	1	Small
Scenario - II	5	Medium
Scenario – III (Worst Case)	10	Large

The modelling of nature gas releases has been carried out using ALOHA. A Flammable Level of Concern approach has been utilized for assessing safety risk associated with the release of flammable gases (here methane) from well blow outs. In ALOHA, a flammable Level of Concern (LOC) is a threshold concentration of fuel in the air above which a flammability hazard may exist. While modelling the release of a flammable gas that may catch fire—but which is not currently burning—ALOHA can predict the flammable area of the vapour cloud so that flammability hazard can be established.

The flammable area is the part of a flammable vapour cloud where the concentration is in the flammable range, between the Lower and Upper Explosive Limits (LEL and UEL). These limits are percentages that represent the concentration of the fuel (that is, the chemical vapour) in the air. If the chemical vapour comes into contact with an ignition source (such as a spark),

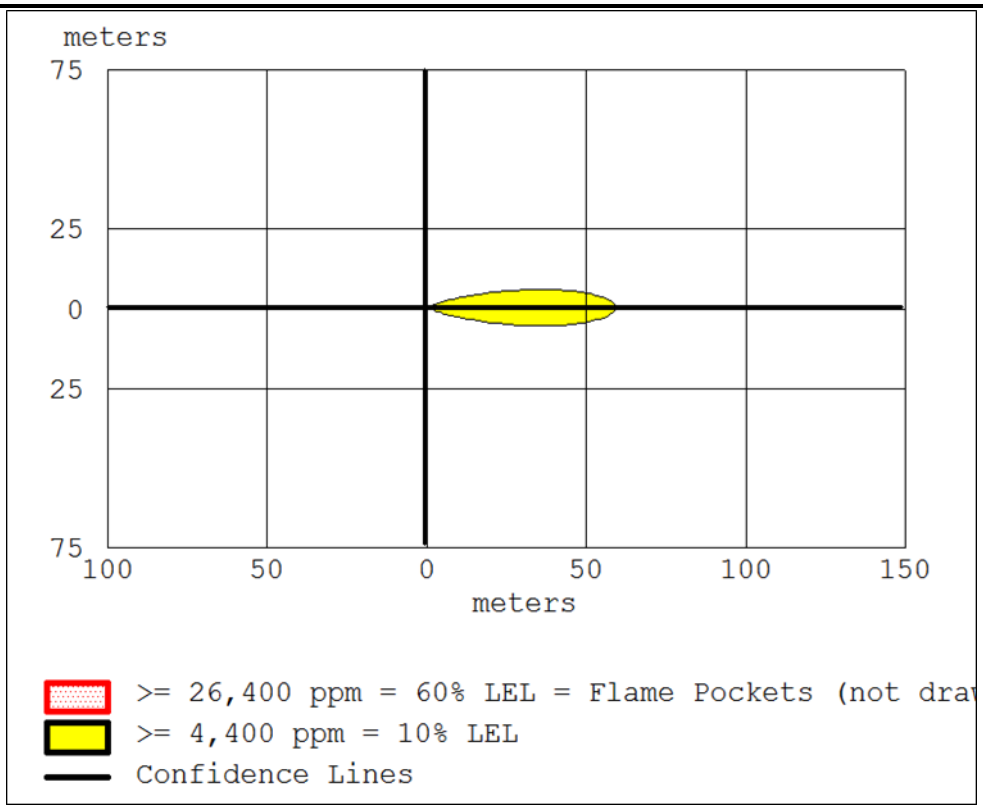
it will burn only if its fuel-air concentration is between the LEL and the UEL—because that portion of the cloud is already pre-mixed to the right mixture of fuel and air for burning to occur. If the fuel-air concentration is below the LEL, there is not enough fuel in the air to sustain a fire or an explosion—it is too lean. If the fuel-air concentration is above the UEL, there is not enough oxygen to sustain a fire or an explosion because there is too much fuel—it is too rich.

When a flammable vapour cloud is dispersing, the concentration of fuel in the air is not uniform; there will be areas where the concentration is higher than the average and areas where the concentration is lower than the average. This is called concentration patchiness. Because of concentration patchiness, there will be areas (called pockets) where the chemical is in the flammable range even though the average concentration has fallen below the LEL. Because of this, ALOHA's default flammable LOCs are each a fraction of the LEL, rather than the LEL itself. ALOHA uses 60% of the LEL as the default LOC for the red threat zone, because some experiments have shown that flame pockets can occur in places where the average concentration is above that level. Another common threat level used by responders is 10% of the LEL, which is ALOHA's default LOC for the yellow threat zone. The flammable LOC threat zones for methane release are as follows:

Red : 26,400 ppm = 60% LEL = Flame Pockets
Yellow: 4,400 ppm = 10% LEL

Well site risk contour maps for worst case scenario prepared based on ALOHA modelling of natural gas releases for flammable vapour cloud has been presented in ***Figures 7.3-7.5*** below.

Figure 7.3 Scenario I: Risk Contour Map



THREAT ZONE:
Threat Modelled: Flammable Area of Vapour Cloud

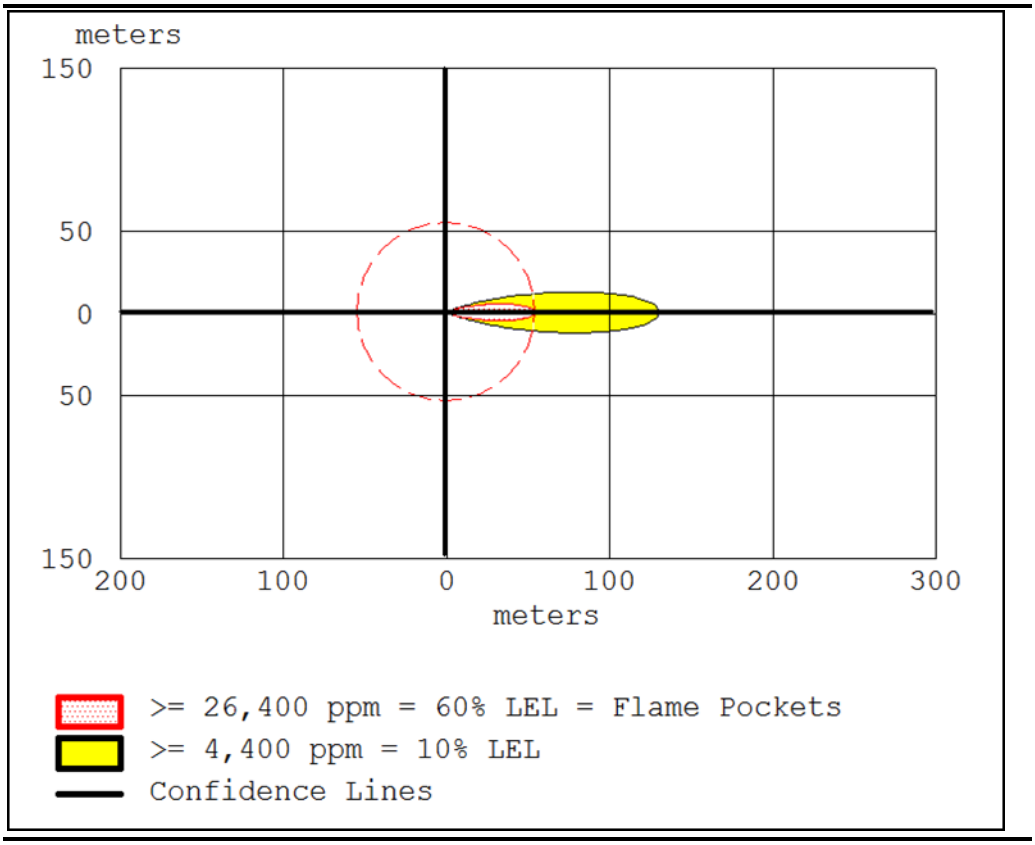
Model Run: Gaussian

Red : 25 meters --- (26,400 ppm = 60% LEL = Flame Pockets)

Note: Threat zone was not drawn because effects of near-field patchiness make dispersion predictions less reliable for short distances.

Yellow: 60 meters --- (4,400 ppm = 10% LEL)

Figure 7.4 Scenario II: Risk Contour Map



THREAT ZONE:

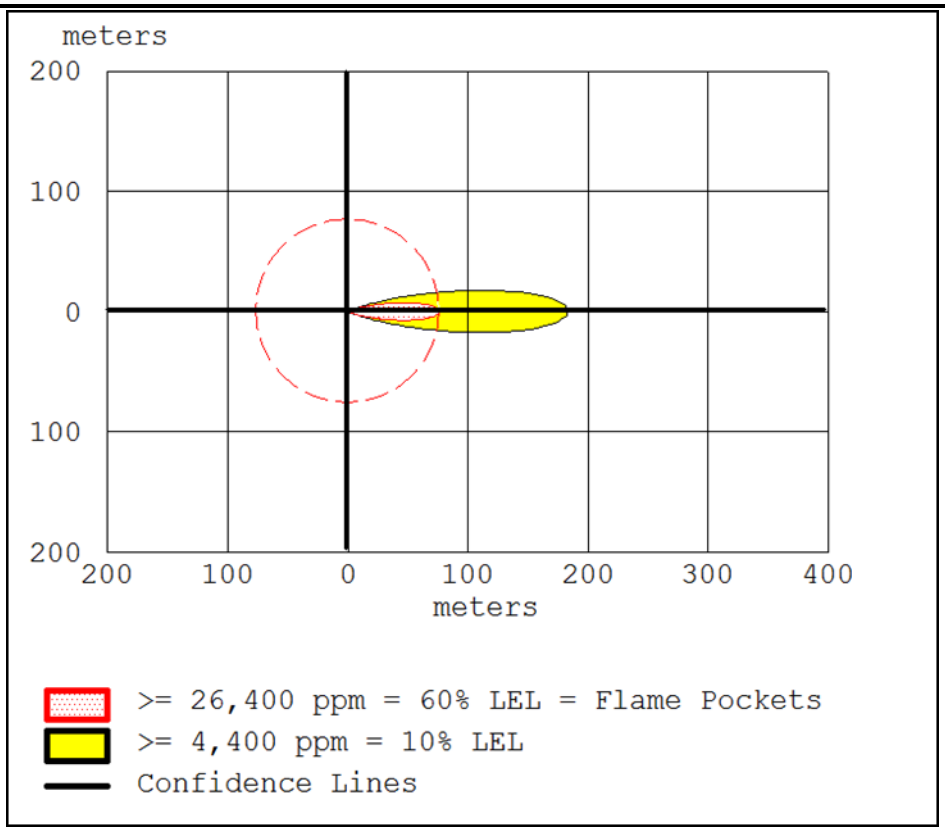
Threat Modeled: Flammable Area of Vapour Cloud

Model Run: Gaussian

Red : 55 meters --- (26,400 ppm = 60% LEL = Flame Pockets)

Yellow: 131 meters --- (4,400 ppm = 10% LEL)

Figure 7.5 Scenario III: Risk Contour Map



THREAT ZONE:

Threat Modelled: Flammable Area of Vapour Cloud

Model Run: Gaussian

Red : 77 meters --- (26,400 ppm = 60% LEL = Flame Pockets)

Yellow: 183 meters --- (4,400 ppm = 10% LEL)

The zone of flammable vapour cloud calculated for hypothetical natural gas release under risk scenarios discussed in the earlier sections have been presented in the ***Table 7.12*** below.

Table 7.12 Zone of Flammable Vapour Cloud-Natural Gas Release Scenarion

Release Type	Release Rate (kg/s)	Red -60% LEL (m)	Yellow -10% LEL (m)
Small	1	25	65
Medium	5	55	131
Large	10	77	183

Hence for a worst case scenario (10kg/s) the flammable vapour cloud zone/flame pockets' resulting from accidental release of natural gas will be covering a radial zone of 77m from source with the flammable gas concentration within this zone being 26,400 ppm.

Based on the flammable vapour cloud concentration modelled for the worst case scenario (10 kg/s) an effort was made to establish the overpressure (blast force zone) that may result from delayed ignition of vapour cloud generated from any such accidental release. For overpressure risk modelling using ALOHA a delayed ignition time of 5 minutes was considered of the vapour cloud mass. However the threat modelled revealed that Level of Concern (LOC) was never exceeded that may possibly lead to damage to property or life within the blast radius. The results have been provided in ***Figure 7.6*** below.

Figure 7.6 ***Scenario III (Worst Case) – Overpressure Risk Modelling***

```
Threat Modeled: Overpressure (blast force) from vapor cloud explosion
Time of Ignition: 5 minutes after release begins
Type of Ignition: ignited by spark or flame
Level of Congestion: uncongested
Model Run: Gaussian
Explosive mass at time of ignition: 188 kilograms
Red   : LOC was never exceeded --- (8.0 psi = destruction of buildings)
Orange: LOC was never exceeded --- (3.5 psi = serious injury likely)
Yellow: LOC was never exceeded --- (1.0 psi = shatters glass)
```

The risk significance for the potential blow out scenario resulting from development drilling has been presented below. For calculating the risk significance, the likelihood ranking is considered to be "3" as the frequency analysis for blow outs incidents is computed at "1.04×10^{-4}" whereas the consequence ranking has been identified to be as "4" given the worst case scenario modelling (blast overpressure) indicates that the LOC was never exceeded leading to multiple fatalities (For criteria ranking please refer to Table 7.1 & 7.2).

Risk Ranking – Blowout Natural Gas Release (Worst Case Scenario)

Likelihood ranking	**3**	**Consequence ranking**	**4**
Risk Ranking & Significance = 12 i.e. "Medium" i.e. Risk is Tolerable and can be managed through adoption of necessary controls.			

7.4.2 Hydrocarbons Leaks Due to Loss of Containment While Drilling & Testing

The releases of hydrocarbons that may be isolated from reservoir fluids include gas releases in the mud return area during drilling. The consequences of gas releases are described in this section. ALOHA model has been used to model the releases from failure of the test separator.

Frequency Analysis

Review of the hydrocarbon release database (HCRD) of 2003 for **One North Sea Platform** indicates the process gas leak frequencies for large releases (>10

kg/s) to be about **6.0 x 10^{-3} per year**. The same frequency has been considered for potential release from leaks due to loss of containment while drilling.

Gas Releases during Drilling

a) Flash Fire

If gas is entrained in the mud then it could be released from the mud pits or shakers. The amount of gas returned is unlikely to be so great that a jet fire could occur, but the gas could build up into a flammable vapour cloud in the mud pit area. If the cloud then ignites it will result in a flash fire or vapour cloud explosion. Again, there is also the potential for a toxic cloud to be present if the release is during a period when sour crude is a possibility. The mud return typically contains around 50% water this means it cannot be ignited in liquid form so there is no danger of pool fires. Liquid mud fires are therefore not considered further.

The mud - gas separator can be other source that contains both flammable liquid and gas.

A well test separator rupture could result in release of gas when a gas cloud will form, initially located around the release point. If the release is ignited immediately then a fireball will be formed. If this cloud is not immediately ignited, then a vapour cloud will form, which will disperse with the wind and diluted as a result of air entrainment. The principal hazard arising from a cloud of dispersing flammable material is its subsequent (delayed) ignition, resulting in a flash fire. Large-scale experiments on the dispersion and ignition of flammable gas clouds show that ignition is unlikely when the average concentration is below the lower flammability limit (LFL).

As in the case for blow outs, an effort was made to establish the overpressure (blast force zone) that may result from delayed ignition of vapour cloud generated from any such accidental release. For overpressure risk modelling using ALOHA a delayed ignition time of 5 minutes was considered of the vapour cloud mass. However the threat modelled revealed that Level of Concern (LOC) was never exceeded that may possibly lead to damage to property or life within the blast radius. The results have been provided in ***Figure 7.7*** below.

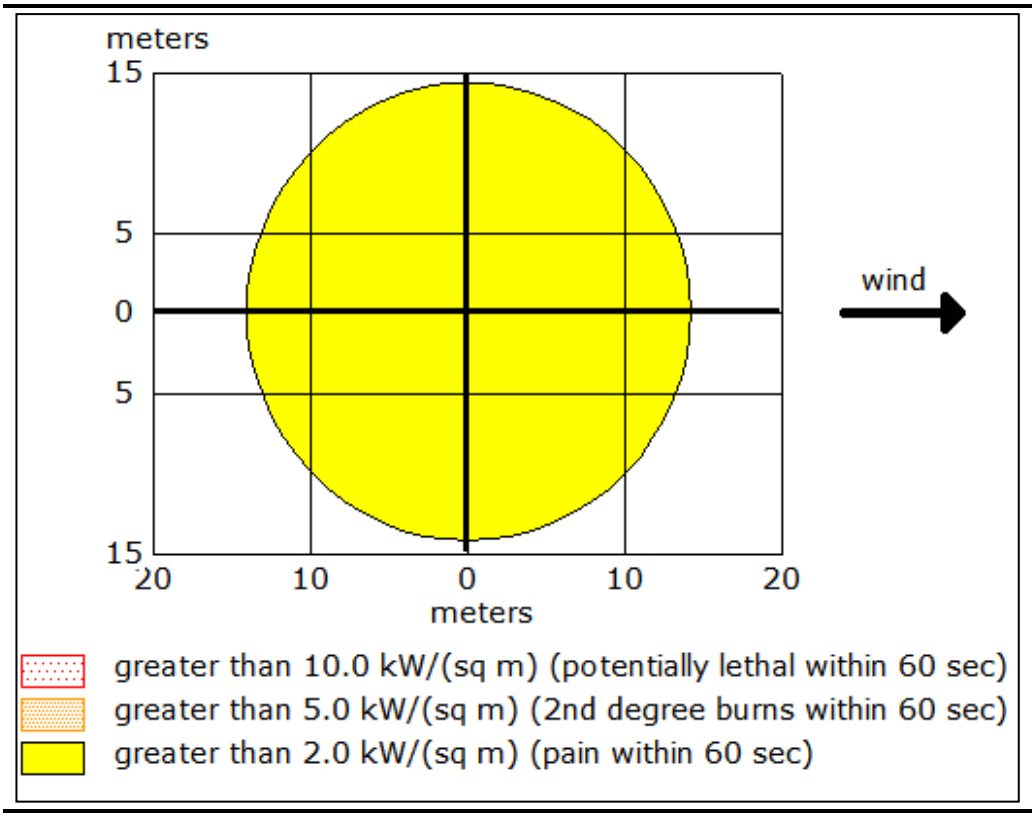
Figure 7.7 Overpressure Risk Modelling – Well Releases during drilling

Threat Modeled: Overpressure (blast force) from vapor cloud explosion
Type of Ignition: ignited by spark or flame
Level of Congestion: uncongested
Model Run: Gaussian
Red : LOC was never exceeded --- (8.0 psi = destruction of buildings)
Orange: LOC was never exceeded --- (3.5 psi = serious injury likely)
Yellow: LOC was never exceeded --- (1.0 psi = shatters glass)

b) Jet Fire

The term jet fire is used to describe the flame produced due to the ignition of a continuous pressurised leakage from the pipe work. Combustion in a jet fire occurs in the form of a strong turbulent diffusion flame that is strongly influenced by the initial momentum of the release. Flame temperatures for typical jet flames vary from 1600°C for laminar diffusion flames to 2000°C for turbulent diffusion flames. The principal hazards from a jet fire are thermal radiation and the potential for significant knock-on effects, such as equipment failure due to impingement of the jet fire. The thermal radiations distances due to Jet Flame are shown in ***Figure 7.8*** and ***Figure 7.9*** below.

Figure 7.8 ***Thermal Radiation Distances of Jet Flame due to Leak of 25 mm size***



THREAT ZONE:

Threat Modelled: Thermal radiation from jet fire

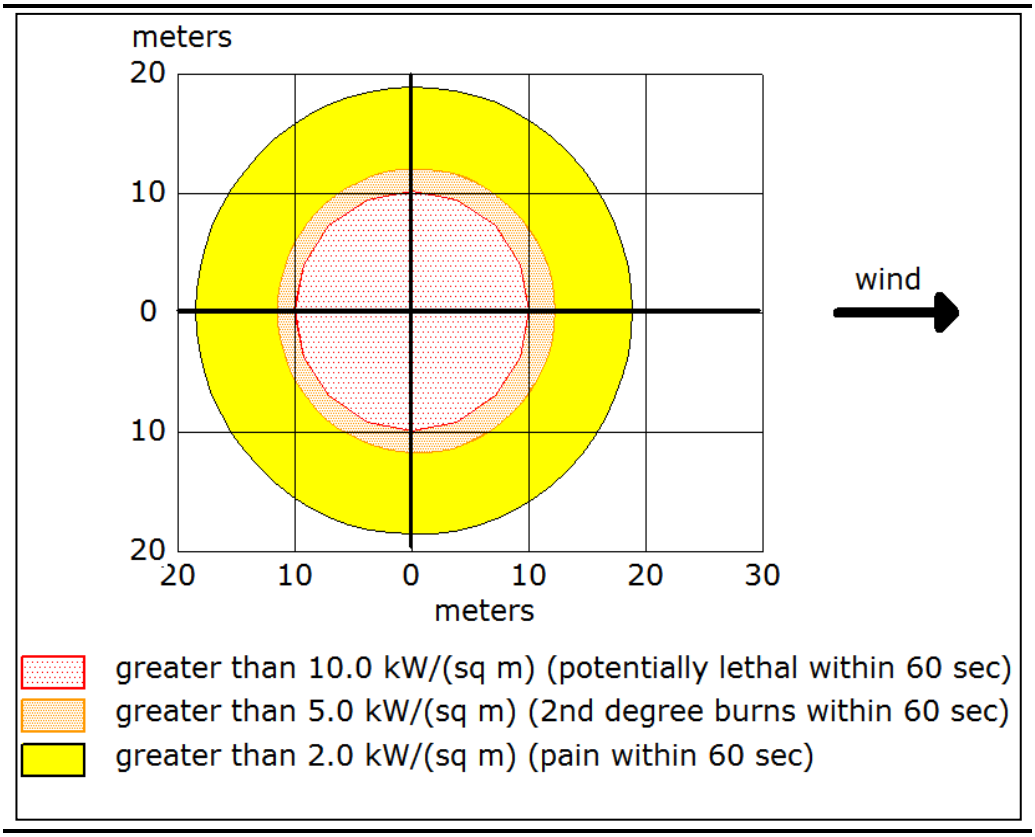
Model Run: Gaussian

Red: < 10 meters --- (10.0 kW/(sq. m) = potentially lethal within 60 sec)

Orange: < 10 meters --- (5.0 kW/(sq. m) = 2nd degree burns within 60 sec)

Yellow: 14 meters --- (2.0 kW/(sq. m) = pain within 60 sec)

Figure 7.9 Thermal Radiation Distances of Jet Flame due to Leak of 50 mm size



THREAT ZONE:
Threat Modelled: Thermal radiation from jet fire

Model Run: Gaussian

Red : 10 meters --- (10.0 kW/(sq. m) = potentially lethal within 60 sec)

Orange: 12 meters --- (5.0 kW/(sq. m) = 2nd degree burns within 60 sec)

Yellow: 19 meters --- (2.0 kW/(sq. m) = pain within 60 sec)

The zone of thermal radiation calculated for hypothetical release and ignition of natural gas during well testing have been presented in the ***Table 7.13*** below.

Table 7.13 Thermal Radiation Zone -Natural Gas Release Scenario during Well Testing

Release Type	Red (kW/sqm)	Orange (kW/sqm)	Yellow (kW/sqm)
Leak of 25 mm size	<10	<10	14
Leak of 50 mm size	10	12	19

Hence for a worst case scenario (50 mm leak) the ignition of natural gas release will be resulting in generation of thermal radiation which will be lethal within a maximum radius of 10m within 1 minute of its occurrence.

The risk significance for the potential well release scenario resulting from exploratory drilling has been presented below. For calculating the risk

significance, the likelihood ranking is considered to be "3" as the frequency analysis for blow outs incidents is computed at "*1.04 X 10^{-4}*" whereas the consequence ranking has been identified to be as "4" given the worst case scenario modelling (blast overpressure)/jet fire indicates that the LOC was never exceeded leading to multiple fatalities (For criteria ranking please refer to Table 7.1 & 7.2).

Risk Ranking – Jet Fire/Blast Overpressure from Well Releases (Worst Case Scenario)

Likelihood ranking	**3**	**Consequence ranking**	**4**
Risk Ranking & Significance = 12 i.e. "Medium" i.e. Risk is Tolerable and can be managed through adoption of necessary controls and technologies.			

7.4.3 Interconnecting Hydrocarbon Pipeline Network

As discussed in the project description section, the project involves laying of approximately 201 km of pipelines including 200 mm 21 km long crude oil pipeline from East Khagorijan GGS to Dikom OCS, 300 mm 20 km long natural gas pipeline from East Khagorijan GGS to Chabua FGGS, 200 mm 10 km long natural gas pipeline from Nadua OCS to Dikom OCS and 50 mm to 300 mm approx. 150 km long assorted oil & gas flow lines/ delivery lines in Khagorijan Oil & Gas Field under Dibrugarh and Tinsukia districts of Assam. Some of the key hazard likely to be associated with same has been presented below

- Jet fires associated with pipework failures;
- Vapour cloud explosions; and
- Flash fires.

Each of these hazards has been described below.

Jet Fire

Jet fires result from ignited releases of pressurized flammable gas or superheated/pressurized liquid. The momentum of the release carries the material forward in a long plume entraining air to give a flammable mixture. Jet fires only occur where the natural gas is being handled under pressure or when handled in gas phase and the releases are unobstructed.

Flash Fire

Vapour clouds can be formed from the release of vapour of pressurized flammable material as well as from non-flashing liquid releases where vapour clouds can be formed from the evaporation of liquid pools or leakage/rupture of pressurized pipelines transporting flammable gas.

Where ignition of a release does not occur immediately, a vapour cloud is formed and moves away from the point of origin under the action of the wind.

This drifting cloud may undergo delayed ignition if an ignition source is reached, resulting in a flash fire if the cloud ignites in an unconfined area or vapour cloud explosion (VCE) if within confined area.

Vapour Cloud Explosion

If the generation of heat in a fire involving a vapour-air mixture is accompanied by the generation of pressure then the resulting effect is a vapour cloud explosion (VCE). The amount of overpressure produced in a VCE is determined by the reactivity of the gas, the strength of the ignition source, the degree of confinement of the vapour cloud, the number of obstacles in and around the cloud and the location of the point of ignition with respect to the escape path of the expanding gases.

However, in the case of the interconnecting gas pipeline network *jet fire* has been identified as the most probable hazard.

Pipeline Frequency Analysis

An effort has also been made to understand the primary failure frequencies of pressurised gas/oil to be transported through the interconnecting pipeline network. Based on the European Gas Pipeline Incident Data Group (EGIG) database the evolution of the primary failure frequencies over the entire period and for the last five years has been provided in ***Table 7.14*** below.

Table 7.14 Primary Gas Pipeline Failure Frequency

Period	No. of Incidents	Total System Exposure (km.yr)	Primary failure frequency (1000 km.yr)
1970-2007	1173	$3.15.10^6$	0.372
1970-2010	1249	$3.55.10^6$	0.351
1970-2013	1309	$3.98.10^6$	0.329
1974-2013	1179	$3.84.10^6$	0.307
1984-2013	805	$3.24.10^6$	0.249
1994-2013	426	$2.40.10^6$	0.177
2004-2013	209	$1.33.10^6$	0.157
2009-2013	110	$0.70.10^6$	0.158

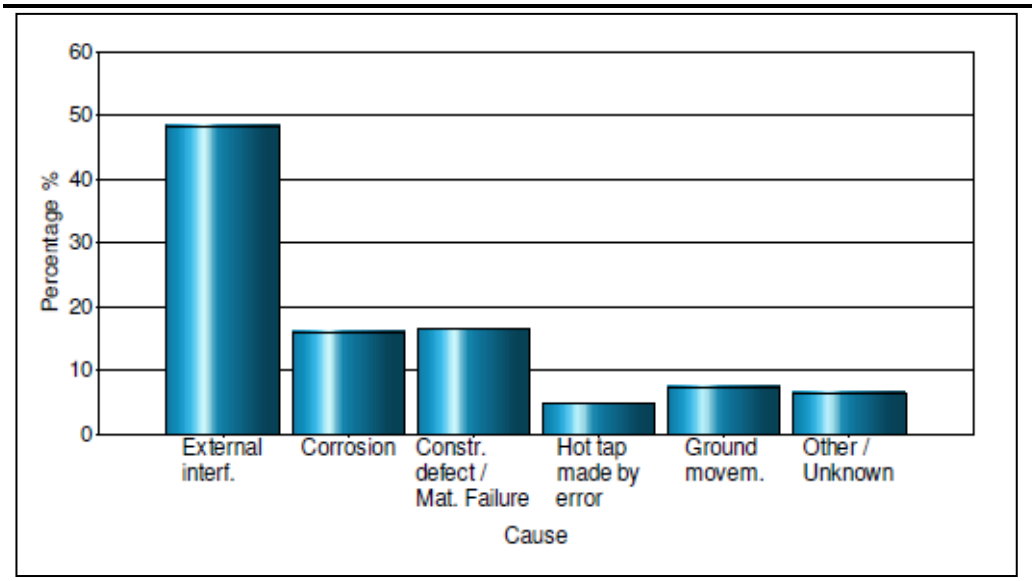
Source: 9th EGIG Report

As referred in the above table the overall failure frequency (0.33) of the entire period (1970-2013) is slightly lower than the failure frequency of 0.35 reported in the 8th EGIG report (1970-2010). The failure frequency of the last 5 years was found to be 0.16 per 1000km.year, depicting an improved performance over the recent years.

Incident Causes

Gas pipeline failure incidents can be attributed to the following major causes viz. external interference, construction defects, corrosion (internal & external), ground movement and hot tap. The distribution of incidents with cause has been presented in the ***Figure 7.10*** below.

Figure 7.10 Gas Pipeline Failure – Distribution of Incident & Causes



Source: 8th EGIG Report

The interpretation of the aforesaid figure indicated external interference as the major cause of pipeline failure contributing to about 48.4% of the total failure incidents followed by construction defects (16.7%) and corrosion related problems (16.1%). Ground movement resulting from seismic disturbance, landslides, flood etc. contributed to only 7.4% of pipeline failure incident causes.

Review of the 9th EGIG report indicates that primary failure frequency varies with pipeline diameter, and the same has been presented in ***Table 7.15*** below.

Table 7.15 Primary Failure Frequency based on Diameter Class (1970-2013)

Nominal Diameter (inch)	Primary failure frequency (per km.yr)		
	Pinhole/Crack	Hole	Rupture
diameter < 5"	4.45×10^{-4}	2.68×10^{-4}	1.33×10^{-4}
5" ≤ diameter < 11"	2.80×10^{-4}	1.97×10^{-4}	6.40×10^{-5}
11" ≤ diameter < 17"	1.27×10^{-4}	0.98×10^{-4}	4.10×10^{-5}
17" ≤ diameter < 23"	1.02×10^{-4}	5.00×10^{-5}	3.40×10^{-5}
23" ≤ diameter < 29"	8.50×10^{-5}	2.70×10^{-5}	1.20×10^{-5}
29" ≤ diameter < 35"	2.30×10^{-5}	5.00×10^{-6}	1.40×10^{-5}
35" ≤ diameter < 41"	2.30×10^{-5}	8.00×10^{-6}	3.00×10^{-6}
41" ≤ diameter < 47"	7.00×10^{-6}	-	-
diameter ≥ 47"	6.00×10^{-6}	6.00×10^{-6}	6.00×10^{-6}

Source: 9th EGIG Report

The pipeline failure frequency viz. leaks or rupture for the natural gas pipeline has been computed based on the aforesaid table. Considering the interconnecting gas pipeline to be laid is likely to have the following diameters - 50mm (1.96 inches), 200mm (7.87 inches) to 300mm (11.81 inches), the failure frequency has been presented in ***Table 7.16*** below.

Table 7.16 Interconnecting Pipeline - Failure Frequency

Sl. No	Pipeline Failure Case	EGIG Failure Frequency (per km.year)	Pipeline Dia (mm)	Avg. Pipeline Length (km)	Project Pipeline Failure Frequency (per year)	Frequency
1	Pipeline Rupture	1.33×10^{-4}	50	10	1.33×10^{-3}	Occasional/ Rare
2	Pipeline Leak	4.45×10^{-4}	50	10	4.45×10^{-3}	Occasional/ Rare
3	Pipeline Rupture	6.40×10^{-5}	200	180	11.52×10^{-3}	Occasional/ Rare
4	Pipeline Leak	2.80×10^{-4}	200	180	5.04×10^{-2}	Occasional/ Rare
5	Pipeline Rupture	4.10×10^{-5}	300	10	4.10×10^{-4}	Not Likely
6	Pipeline Leak	1.27×10^{-4}	300	10	1.27×10^{-3}	Occasional/ Rare

Thus the probability of pipeline leak and rupture with respect to the interconnecting hydrocarbon pipeline network is identified to be as "*Occasional/Rare*".

Pipeline Failure – Ignition Probability

The ignition probability of natural gas pipeline failure (rupture & leaks) with respect to the proposed expansion project is derived based on the following equations as provided in the IGEM/TD/2 standard

$P_{ign} = 0.0555 + 0.0137pd2$; for $0 \leq pd^2 \leq 57$
(For pipeline ruptures)
$P_{ign} = 0.81$; for $pd^2 > 57$

$P_{ign} = 0.0555 + 0.0137(0.5pd2)$; for $0 \leq 0.5pd^2 \leq 57$
(For pipeline leaks)
$P_{ign} = 0.81$; for $0.5pd^2 > 57$

Where:

P_{ign} = Probability of ignition
p = Pipeline operating pressure (bar)
d = Pipeline diameter (m)

The ignition and jet fire probability of natural gas release from a leak/rupture of interconnected pipeline network is calculated based on the above equations and presented in ***Table 7.17*** below.

Table 7.17 Interconnecting Pipeline – Ignition & Jet Fire Probability

Sl. No	Pipeline Failure Case	Pipeline Dia (mm)	Project Pipeline Failure Frequency (per year)	Ignition Probability	Jet Fire Probability
1	Pipeline Rupture	50	1.33×10^{-3}	0.056	7.46×10^{-5}
2	Pipeline Leak	50	4.45×10^{-3}	0.055	2.48×10^{-4}
3	Pipeline Rupture	200	11.52×10^{-3}	0.064	7.48×10^{-4}
4	Pipeline Leak	200	5.04×10^{-2}	0.060	3.03×10^{-3}
5	Pipeline Rupture	300	4.10×10^{-4}	0.076	3.14×10^{-5}
6	Pipeline Leak	300	1.27×10^{-3}	0.066	0.83×10^{-4}

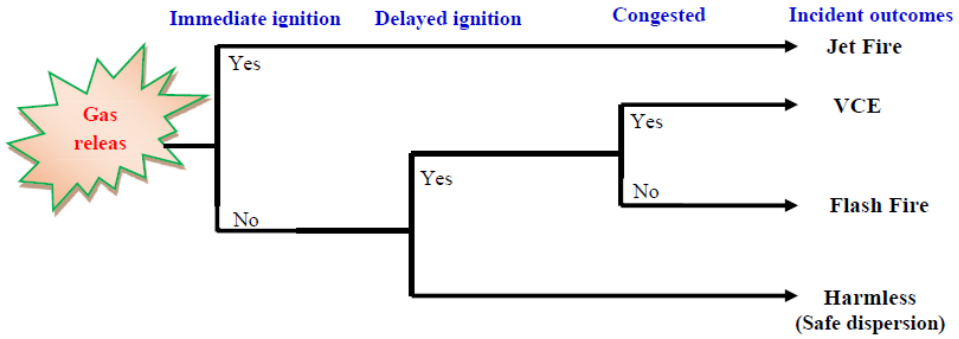
Hence from the above table it can be concluded that ignition probability of natural gas that may be released from the trunk and assorted pipelines due to any accidental event is mostly considered to be "***Not likely***".

Consequence Analysis – Pipelines & GCS

Pipelines generally contains large inventories of oil or gas under high pressure; although accidental releases from them are remote they have the potential of catastrophic or major consequences if related risks are not adequately analysed or controlled. The consequences of possible pipeline failure is generally predicted based on the hypothetical failure scenario considered and defining parameters such as meteorological conditions (stability class), leak hole & rupture size and orientation, pipeline pressure & temperature, physicochemical properties of chemicals released etc.

In case of pipe rupture containing highly flammable natural gas, an immediate ignition will cause a jet fire. Flash fires can result from the release of natural gas through the formation of a vapour cloud with delayed ignition and a fire burning through the cloud. A fire can then flash back to the source of the leak and result in a jet fire. Flash fires have the potential for offsite impact as the vapour clouds can travel considerable distances downwind of the source. Explosions can occur when a flammable gas cloud in a confined area is ignited; however where vapour cloud concentration of released material is lower than Lower Flammability Limit (LFL), consequently the occurrence of a VCE is highly unlikely. VCE, if occurs may result in overpressure effects that become more significant as the degree of confinement increases (Refer ***Figure 7.11***).Therefore, in the present study, only the risks of jet fires for the below scenarios have been modelled and calculated.

Figure 7.11 Natural Gas Release – Potential Consequences



[*Source: "Safety risk modelling and major accidents analysisof hydrogen and natural gas releases: Acomprehensive risk analysis framework" - Iraj Mohammadfam, Esmaeil Zarei*]

Based on the above discussion and frequency analysis as discussed in the earlier section, the following hypothetical risk scenarios (Refer ***Table 7.18***) have been considered for consequence analysis of the interconnecting pipelines.

Table 7.18 Interconnecting Pipeline Risk Modelling Scenarios

Scenario	Source	Pipeline dia (mm)	Accident Scenario	Design Pressure (bar)	Temperature	Potential Risk
1	Pipeline	50	Complete rupture	17.23	24°C	Jet Fire
2	Pipeline	300	Leak of 75mm dia	17.23	24°C	Jet Fire
3	Pipeline	300	Complete rupture	17.23	24°C	Jet Fire
4	Pipeline	200	Leak of 50mm dia	17.23	24°C	Jet Fire
5	Pipeline	200	Complete Rupture	17.23	24°C	Jet Fire

The pipeline failure risk scenarios have been modeled using ALOHA and interpreted in terms of Thermal Radiation Level of Concern (LOC) encompassing the following threshold values (measured in kilowatts per square meter) for natural gas (comprising of ~95% methane[1]) to create the default threat zones:

Red: 10 kW/ (sq. m) -- potentially lethal within 60 sec;

Orange: 5 kW/ (sq. m) -- second-degree burns within 60 sec; and

Yellow: 2 kW/ (sq. m) -- pain within 60 sec.

For vapour cloud explosion, the following threshold level of concern has been interpreted in terms of blast overpressure as specified below:

[1] https://www.naesb.org//pdf2/wgq_bps100605w2.pdf
http://www.google.co.in/url?sa=t&rct=j&q=&esrc=s&source=web&cd=18&ved=0ahUKEwjF7MiDttPRAhVCMI8KHd7aD6cQFghrMBE&url=http%3A%2F%2Fwww.springer.com%2Fcda%2Fcontent%2Fdocument%2Fcda_downloaddocument%2F9781848828711-c1.pdf%3FSGWID%3D0-0-45-862344-p173918930&usg=AFQjCNEaJklfYKl3fRUdi6xiRYeW-FJb2A

Red: 8.0 psi – destruction of buildings;

Orange: 3.5 psi – serious injury likely; and

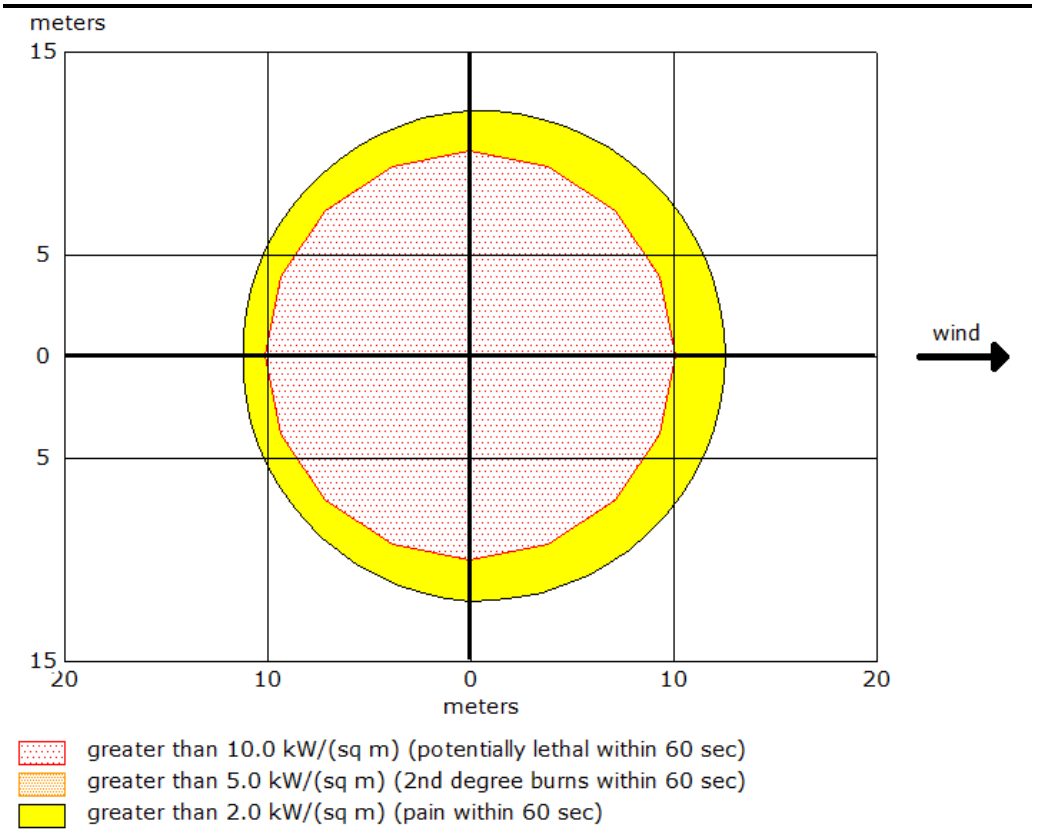
Yellow: 1.0 psi – shatters glass

The risk scenarios modelled for pipeline failure has been presented below:

Scenario 1: 50mm dia Pipeline Complete Rupture

The jet fire threat zone plot for release and ignition of natural gas from 50 mm dia pipeline ruputre is represented in ***Figure 7.12*** below.

Figure 7.12 Threat Zone Plot – 50mm dia pipeline complete rupture



Source: ALOHA

THREAT ZONE:

Threat Modelled: Thermal radiation from jet fire

Red : 10 meters --- (10.0 kW/ (sq. m) = potentially lethal within 60 sec)

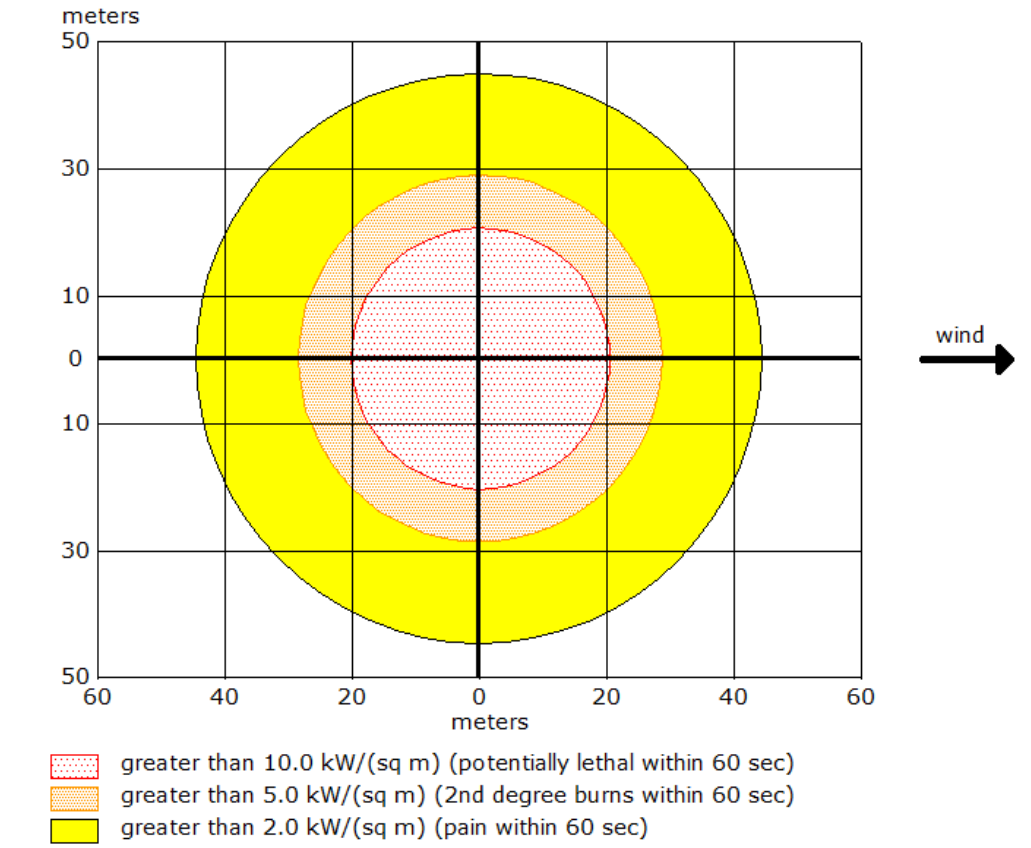
Orange: 10 meters --- (5.0 kW/ (sq. m) = 2nd degree burns within 60 sec)

Yellow: 13 meters --- (2.0 kW/ (sq. m) = pain within 60 sec)

The worst hazard for release and ignition of natural gas from the 50m dia pipeline rupture will be experienced to a maximum radial distance of 10m from the source with potential lethal effects within 1 minute.

The jet fire threat zone plot for release and ignition of natural gas from 300mm dia pipeline leak of 75mm dia is represented in ***Figure 7.13*** below.

Figure 7.13 Threat Zone Plot – 300mm dia pipeline leak (75mm dia)



Source: ALOHA

THREAT ZONE:

Threat Modeled: Thermal radiation from jet fire

Red : 21 meters --- (10.0 kW/ (sq. m) = potentially lethal within 60 sec)

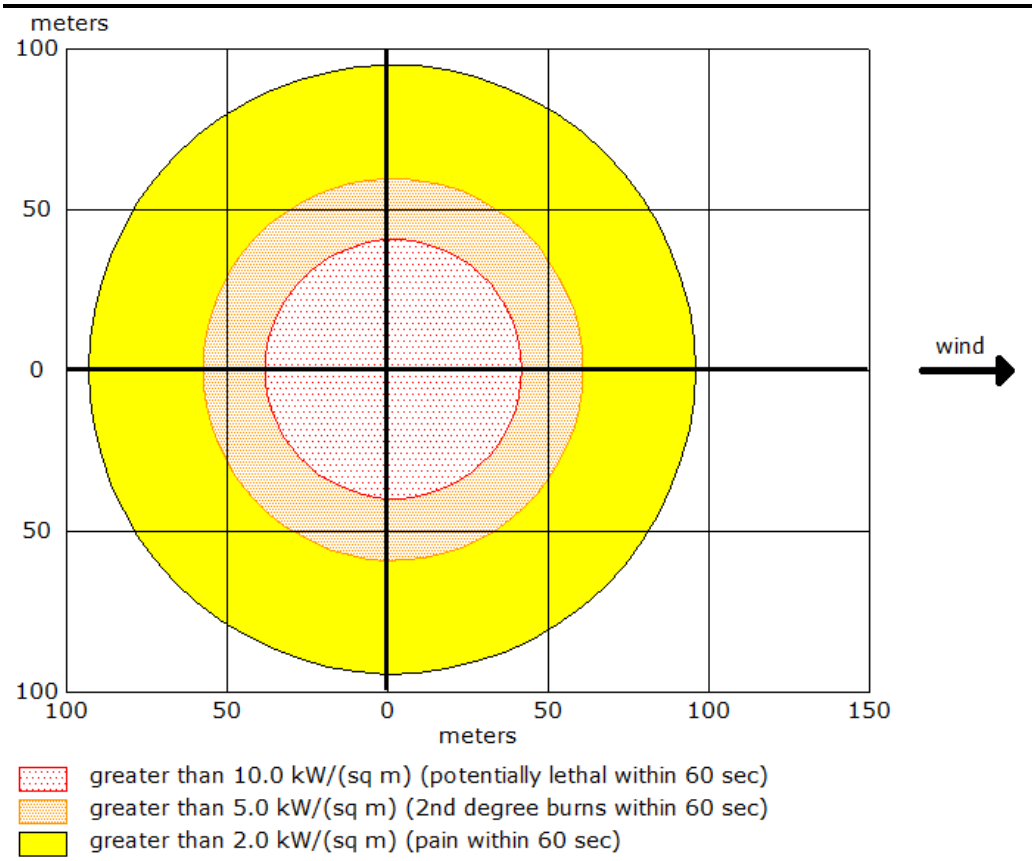
Orange: 29 meters --- (5.0 kW/ (sq. m) = 2nd degree burns within 60 sec)

Yellow: 45 meters --- (2.0 kW/ (sq. m) = pain within 60 sec)

The worst hazard for release and ignition of natural gas from 300m dia pipeline leak of 75mm dia will be experienced to a maximum radial distance of 21m from the source with potential lethal effects within 1 minute.

The jet fire threat zone plot for release and ignition of natural gas from 300m dia pipeline rupture is represented in ***Figure 7.14*** below.

Figure 7.14 Threat Zone Plot – 300mm dia pipeline rupture



Source: ALOHA

THREAT ZONE:

Threat Modeled: Thermal radiation from jet fire

Red : 42 meters --- (10.0 kW/ (sq. m) = potentially lethal within 60 sec)

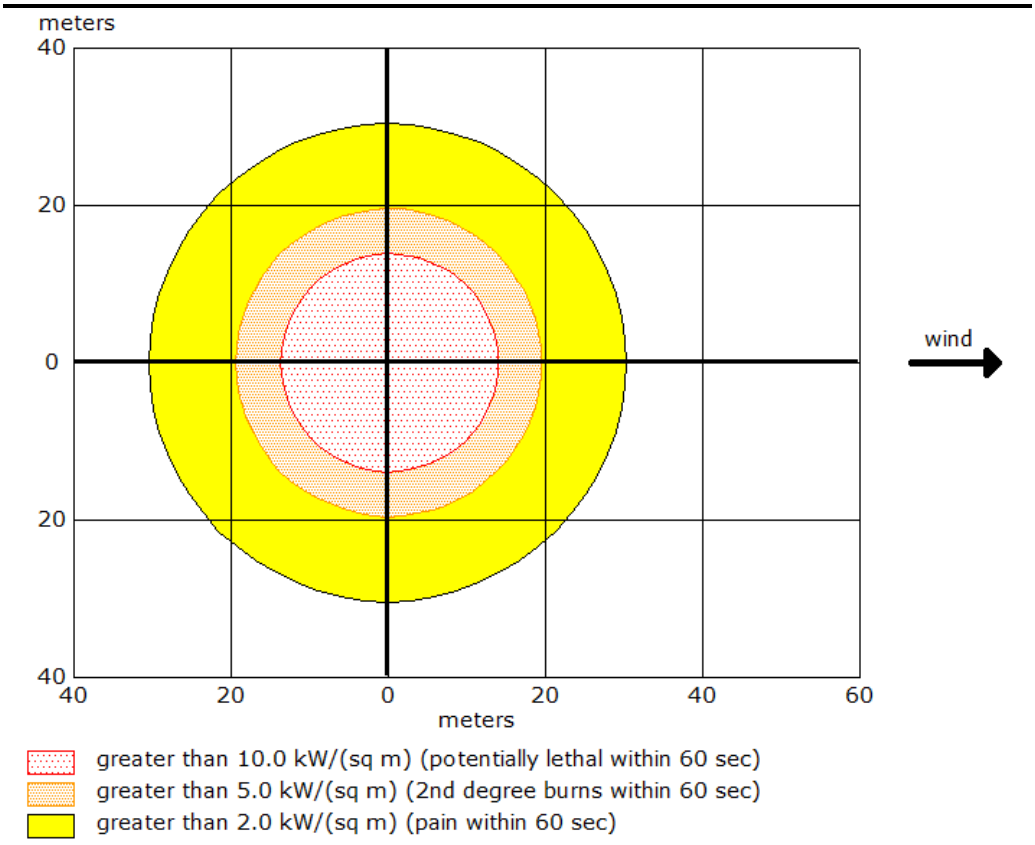
Orange: 61 meters --- (5.0 kW/ (sq. m) = 2nd degree burns within 60 sec)

Yellow: 96 meters --- (2.0 kW/ (sq. m) = pain within 60 sec)

The worst hazard for release and ignition of natural gas from 300mm dia pipeline rupture will be experienced to a maximum radial distance of 42m from the source with potential lethal effects within 1 minute.

The jet fire threat zone plot for release and ignition of natural gas from 200mm dia pipeline leak of 50mm dia is represented in ***Figure 7.15*** below.

Figure 7.15 Threat Zone Plot –200mm dia pipeline leak (50mm dia)



Source: ALOHA

THREAT ZONE:

Threat Modeled: Thermal radiation from jet fire

Red : 14 meters --- (10.0 kW/ (sq. m) = potentially lethal within 60 sec)

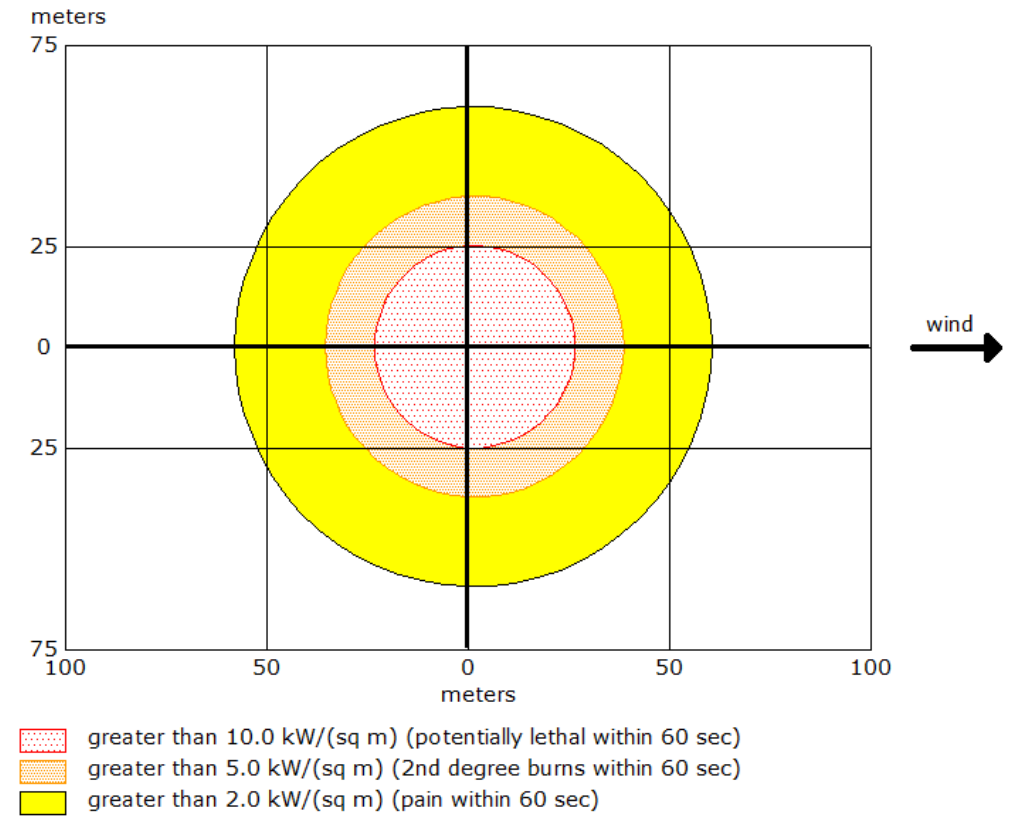
Orange: 20 meters --- (5.0 kW/ (sq. m) = 2nd degree burns within 60 sec)

Yellow: 30 meters --- (2.0 kW/ (sq. m) = pain within 60 sec)

The worst hazard for release and ignition of natural gas from 200mm dia pipeline leak of 50mm dia will be experienced to a maximum radial distance of 14m from the source with potential lethal effects within 1 minute.

The jet fire threat zone plot for release and ignition of natural gas from 200mm dia pipeline rupture is represented in ***Figure 7.16*** below.

Figure 7.16 Threat Zone Plot –200mm dia pipeline rupture



Source: ALOHA

THREAT ZONE:

Threat Modeled: Thermal radiation from jet fire

Red : 27 meters --- (10.0 kW/ (sq. m) = potentially lethal within 60 sec)

Orange: 39 meters --- (5.0 kW/ (sq. m) = 2nd degree burns within 60 sec)

Yellow: 61 meters --- (2.0 kW/ (sq. m) = pain within 60 sec)

The worst hazard for release and ignition of natural gas from 200mm dia pipeline rupture will be experienced to a maximum radial distance of 27m from the source with potential lethal effects within 1 minute.

For VCE modelled for catastrophic failure of interconnecting pipeline the LOC level was never exceeded

THREAT ZONE:

Threat Modeled: Overpressure (blast force) from vapour cloud explosion

Type of Ignition: ignited by spark or flame

Level of Congestion: uncongested

Model Run: Heavy Gas

Red : LOC was never exceeded --- (8.0 psi = destruction of buildings)

Orange: LOC was never exceeded --- (3.5 psi = serious injury likely)

Yellow: LOC was never exceeded --- (1.0 psi = shatters glass)

For calculating the risk significance of natural gas pipeline, the likelihood ranking is considered to be "3" as the probability of pipeline rupture is computed to be ~10^{-4} per year; whereas the consequence ranking has been identified to be as "3" as given for a worst case scenario (rupture) lethal effects is likely to be limited within a radial zone of ~42m. Further as discussed in the earlier section, adequate number of gas leak and fire detection system of appropriate design will be provided for the interconnecting pipeline network including GCS to prevent for any major risk at an early stage of the incident.

Risk Ranking – Pipeline Rupture (Worst Case Scenario)

Likelihood ranking	**3**	**Consequence ranking**	**3**
Risk Ranking & Significance =9 i.e. "Low" i.e. Risk is Acceptable and can be managed through use of existing controls with the option for installation of additional controls, if necessary.			

7.4.4 OCS Tank Failure

This section assesses the risks resulting from the storage of crude oil at the OCS in two production tanks of 795 KL capacity each.

Frequency Analysis – Diesel Storage

The most credible scenario of a storage tank will be pool fire. In order to determine the probability of a pool fire occurring, the failure rate needs to be modified by the probability of the material finding an ignition source. The probability of a pool fire occurring in the event of a release is therefore equal to the product of the failure rate and the probability of ignition. The frequency of the release scenarios identified in the earlier section is represented in ***Table 7.19*** below. The ignition probability is dependent on a number of factors including the type of site, the release rate and the type of material released.

Table 7.19 Tank Failure Frequency

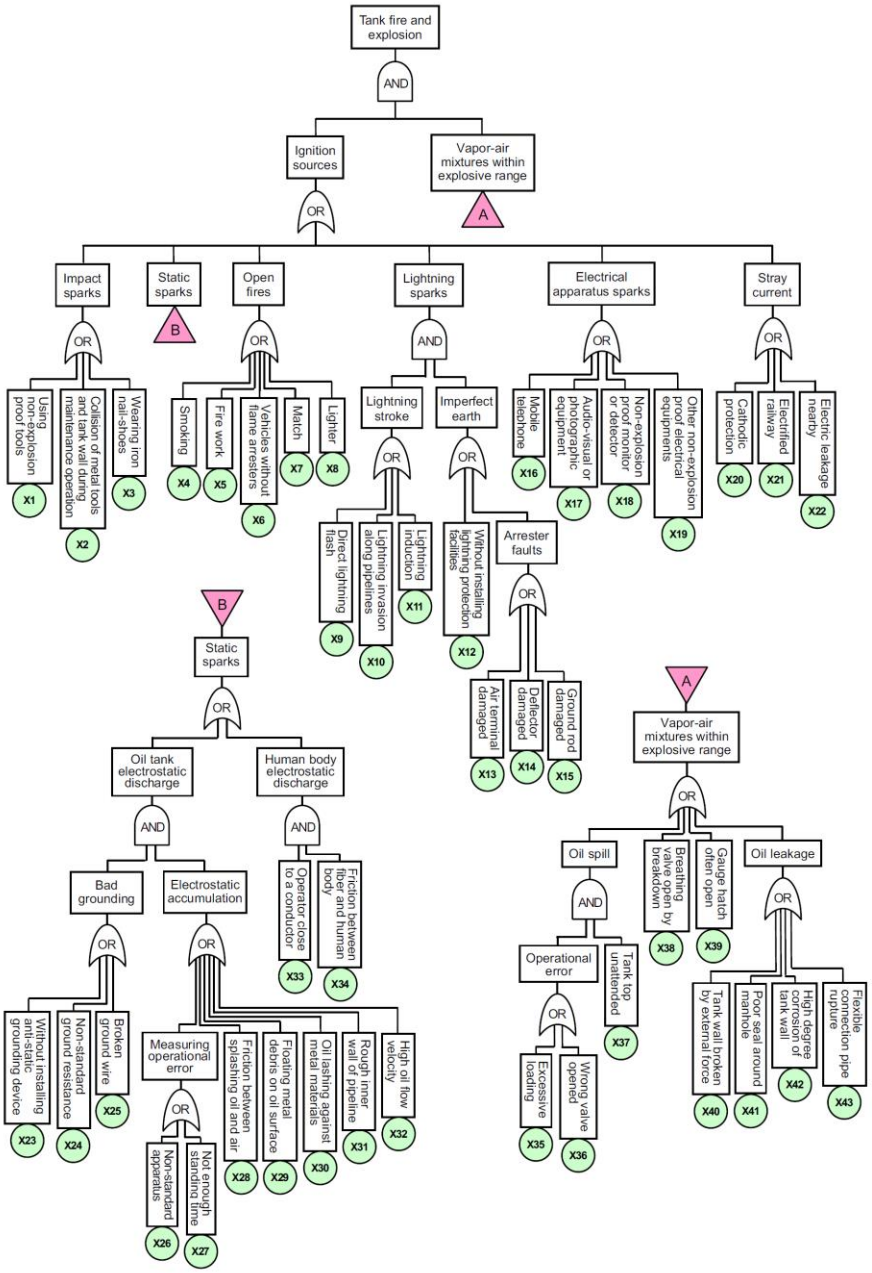
Sl. No	Type of Release	Failure Rate (per vessel per year)	Frequency
1	Catastrophic tanks failure	5.0×10^{-6}	Remote
2	Small bund fire	9.0×10^{-5}	Remote
3	Large bund fire	6.0×10^{-5}	Remote

Source: OGP Risk Assessment Data Directory Report No 434 – 3, March 2010, Section 2 – Summary of Recommended Data

Event Tree Analysis

Event tree analysis (ETA) is used to model the evolution of an event from the initial release through to the final outcome such as jet fire, fireball, flash fire etc. This may depend on factors such as whether immediate or delayed ignition occurs, or whether there is sufficient congestion to cause a vapour cloud explosion. The event tree for fire and explosion for an oil storage tank is shown in ***Figure 7.17***.

Figure 7.17 Event Tree Analysis - Tank Failure



Source: Fuzzy Fault Tree Analysis for Fire and Explosion in Crude Oil Tanks – Daqing Wang, Peng Zhang and Liqiong Chen, Journal of Loss Prevention in the Process Industries

Consequence Analysis – Tankages

The main hazards associated with the storage and handlings of crude oil are pool fires resulting from the ignition of released material as well as explosions and Flash fires resulting from the ignition of a flammable cloud formed in the event of tank overfilling. The hazards may be realised following tank overfilling and leaks/failures in the storage tank and ancillary equipment such as transfer pumps, metering equipment, etc. all of which can release significant quantities of flammable material on failure.

Bulk Storage Tank Scenarios

In addition to overfill, the scenarios considered for the crude oil storage tanks were partial/local failures and cold catastrophic failures. Factors that have been identified as having an effect on the integrity of tanks are related to design, inspection, maintenance, and corrosion[1]. The following representative scenarios for the tanks were considered (Refer ***Table 7.20***).

Table 7.20 OCS Storage Tank – Risk Modelling Scenarios

Scenario	Tank	Tank Diameter (m)	Tank Height (m)	Tank Volume (KL)	Accident Scenario
1	OCS Storage Tank	10.0	10.0	795	50mm leak
2		10.0	10.0	795	100mm leak
3		10.0	10.0	795	300mm leak (worst case)

The OCS storage tank failure risk scenarios have been modeled using ALOHA for n-decane which best represent the properties of crude oil and interpreted in terms of Thermal Radiation Level of Concern (LOC) encompassing the following threshold values (measured in kilowatts per square meter) to create the default threat zones:

Red: 10 kW/ (sq. m) -- potentially lethal within 60 sec;

Orange: 5 kW/ (sq. m) -- second-degree burns within 60 sec; and

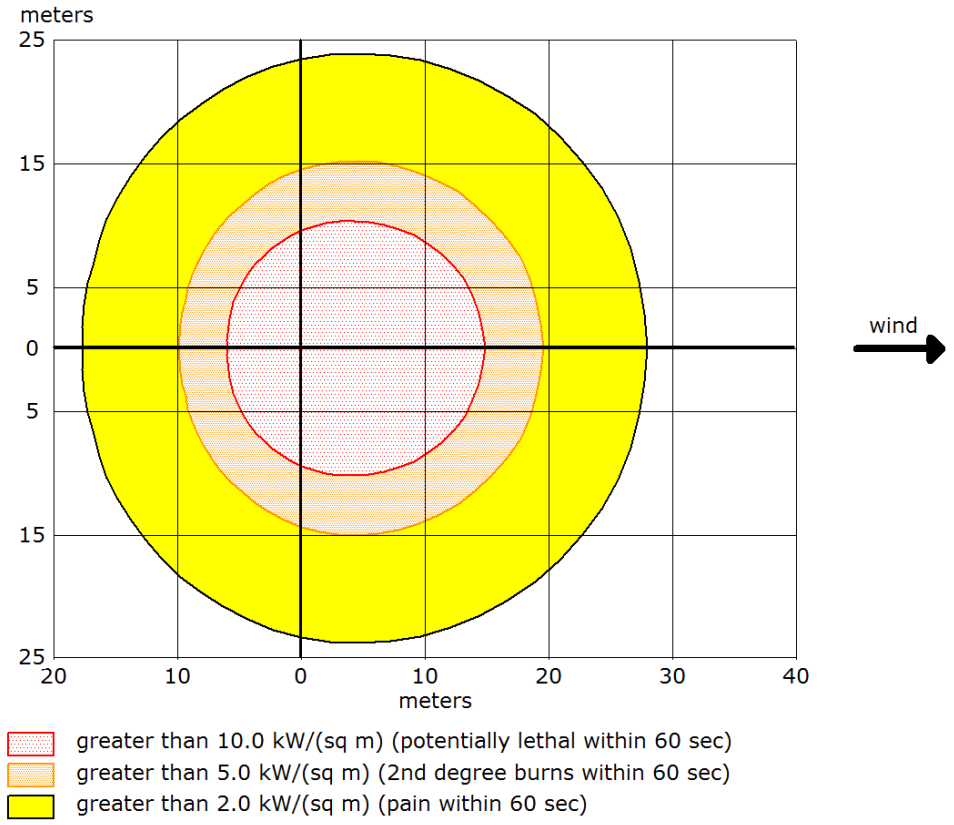
Yellow: 2 kW/ (sq. m) -- pain within 60 sec

[1] AEA Technology, HSE Guidance Document

Scenario 1: OCS Storage Tank Leak (50mm dia)

The pool fire threat zone plot for release and ignition of crude oil from a storage tank leak of 50mm dia is represented in ***Figure 7.18*** below.

Figure 7.18 Threat Zone Plot – OCS Storage Tank Leak (50mm dia)



Source: ALOHA

THREAT ZONE:

Threat Modeled: Thermal radiation from pool fire

Red : 15 meters --- (10.0 kW/ (sq. m) = potentially lethal within 60 sec)

Orange: 20 meters --- (5.0 kW/ (sq. m) = 2nd degree burns within 60 sec)

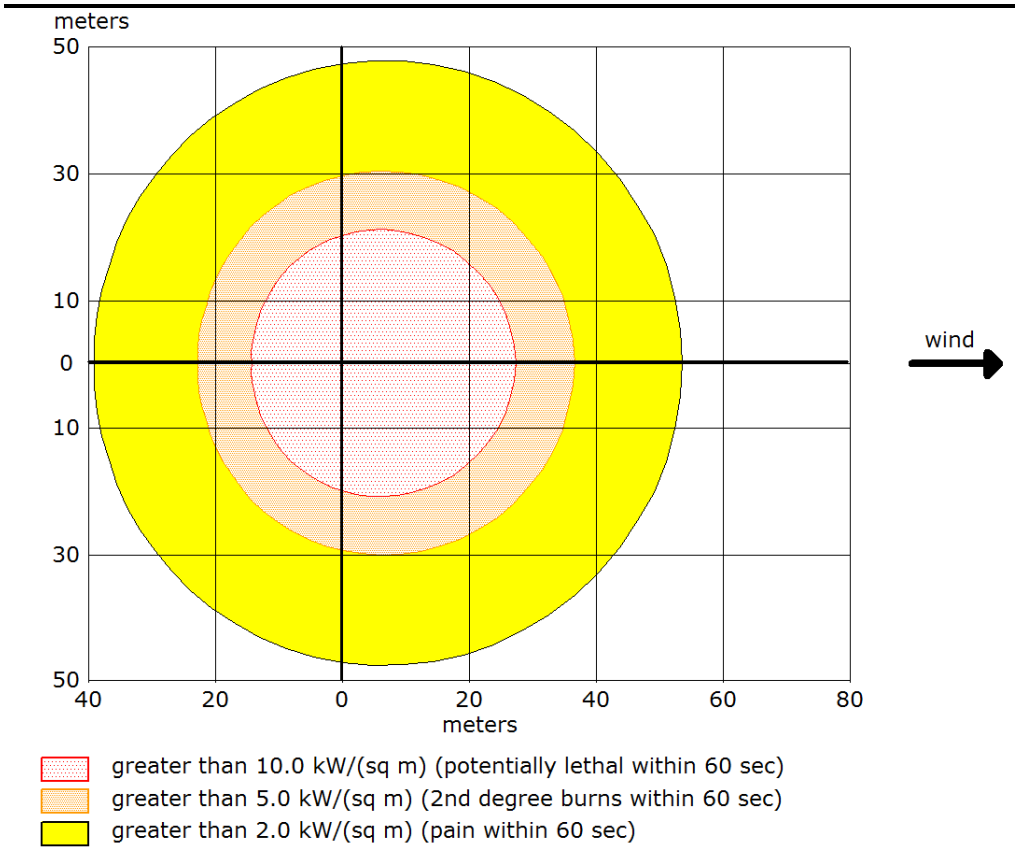
Yellow: 28 meters --- (2.0 kW/ (sq. m) = pain within 60 sec)

The worst hazard for release and ignition of crude oil from storage tank leak (50mm) will be experienced to a maximum radial distance of 15m from the source with potential lethal effects within 1 minute.

Scenario 2: OCS Storage Tank Leak (100mm dia)

The pool fire threat zone plot for release and ignition of crude oil from a storage tank leak of 100mm dia is represented in ***Figure 7.19*** below.

Figure 7.19 Threat Zone Plot – Diesel Storage Tank Leak (100mm dia)



Source: ALOHA

THREAT ZONE:

Threat Modeled: Thermal radiation from pool fire

Red : 27 meters --- (10.0 kW/ (sq. m) = potentially lethal within 60 sec)

Orange: 37 meters --- (5.0 kW/ (sq. m) = 2nd degree burns within 60 sec)

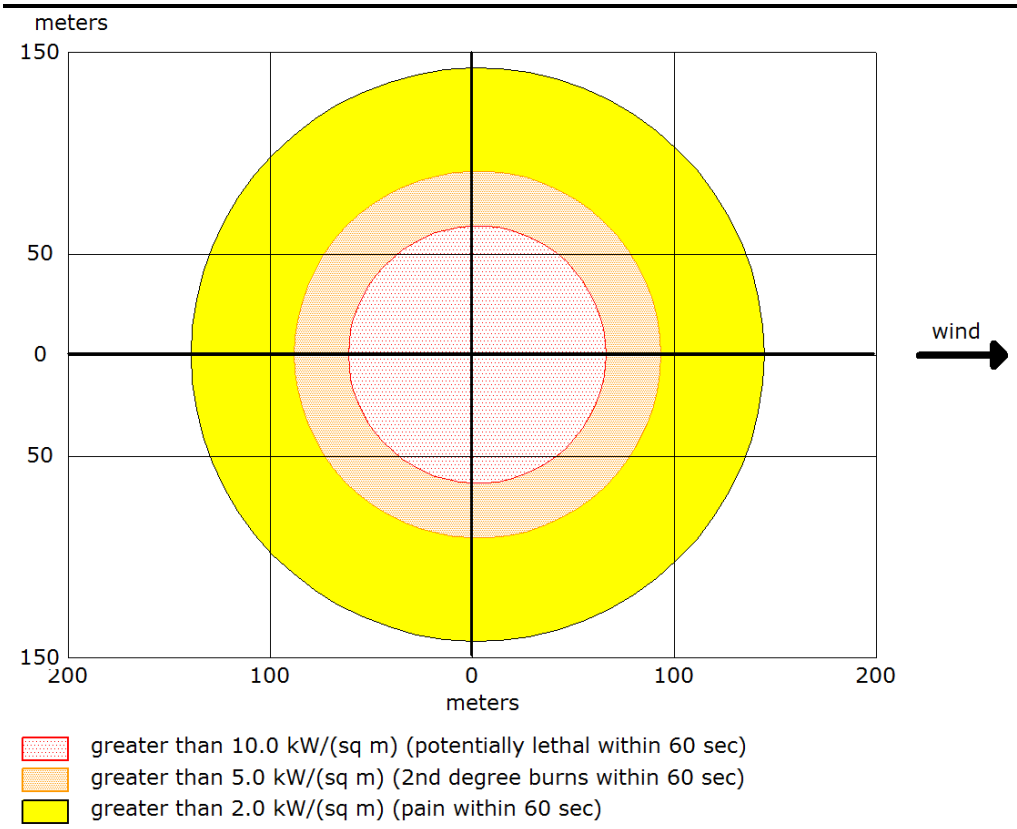
Yellow: 54 meters --- (2.0 kW/ (sq. m) = pain within 60 sec)

The worst hazard for release and ignition of crude oil from OCS storage tank leak (100mm) will be experienced to a maximum radial distance of 27m from the source with potential lethal effects within 1 minute.

Scenario 3: OCS Storage Tank Leak (300mm dia)

The pool fire threat zone plot for release and ignition of crude oil from a storage tank leak of 300mm dia (worst case) is represented in ***Figure 7.20*** below.

Figure 7.20 Threat Zone Plot – OCS Storage Tank Leak (300mm dia)



Source: ALOHA

THREAT ZONE:

Threat Modelled: Thermal radiation from pool fire

Red : 66 meters --- (10.0 kW/ (sq. m) = potentially lethal within 60 sec)

Orange: 93 meters --- (5.0 kW/ (sq. m) = 2nd degree burns within 60 sec)

Yellow: 144 meters --- (2.0 kW/ (sq. m) = pain within 60 sec)

The worst hazard for release and ignition of crude oil from storage tank leak (300mm) will be experienced to a maximum radial distance of 66m from the source with potential lethal effects within 1 minute.

For calculating the risk significance of crude oil storage failure, the likelihood ranking is considered to be "2" as the failure probability for such failure is computed to be ~5 x10^{-6}per year. With respect to consequence ranking, for the aforesaid incident it has been identified to be as "4" given for a worst case scenario lethal effects is likely to be experienced within a maximum radial zone ~66 meters. However, considering that isolated crude oil storages will be equipped appropriate state of the art process and fire safety controls in consistent with OISD-117 requirements, the risk is likely to be less significant.

Risk Ranking – OCS Tank Failure (Worst Case Scenario)

Likelihood ranking	**2**	**Consequence ranking**	**4**
Risk Ranking & Significance =8 i.e. "Low" i.e. Risk is Acceptable and can be managed through use of existing controls with the option for installation of additional controls, if necessary.			

7.4.5 Hazardous Material Releases or Mishaps

Release of following materials are not considered as major accidents and therefore are not quantified in terms of frequency, consequence and the resulting risk.

- Diesel fuel;
- Lubricants;
- Mud Chemicals;
- Explosives.

Exposure to such hazards would be **occupational** rather than **major** hazards.

7.4.6 External Hazards

External hazards which may impair the safety of the rig include the following:

- Severe weather conditions;
- Earthquake or ground movement; and
- Security breaches.

Extreme weather conditions are primarily lightening, cyclones and high winds and heavy rains. They may result in injury (through slips trips of personnel) or equipment damage. Cyclones and high winds may damage the rig structure. There are potential hazards to workers from direct impact of the structure i.e. falling equipment and any subsequent hydrocarbon releases caused by equipment damage. However, no fatalities are expected from such conditions i.e. the risk to workers is low, providing:

- Reliable weather forecasts are available;
- Work or rig move is suspended if conditions become too severe;

- Design and operational limits of the rig structure are known and not exceeded.

Other natural hazards, such as earthquake are predominant in Assam region. The risk of external hazards causing blowouts has been considered in the frequency estimation of oil and gas blowouts in the earlier sections.

7.5 DISASTER MANAGEMENT PLAN

Disaster Management is a process or strategy that is implemented when any type of catastrophic event takes place. The Disaster Management Plan envisages the need for providing appropriate action so as to minimize loss of life/property and for restoration of normalcy within the minimum time in event of any emergency. Adequate manpower, training and infrastructure are required to achieve this.

The objectives of Disaster Management Plan are as follows:

- Rapid control and containment of the hazardous situation;
- Minimising the risk and impact of occurrence and its catastrophic effects;
- Effective rehabilitation of affected persons and prevention of damage to Property and environment;
- To render assistance to outside the factory.

The following important elements in the disaster management plan (DMP) are suggested to effectively achieve the objectives of emergency planning:

- Reliable and early detection of an emergency and careful response;
- The command, co-ordination, and response organization structure along with efficient trained personnel;
- The availability of resources for handling emergencies;
- Appropriate emergency response actions;
- Effective notification and communication facilities;
- Regular review and updating of the DMP;
- Proper training of the concerned personnel.

7.5.1 Emergency Identified

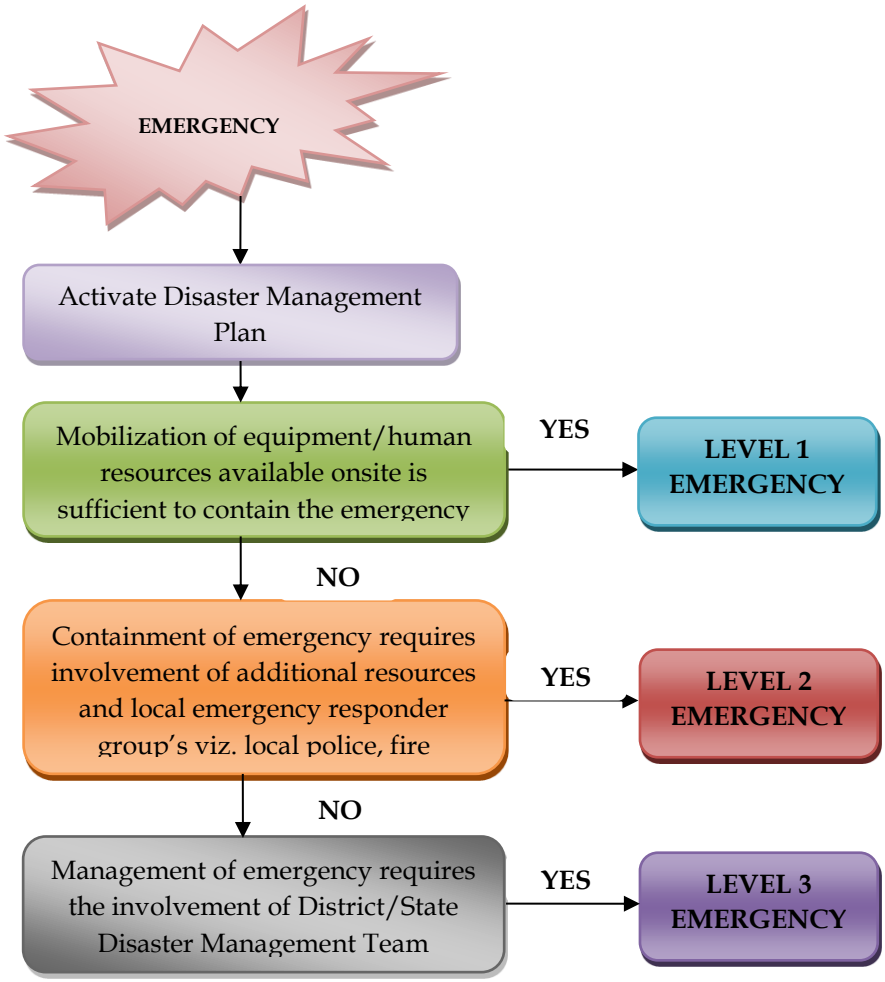
Emergencies that may arise:

- Such an occurrence may result in on-site implications like :
    - Fire or explosion;
    - Leakage of natural gas; and
    - Oil spillage and subsequent fire.
- Incidents having off-site implications can be:
    - Natural calamities like earthquake, cyclone, lightening, etc.
- Other incidents, which can also result in a disaster, are :
    - Agitation / forced entry by external group of people;
    - Sabotage.

7.5.2 *Emergency Classification*

Due consideration is given to the severity of potential emergency situation that may arise as a result of accident events as discussed in the **Risk Analysis (RA**) study. Not all emergency situations call for mobilization of same resources or emergency actions and therefore, the emergencies are classified into three levels depending on their severity and potential impact, so that appropriate emergency response procedures can be effectively implemented by the Emergency Response Team. The emergency levels/tiers defined with respect to this project based on their severity have been discussed in the subsequent sections with 'decision tree' for emergency classification being depicted in ***Figure 7.21.***

Figure 7.21 *Emergency Classification "Decision Tree"*



The emergency situations have been classified in three categories depending upon their magnitude and consequences. Different types of emergencies that may arise at the project site can be broadly classified as:

Level 1 Emergency

The emergency situation arising in any section of one particular plant / area which is minor in nature, can be controlled within the affected section itself, with the help of in-house resources available at any given point of time. The

emergency control actions are limited to level 1 emergency organization only. But such emergency does not have the potential to cause serious injury or damage to property / environment and the domino effect to other section of the affected plant or nearby plants/ areas.

Level 2 Emergency

The emergency situation arising in one or more plants / areas which has the potential to cause serious injury or damage to property / environment within the affected plant or to the nearby plants / areas. This level of emergency situation will not affect surrounding community beyond the power plant facility. But such emergency situation always warrants mobilizing the necessary resources available in-house and/or outsources to mitigate the emergency. The situation requires declaration of On – Site emergency.

Level 3 Emergency

The emergency is perceived to be a kind of situation arising out of an incident having potential threat to human lives and property not only within the power plant facility but also in surrounding areas and environment. It may not be possible to control such situations with the resources available within OIL facility. The situation may demand prompt response of multiple emergency response groups as have been recognized under the off-site district disaster management plan of the concerned district(s).

7.5.3 Preventive and Mitigation Measures for Blow Outs

Blowouts being events which may be catastrophic to any well operation, it is essential to take up as much a preventive measures as feasible. This includes:

- Necessary active barriers (eg. Well-designed Blowout Preventer) be installed to control or contain a potential blowout.
- Weekly blow out drills be carried out to test reliability of BOP and preparedness of drilling team.
- Close monitoring of drilling activity be done to check for signs of increasing pressure, like from shallow gas formations.
- Installation of hydrocarbon detectors.
- Periodic monitoring and preventive maintenance be undertaken for primary and secondary barriers installed for blow out prevention, including third party inspection & testing
- An appropriate Emergency Response Plan be finalized and implemented by OIL.
- Marking of hazardous zone (500 meters) around the well site and monitoring of human movements in the zone.
- Training and capacity building exercises/programs be carried out for onsite drilling crew on potential risks associated with exploratory drilling and their possible mitigation measures.
- Installation of mass communication and public address equipment.

- Good layout of well site and escape routes.

Additionally, OIL will be adopting and implementing the following Safe Operating Procedures (SOPs) developed as part of its Onsite Emergency Response Plan to prevent and address any blow out risks that may result during drilling and work over activities:

- Blow Out Control Equipment
- Choke lines and Choke Manifold Installation with Surface BOP
- Kill Lines and Kill Manifold Installation with Surface BOP
- Control System for Surface BOP stacks
- Testing of Blow Out Prevention Equipment
- BOP Drills

7.5.4 Preventive Measures for Handling of Natural Gas

- Leak detection sensors to be located at areas prone to fire risk/ leakages;
- All safety and firefighting requirements as per OISD norms to be put in place;
- High temperature and high pressure alarm with auto-activation of water sprinklers as well as safety relief valve to be provided;
- Flame proof electrical fittings to be provided for the installation;
- Periodical training/awareness to be given to work force at the project site to handle any emergency situation;
- Periodic mock drills to be conducted so as to check the alertness and efficiency and corresponding records to be maintained;
- Signboards including emergency phone numbers and 'no smoking' signs should be installed at all appropriate locations;
- Plant shall have adequate communication system;
- Pipeline route/equipment should be provided with smoke / fire detection and alarm system. Fire alarm and firefighting facility commensurate with the storage should be provided at the unloading point;
- 'No smoking zone' to be declared at all fire prone areas. Non sparking tools should be used for any maintenance; and
- Wind socks to be installed to check the wind direction at the time of accident and accordingly persons may be diverted towards opposite direction of wind.

7.5.5 Preventive Measures for Interconnecting Pipeline Risk Management

- Design all pipes and vessels to cope with maximum expected pressure;
- Install pressure transmitters that remotely monitor high- and low-pressure alarms;
- Design equipment to withstand considerable heat load;
- Conduct regular patrols and inspections of pipeline easements;
- Fit pumps with automatic pump shutdown or other safety devices;
- Minimise enclosed spaces where flammable gas may accumulate;

- Where necessary, automate emergency shutdown systems at production facilities;
- Consider installing flow and pressure instrumentation to transmit upset conditions and plant shutdown valves status;
- Install fire and gas detection systems;
- Implement security controls;
- Install emergency shutdown buttons on each production facility;
- Bury gathering lines at a minimum depth of 600 mm and where above ground, maintain a clear area;
- Implement management of change processes; and
- Conduct pressure testing and inspection of equipment and pipelines.

7.5.6 Preventing Fire and Explosion Hazards

- Proper marking to be made for identification of locations of flammable storages;
- Provision of secondary containment system for all fuel and lubricating oil storages;
- Provision of fire and smoke detectors at potential sources of fire and smoke;
- Storing flammables away from ignition sources and oxidizing materials;
- Providing specific worker training in handling of flammable materials, and in fire prevention or suppression;
- Equipping facilities with fire detectors, alarm systems, and fire-fighting equipment;
- Fire and emergency alarm systems that are both audible and visible;
- For safety of people the building, regulations concerning fire safety to be followed. Some of the requirements include:
- Installation of fire extinguishers all over the building;
- Provision of water hydrants in operative condition;
- Emergency exit;
- Proper labelling of exit and place of fire protective system installation;
- Conducting mock drills;
- Trained personnel to use fire control systems.

7.5.7 General Health and Safety

- The facility will adopt a total safety control system, which aims to prevent the probable accidents such as fire accidents or chemical spills.
- Fire fighting system, such as sprinklers system, portable extinguishers (such as CO_2) and automated fire extinguishers shall be provided at strategic locations with a clear labelling of the extinguisher so the type of the extinguisher is easily identifiable. Also a main hydrant around the buildings will be available. On all floors an automated fire detection system will be in place.

- The site operations manager will take steps to train all emergency team members and shall draw up an action plan and identify members. The appointed emergency controller shall act as the in-charge at the site of the incident to control the entire operation.
- The staff shall be trained for first-aid and firefighting procedures. The rescue team shall support the first-aid and firefighting team.
- A first-aid medical centre will be onsite to stabilise the accident victim. The emergency team will make contact with a nearby hospital for further care, if required.
- A training and rehearsal of the emergency response by emergency team members and personnel on site will be done regularly.
- A safe assembly area will be identified and evacuation of the premises will be practised regularly through mock drills.
- In case an emergency is being declared, the situation shall be reported to the authorities such as local police, the chief inspector of factories and the state pollution control board as per rules and regulation of law of the land.
- Safety manual for storage and handling of Hazardous chemicals shall be prepared.
- All the personnel at the site shall be made aware about the hazardous substance stored and risk associated with them.
- Personnel engaged in handling of hazardous chemicals shall be trained to respond in an unlikely event of emergencies.
- A written process safety information document shall be compiled for general use and summary of it shall be circulated to concerned personnel.
- MSDS shall be made available and displayed at prominent places in the facility. The document compilation shall include an assessment of the hazards presented including (i) toxicity information (ii) permissible exposure limits. (iii) Physical data (iv) thermal and chemical stability data (v) reactivity data (vi) corrosivity data (vii) safe procedures in process.
- Safe work practices shall be developed to provide for the control of hazards during operation and maintenance
- In the material storage area, hazardous materials shall be stored based on their compatibility characteristics.
- Near miss and accident reporting system shall be followed and corrective measures shall be taken to avoid / minimize near miss incidents.
- Safety measures in the form of DO and Don't Do shall be displayed at strategic locations.
- Safety audits shall be conducted regularly.
- Firefighting system shall be tested periodically for proper functioning.
- All hydrants, monitors and valves shall be visually inspected every month.
- Disaster Management Plan shall be prepared and available with concerned personnel department.

7.5.8 Personal Protective Equipment

In certain circumstances, personal protection of the individual maybe required as a supplement to other preventive action. It should not be regarded as a

BEFORE THE NATIONAL GREEN TRIBUNAL

EASTERN ZONE BENCH AT KOLKATA

APPEAL NO. 04/2020/EZ

IN THE MATTER OF :

BIMAL GOGOI & ANR.

Vs

UNION OF INDIA & ORS.

INDEX OF PAPERS

(VOLUMNE – II)

Sl. No.	Particulars	Pages
	Annexure-D-Copy of the Draft EIA report and Executive Summary, uploaded in the Website of the Assam State Pollution Control Board.	273–479

Filed by:-

ASSAM STATE POLLUTION CONTROL BOARD
Through its Member Secretary

Bamunimaidam, Guwahati – 781021, Assam

[Email : membersecretary@pcbassam.org]

FILED BY:

Sri Sushovit Dutt Majumdar

Advocate, High Court Kolkata

Kolkata, Pin – 700 039

DATE -

substitute for other control measures and must only be used in conjunction with substitution and elimination measures. PPEs must be appropriately selected individually fitted and workers trained in their correct use and maintenance. PPEs must be regularly checked and maintained to ensure that the worker is being protected.

7.5.9 First Aid

First aid procedures and facilities relevant to the needs of the particular workforce should be laid down and provided in consultation with an occupational physician or other health professional.

Health assessment should form a part of a comprehensive occupational health and safety strategy. Where employees have to undergo health assessment, there should be adequate consultation prior to the introduction of such program. Medical records should be kept confidential. Site should be able to relate employee health and illness data to exposure levels in the workplace.

8 PROJECT BENEFITS

Oil and natural gas produced from the Khagorijan Field will ultimately cater to fulfil the energy requirement of India. The dependency of India on other countries will be lessened to an extent. Additionally, the project will benefit people living in neighbouring villages in relation to direct & indirect employment associated with various project activities and will boost the local economy. The benefits of the project are listed below;

- Provision of more royalty to Assam Government and more cess to Govt. of India;
- Provision of more employment opportunity to local people;
- Development of infrastructure (roads, culverts, bridges, schools etc.) in the area;
- Increase in business opportunity for the local people;
- Energy security for the country;
- Programs related to livelihood generation, health improvement as per OIL's Corporate Social Responsibility (CSR) programmes.

Corporate Social Responsibility

OIL has taken up various CSR initiatives in and around its operational areas for the benefit of the residents as per the CSR Act and Rules, Govt. of India. OIL's CSR Vision Statement envisages 2% allocation of its net profit towards CSR. OIL would initiate a need assessment study in the area which will help to find out the infrastructure deficiencies, local demands and in course would help to delineated the detailed CSR plan.

The broad areas to be focused under the CSR plan would include;

- Health - arranging mobile health camps including eye camps, school health programmes which includes free dental awareness examination camps and free check-ups of the students; universal immunization programme etc.
- Education - Providing financial assistance to institutions towards purchasing of furniture and required amenities to school, libraries, auditoriums, teacher's common room etc.
- Funding for sports, cultural events etc.

9 ENVIRONMENTAL MANAGEMENT PLAN

This Environmental Management Plan and Monitoring Framework is a site-specific document for the drilling and production activities that have been developed to ensure that OIL can implement the project in an environmentally conscious manner and where all contractors, understand the potential environmental risks arising out of the proposed project and take appropriate actions to properly manage such risk.

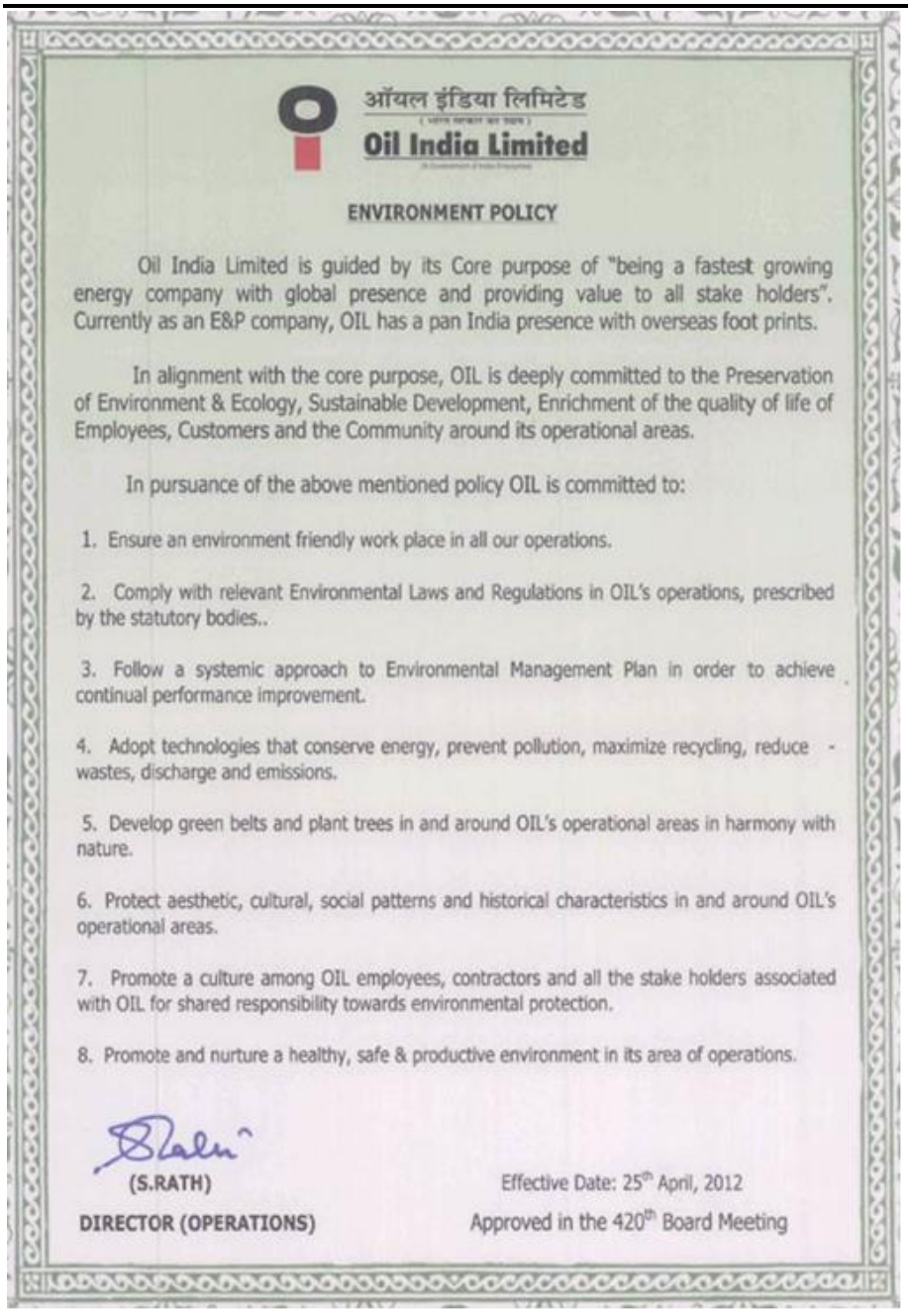
This EMP will be an overview document that will guide environmental management of all aspects of OIL's activities i.e. construction and operation of drilling wells, productions facilities and pipeline in Khagorijan Field. This EMP will be backed up by more specific Environmental Action Plans, Procedures and Bridging Documents with the progress of the site preparation, developmental drilling, well testing, construction of production facilities, construction of pipeline, operation of production facilities and pipeline and site decommissioning activities.

The EMP describes the actions to be adopted in terms of:

- National Policies and Regulations;
- Best Practices and guides; and
- Local Environmental and Social Sensitivities.

The Environment Policy of OIL is presented at ***Box 9.1.***

Box 9.1 OIL Corporate Environment Policy



ऑयल इंडिया लिमिटेड
Oil India Limited

ENVIRONMENT POLICY

Oil India Limited is guided by its Core purpose of "being a fastest growing energy company with global presence and providing value to all stake holders". Currently as an E&P company, OIL has a pan India presence with overseas foot prints.

In alignment with the core purpose, OIL is deeply committed to the Preservation of Environment & Ecology, Sustainable Development, Enrichment of the quality of life of Employees, Customers and the Community around its operational areas.

In pursuance of the above mentioned policy OIL is committed to:

1. Ensure an environment friendly work place in all our operations.
2. Comply with relevant Environmental Laws and Regulations in OIL's operations, prescribed by the statutory bodies..
3. Follow a systemic approach to Environmental Management Plan in order to achieve continual performance improvement.
4. Adopt technologies that conserve energy, prevent pollution, maximize recycling, reduce wastes, discharge and emissions.
5. Develop green belts and plant trees in and around OIL's operational areas in harmony with nature.
6. Protect aesthetic, cultural, social patterns and historical characteristics in and around OIL's operational areas.
7. Promote a culture among OIL employees, contractors and all the stake holders associated with OIL for shared responsibility towards environmental protection.
8. Promote and nurture a healthy, safe & productive environment in its area of operations.

(S.RATH)
DIRECTOR (OPERATIONS)

Effective Date: 25th April, 2012
Approved in the 420th Board Meeting

The environmental mitigation measures and plans are presented in form of a matrix according to the sequential flow of activities in the project life cycle. The matrix focuses on strategies to be adopted for safe guard of the environment from possible impacts resulting out of the project activities. The strategies have further been detailed out as management procedures and programmes in subsequent sections. These measures would be further updated by OIL during the implementation of the EMP.

The EMP helps establish the linkage between the activities environmental impacts and mitigation measures and presents the monitoring framework i.e. the Environmental Performance Indicator (EPI) No. as well as the Environmental Quality Indicator (EQI).

Table 9.1 Environment Management Matrix

S No	Activity	Ref	Aspect	Impact	Mitigation Measures	Monitoring	Timing/ Frequency	Responsible Party	Related Plans
	Physical Presence of drill site, rig and machineries, production sites	1.1	Change in visual characteristics of the area due to installation of drilling setup	Temporary change in landscape	On completion of works (in phases) all temporary structures, surplus materials and wastes will be completely removed. Only structure required for safety purposes would be retained on the bare drill site.	Site Inspection	Construction, Drilling, operation of production facilities & pipelines	OIL/Contractor	Waste Management Plan
		1.2	Increase of illumination at night time due to installation of drilling/production setup	Temporary disturbance of the nearby villagers	Appropriate shading of lights to prevent scattering	Grievance records/ Consultation with Villagers	Construction, Drilling, operation of production facilities & pipelines	OIL/Contractor	Management of social issues & concerns
		1.3	Influx of man power & immigrant labour force to nearby villages	Possibility Cultural and behavioural conflict	Preference used of local labour forces to the extent possible	Grievance records	Construction, Drilling, operation of production facilities & pipelines	OIL/Contractor	Management of social issues & concerns
	Storage & Handling of Materials & Spoils	2.1	Emission of fugitive dust from loading & unloading operation	Temporary impact on air quality especially SPM	All loading and unloading activities to be carried out as close as possible to the storage facilities.	Site Inspection	Construction, Drilling, operation of production facilities & pipelines	OIL/Contractor	Air Quality Management
		2.2	Accidental spillage of oil & chemicals	Potential contamination surface water body resulting impact on aquatic ecosystem	All spills to be reported and & contained to prevent entry of spilled chemicals/fuels to any surface water body or drainage channel	Records of spills/Community Grievances	Construction, Drilling, operation of production facilities & pipelines	OIL/Contractor	Surface water quality management plan, Wildlife Management Plan

S No	Activity	Ref	Aspect	Impact	Mitigation Measures	Monitoring	Timing/ Frequency	Responsible Party	Related Plans
				Potential impact on soil quality	All spills to be reported and remedial measures to be taken for clean-up of the spill.	Records of Spills/Site Inspection	Construction, Drilling, operation of production facilities & pipelines	OIL/Contractor	Spill management plan
	Transport of Materials, Spoils and Machinery	3.1	Emission of gaseous pollutants from vehicle during transportation of materials, spoils and machinery	Temporary deterioration on air quality along transport route	All diesel-powered equipment will be regularly maintained and idling time reduced to minimise emissions; Vehicle / equipment air emissions will be controlled by good practice procedures (such as turning off equipment when not in use); Vehicle / equipment exhausts observed emitting significant black smoke in their exhausts will be serviced/ replaced	Records and Site Inspection	Construction, Drilling, operation of production facilities & pipelines	OIL/Contractor	Air Quality Management plan
		3.2	Noise emission during transport of materials, spoils and machinery	Temporary deterioration in ambient noise along the transportation route	Undertake preventive maintenance of vehicles and machinery to reduce noise levels. Restriction on unnecessary use of horns by trucks and vehicle in settlement area	Site Inspection/ Records of repairs	Construction, Drilling, operation of production facilities & pipelines	OIL/Contractor	Noise Quality Management Plan
	Operation & maintenance of rig and associated and	4.1	Emission of air pollutant from DG/GG sets	Temporary impact on air quality due to increase in	Preventive maintenance of DG sets to be undertaken as per manufacturers schedule	Site Inspection/ Records of repairs	Drilling, operation of production facilities	OIL/Contractor	Air Quality Management plan

S No	Activity	Ref	Aspect	Impact	Mitigation Measures	Monitoring	Timing/ Frequency	Responsible Party	Related Plans
	machinery; operation of production installations, operation of pipelines			concentration of gaseous pollutants e.g. NOx , HC					
		4.2	Emission of Noise from DG/GG sets	Temporary increase of ambient as well a work place noise level	All workers working near high noise generating equipment to be provided with Personal Protective equipment Preventive maintenance of machinery to be undertaken as per manufacturers schedule Install sufficient engineering control (mufflers) to reduce noise level at source	Recording of Noise	Drilling, operation of production facilities	OIL/Contractor	Noise Quality Management Plan and Occupational Health & Safety Management Plan
		4.3	Emission of noise from operation of the rig	Temporary increase of ambient as well a work place noise level	All workers working near high noise generating equipment to be provided with Personal Protective equipment Preventive maintenance of machinery to be undertaken as per manufacturers schedule	Site Inspection	Drilling of Wells	OIL/Contractor	Noise Quality Management Plan and Occupational Health & Safety Management Plan
		4.4	Abstraction of ground water for project usage	Depletion of ground water resources	Optimize use of water during drilling operations	Record Keeping and Auditing	Drilling of Wells, operation of production facilities	OIL/Contractor	None

S No	Activity	Ref	Aspect	Impact	Mitigation Measures	Monitoring	Timing/ Frequency	Responsible Party	Related Plans
		4.5	Noise from mud pump during preparation of drilling mud	Temporary increase of ambient & work place noise level	Preventive maintenance of machinery to be undertaken as per manufacturers schedule All workers working near high noise generating equipment to be provided with Personal Protective equipment	Recording of Noise	Drilling of Wells	OIL/Contractor	Noise Quality Management Plan and Occupational Health & Safety Management Plan
		4.6	Accidental spillage of chemicals during preparation drill mud	Contamination of soil resulting loss of soil living organism	Manage spills of contaminants on soil	Records of spills	Drilling of Wells	OIL/Contractor	Spill Management plan
		4.7	Accidental spillage of chemicals during preparation drill mud	Potential impact on surface water quality and aquatic ecosystem	All spill to be contained so that it does not reach any surface water body or drainage channels	Records of spills	Drilling of Wells	OIL/Contractor	Surface water quality management plan
	Operation & maintenance of Vehicles	5.1	Emission of Noise from vehicles	Temporary increase of noise level in areas abutting transport route	Preventive maintenance of vehicles to be undertaken as and when required	Maintenance Records	Drilling, operation of production facilities	OIL/Contractor	Noise quality management plan
		5.2	Emission of gaseous air pollutant from vehicles	Temporary deterioration air quality in areas abutting transport routes	Preventive maintenance of vehicles to be undertaken as and when required	Site Inspection/ Records of repairs	Drilling, operation of production facilities	OIL/Contractor	Air quality management plan

S No	Activity	Ref	Aspect	Impact	Mitigation Measures	Monitoring	Timing/ Frequency	Responsible Party	Related Plans
		5.3	Spillage of fuels & lubricants from vehicles	Contamination of soil resulting loss of soil living organism	Adopt best practices e.g. use pumps and dispensing nozzle for transfer of fuel, use of drip trays. Etc.	Site Inspections /Audits	Drilling, operation of production facilities	OIL/Contractor	Spill Management plan
				Impact on surface water quality and aquatic ecosystem	The drainage system on site to be provided with Sedimentation tank and Oil-water Separator to prevent contamination especially oil and grease from being carried off by runoff.	Site Inspection/ Audits	Drilling, operation of production facilities	OIL/Contractor	Surface water quality management plan and Spill Management plan
	Casing & cementing of well	6.1	Noise from machinery during preparation of cement slurry	Temporary increase of ambient noise level	Install sufficient engineering control on equipment and machineries (like mufflers in DG sets) to reduce noise and vibration emission levels at source, carry out proper maintenance and subject them to rigid noise and vibration control procedures.	Site Inspection	Drilling of Wells	OIL/Contractor	Noise quality management plan
		6.2	Loss of drilling mud and cement slurry during casing of well	Potential contamination of ground water aquifer	Proper engineering controls during cementing operation to prevent migration of drilling mud and cement slurry into ground water aquifer	Site Inspection	Drilling of Wells	OIL/Contractor	Ground water quality management plan
	Temporary storage, handling &	7.1	Accidental spillage of process waste (unused cement	Potential for contamination	Proper engineering controls for the drilling	Drilling and Decommiss	Drilling and Decommissioning Phases	OIL/Contractor	Ground water quality

S No	Activity	Ref	Aspect	Impact	Mitigation Measures	Monitoring	Timing/ Frequency	Responsible Party	Related Plans
	disposal of process waste		slurry, return mud & drill cuttings) at the temporary storage site	of soil and ground water	and cementing operations;	ioning Phases			management plan
		7.2	Surface runoff from temporary storage site of drill cuttings & unused mud into surface water bodies	Impact on surface water quality and aquatic ecosystem	All Temporary waste storage area will have proper bunds to prevent any escape of contaminated runoff Ensure that any runoff from such temporary storage area are channelized into ETP	Site Inspection and Record keeping	Drilling and Decommissioning Phases	OIL/Contractor	Surface water quality management plan and Spill Management plan
		7.3	Accidental leakage/spillage of oils and lubricants from temporary storages	Contamination of soil resulting in loss of soil living organism	Dispose process waste and domestic waste as per regulation/ best practices Dispose debris and waste in designated areas and as per plan to prevent degradation of land	Site Inspection	Drilling, operation of production facilities	OIL/Contractor	Waste Management Plan and Spill Management plan
		7.4	Accidental leakage/spillage of oils and lubricants from temporary storages	Contamination of surface water resulting in deterioration of surface water quality and adverse impact on aquatic ecosystem	All chemical and fuel storage areas will have proper bunds so that contaminated run-off cannot escape into the storm-water drainage system. The waste pits (waste water and drill cuttings) will be bounded and covered by tarpaulin sheet to prevent mixing	Site Inspection	Drilling, operation of production facilities	OIL/Contractor	Waste Management Plan and Spill Management plan

S No	Activity	Ref	Aspect	Impact	Mitigation Measures	Monitoring	Timing/ Frequency	Responsible Party	Related Plans
					of runoff water with waste water and leachate from waste pit and also reduce the volume of waste water.				
		7.5	Disposal/spillage of spent oils & lubricants into environmental media	Contamination of soil resulting loss of soil living organism Contamination of surface water resulting deterioration of surface water quality and aquatic ecosystem	Ensure recycling of spent oil & lubricant through authorized dealer	Site Inspection	Drilling, operation of production facilities	OIL/Contractor	Waste Management Plan and Spill Management plan
		7.6	Disposal of used battery & spent filters in environmental media	Potential for contamination of soil, ground water and surface water body	Ensure recycling of waste through authorized waste recycler	Site Inspection and Record Keeping	Drilling, operation of production facilities	OIL/Contractor	Waste Management Plan and Spill Management plan
		7.7	Offsite disposal of metallic, packing, scrap	Localized visual impacts		Site Inspection and Record Keeping	Drilling, operation of production facilities	OIL/Contractor	Waste Management Plan
	Testing & Flaring of natural gas	8.1	Emission of air pollutants from flare stack at drill site and production facilities	Temporary localized deterioration air quality (NOx, HC)	Proper engineering controls to ensure complete combustion of gas Location of Flare stack to be chosen considering	Engineering Designs /Site inspections	Drilling, operation of production facilities	OIL S& E Team and Drilling team	Waste Management Plan

S No	Activity	Ref	Aspect	Impact	Mitigation Measures	Monitoring	Timing/ Frequency	Responsible Party	Related Plans
					the sensitive receptors adjoining the site				
	Discharge of process waste water	9.1	Discharge process waste water into the surface water body	Contamination of surface water resulting deterioration of surface water quality and aquatic ecosystem	Treatment of process waste water in the ETP before discharge into the surface water body	Site Inspection and Record Keeping	Drilling, operation of production facilities	OIL/Contractor	Surface water quality management plan
	Storage of materials (equipment, chemicals, fuel)	10.1	Accidental spillage during storage and handling of materials	Potential for contamination of soil & ground water	Impervious storage area, especially for fuel & lubricant, chemical, hazardous waste, etc.	Site Inspection	Drilling, operation of production facilities	OIL/Contractor	Spill Management plan
				Safety concerns for workers involved in handing of hazardous materials	Personal protective equipment to be provided to workers involving in handling of hazardous materials	Site Inspection	Drilling, operation of production facilities	OIL/Contractor	Health and Safety Plan
	Technical Emergencies	11.1	Probability of accidental leakage of gas/ liquid hydro-carbons due to failure of safety devices	Potential adverse impact on personnel, environment & assets	Proper engineering controls to prevent leakage of sour gases Obtain an early warning of emergency conditions so as to prevent a negative impact on personnel, the environment, and assets Safeguard personnel to prevent injuries or loss of life by either protecting personnel	Site Inspection	Drilling, operation of production facilities	OIL/Contractor	Emergency Response Plan

S No	Activity	Ref	Aspect	Impact	Mitigation Measures	Monitoring	Timing/ Frequency	Responsible Party	Related Plans
					from the hazard and/or evacuating them from the facilities Minimize the impact of such an event on the environment and the facilities by mitigating the potential for escalation and, where possible, containing the release Develop evacuation procedures to handle emergency situations.				
	Dismantling of rig & associated machineries	12.1	Emission of noise during dismantling of rig	Temporary deterioration of ambient noise quality resulting in discomfort	All noise generating activities will be restricted during day time	Site Inspection	Well Decommissioning Phase	OIL/Contractor	Noise quality management plan
		12.2	Generation of waste during dismantling of rig	Temporary visual impacts	Storage of waste in designated areas only recyclable waste should be recycled through authorized water recycler	Site Inspection	Well Decommissioning Phase	OIL/Contractor	Waste Management Plan
		12.3	Disposal/spillage of spent oils & lubricants into environmental media	Contamination of soil resulting loss of soil living organism Contamination of surface water resulting	Manage spills of contaminants on soil	Site Inspection and Record keeping	Well Decommissioning Phase	OIL/Contractor	Waste Management Plan

S No	Activity	Ref	Aspect	Impact	Mitigation Measures	Monitoring	Timing/ Frequency	Responsible Party	Related Plans
				deterioration of surface water quality and aquatic ecosystem					
	Transportation of drilling facilities	13.1	Emission of gaseous air pollutant during transportation of drilling facilities	Temporary localized deterioration of air quality due to emission gaseous pollutants	Vehicle / equipment air emissions will be controlled by good practice procedures (such as turning off equipment when not in use); and Vehicle / equipment exhausts observed emitting significant black smoke in their exhausts will be serviced/ replaced	Site Inspection and Record keeping	Well Decommissioning Phase	OIL/Contractor	Air quality management plan
		13.2	Fugitive emissions due to re-entrainment of dust during transport of drilling facilities	Temporary localized deterioration of air quality due to increase in SPM levels	Approach road to be sprinkled daily with water	Site Inspection	Well Decommissioning Phase	OIL/Contractor	Air quality management plan
		13.3	Emission of noise during transport of drilling facilities	Temporary deterioration of noise quality	Restrict all noise generating operations, except drilling, to daytime Restriction on unnecessary use of horns by trucks and vehicle in settlement area	Site Inspection	Well Decommissioning Phase	OIL/Contractor	Noise quality management plan

9.1 SPECIFIC MANAGEMENT PLANS

The specific management plans to address the impacts have been described in the sections below:

9.1.1 Air Quality Management Plan

Scope

The Air Quality Management Plan (AQMP) is applicable for and encompasses both construction and operational phase activities for the proposed project that has the potential to adversely affect ambient air quality due to the proposed project.

Purpose

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, production facilities and pipelines, drilling operations, operation of production facilities and decommissioning/site closure of well sites. The plan also details out roles and responsibilities of OIL and the contractors to ensure effective implementation of the plan.

Mitigation Measures –Construction

Designing, Planning & Procurement

- Vehicles delivering raw materials like fine aggregates will be covered to prevent fugitive emissions;
- Storage and handling of construction material and debris to be carefully managed to prevent generation of fugitive dust;
- All vehicles utilized in transportation of raw material and personnel will have valid Pollution under Control Certificate (PUC). Vehicular exhaust will be complying with the CPCB specified emission norms for heavy diesel vehicles;
- The top soil generated from site clearance activities will be stored in designated area and stabilized to prevent fugitive dust emissions;
- Adequate stack height to be provided to DG sets in accordance CPCB standards.

Dust Suppression

- Sprinkling of water on earthworks, material haulage and transportation routes on a regular basis.

Monitoring

- Periodic ambient air quality monitoring will be conducted in accordance with the Environment Monitoring Program.

Mitigation Measures- Drilling, Operation of Production Facilities

Operation of Machineries, Vehicle & Drilling Rig

- Exhausts of diesel generators will be positioned at a sufficient height to ensure dispersal of exhaust emissions; engines will not be left running unnecessarily;
- Vehicles involved in the transportation of project personnel will have valid PUC Certificate and will be subjected to periodic preventive maintenance;
- An efficient test flare burner head equipped with an appropriate combustion enhancement system will be selected to minimize incomplete combustion, black smoke and hydrocarbon fallout;
- OIL never encountered H_2S and no such evidence exists in the field of operation of OIL in Khagorijan Field. However, action is being initiated to develop a contingency plan for H_2S release. H_2S detector and self-containing breathing apparatus will be made available to drill sites and production facilities.

Regular Maintenance of Machineries and Vehicles

- Preventive maintenance of DG sets will be undertaken as per manufacturers schedule to ensure compliance with CPCB specified generator exhaust;
- Flaring will be undertaken in accordance with the CPCB Guidelines for Discharge of Gaseous Emissions for Oil & Gas Extraction Industry;
- Maintenance of diesel engines which are to be used as prime movers for mainline & fire water pumps, instrument air compressors and emergency generators will be carried out in accordance with OISD Standard "OISD-STD-121- Inspection of Turbines & Diesel Engines";
- Periodic monitoring of DG set stack emission will be carried out in accordance with the Environmental Monitoring Plan to assess compliance with CPCB DG set exhaust standards.

Monitoring

- Periodic monitoring of ambient air quality and equipment emission will be conducted in accordance with the Environment Monitoring Program.

Mitigation Measures- Decommissioning/Site Closure

Mitigation measures to address the air quality impacts resulting from vehicular movement, operation of heavy construction machinery and material handling are similar to those discussed above.

9.1.2 Noise Management Plan

Scope

The noise control plan is applicable for construction of well sites, production facilities and pipelines, drilling operations, operation of production facilities and decommissioning/site closure of well sites.

Purpose

The noise control plan to ensure specific measures to minimize noise level in the project site 75 dB(A) as per CPCB Noise rules. The plan also outlines roles and responsibilities of both OIL and the contractors involved in the implementation of the plan.

Mitigation Measures –Construction

Planning, Designing & Procurement

- 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 will have valid PUC Certificate;
- All high noise generating equipment will be identified and subjected to periodic preventive maintenance;
- No night time operation of vehicles and construction activities will be undertaken;
- Site personnel will be trained in the proper use and maintenance of tools and equipment, including the positioning of machinery on site to reduce noise related to neighbouring communities.

Maintenance of Machineries & Equipment

- Periodic preventive maintenance of DG sets and vehicles will be carried out as per manufacturer's schedule to ensure compliance with noise limits specified by CPCB for vehicles and DG sets.

Monitoring

- Periodic monitoring of ambient noise quality will be conducted in accordance with the Environment Monitoring Program.

Mitigation Measures- Drilling, Operation of Production Facilities

Operation and maintenance of machineries

- Installing acoustic enclosures and muffler on engine exhaust of DG sets to ensure compliance with generator noise limits specified by CPCB;

- Undertaking preventive maintenance of the mainline and booster pumping units in accordance with guidelines and schedule referred in the OISD Standard- "OISD-STD-119 –Inspection of Pumps";
- Relevant guidelines/standards viz. API 615--Sound Control of mechanical equipment etc. will be followed in controlling noise generated from mechanical equipment and machineries.

Monitoring

- Periodic monitoring of ambient noise quality will be conducted in accordance with the Environment Monitoring Program.

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" of this section.

9.1.3 Soil Quality Management Plan

Scope & Purpose

Topsoil is generally defined as the top, fertile layer of material on the land surface that is capable of supporting plant growth. It contains the seed bank and is therefore an essential component of the re-vegetation programme. Maintenance of topsoil quality, particularly its structure and the integrity of its seed bank, is vital to both bio-restoration work and erosion control.

The Soil Quality Management Plan is applicable for construction of well sites, production facilities and pipelines, drilling operations, operation of production facilities and decommissioning/site closure of well sites that has the potential to adversely impact the soil quality.

Mitigation Measures-Construction Phase

Stripping of top soil

At the commencement of site preparation activities, the topsoil of the additional land acquired for the project will be carefully stripped to its full depth and stored separately. Topsoil will not be stripped from areas that will only be used for storing topsoil and reclamation of drill sites. Topsoil will be stored where it will not be compacted by vehicles or contaminated and will be stored in a manner that will minimise its loss and/or degradation. Topsoil will not be mixed with subsoil or any other inert material during the entire drilling activity.

Subsequently, the topsoil will be stored in a stockpile within the site premises in a heap not more than 2m high with side slopes <45°, drained with open

ditches. The surface of the stockpile will be lightly compacted to reduce rainfall penetration but not enough to promote anaerobic conditions. The stockpiles will be selected away from natural drainage channel. Vegetation will be grown on the topsoil stacks in the form of grass and herbs to prevent erosion during monsoon. The stockpiles will have peripheral drains and same will be connected with sedimentation tank.

Prevention of soil contamination

- Drip trays to be used during vehicular/equipment maintenance and during re-fuelling operations;
- Fuel and lubricant storage areas will be paved and properly bunded. Bunded areas will be designed to accommodate 110% of the volume of spilled material;
- Spill kits will be made available at all fuel and lubricant storage areas. All spills/leaks contained, reported and cleaned up immediately;

Monitoring

- Periodic monitoring of soil quality monitoring will be conducted in accordance with the Environment Monitoring Program.

Mitigation Measures- Drilling, Operation of Production Facilities

Prevention of soil contamination

- In case of a spill, the spilled soil is to be removed and stored in hazardous waste storage area in each facility;
- Management of drill cuttings, waste drilling mud, waste oil and domestic waste will be made in accordance with "Waste Management Plan".

Mitigation Measures- Decommissioning/Site Closure.

During decommissioning/site closure phase, the management measures will be similar to those discussed in the "Construction Phase" of this section.

Monitoring
The soil would be tested for fertility as per the standard procedure of ICAR and compared to the fertility values done during the Pre Project Baseline Environment Assessment in accordance with the Environment Monitoring Program.

9.1.4 Site Closure Plan

The site closure plan for will identify all the activities which would be performed during the decommissioning and closure of a particular site after the drilling activity.

Chronological inventory of activities which would be performed during the closure of the site are detailed in this section.

Well sites

The following activities have been considered in the closure plan for well sites: Plugging & Abandonment of well: Close the wellhead properly to prevent any further leakage:

- Decommissioning Phase : Removal of the materials form the site;
- Waste/mud pit closure and reclamation;

Plugging & Abandonment of well

As and when the well will be declared as non-productive, plugging of the well will 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 will be dumped in the designated area as per the guidelines of local pollution control board;

Waste and mud pit closure and reclamation

Following decommissioning and abandonment of the well site the waste and mud pits will be subject to closure through onsite burial of solids in accordance with local, state and national regulations.

9.1.5 Surface Water Quality Management Plan

Scope

The Surface Water Quality Management Plan is applicable during construction of well sites, production facilities and pipelines, drilling operations, operation of production facilities and decommissioning/site closure of well sites that has the potential to adversely affect the surface water quality.

Purpose

The surface water is the important resources for the local community, as surface water is utilized for domestic purposes and also for catching fish. The Surface Water Quality Management Plan establishes specific measures and guidelines aimed at effectively addressing and mitigating the surface water quality impacts that may arise at different phases of the project. The effective

surface water quality management plan will mitigate the potential impact on surface water quality from the proposed activity.

Mitigation Measures- Construction Phase

Planning, designing & procurement

- Levelling and grading operations will be undertaken with minimal disturbance to the existing contour thereby maintaining the general slope of site;
- Minimize clearing and construction activities during monsoon season (as far as practicable);
- Construction work close to the streams will be avoided during monsoon;
- During site preparation and construction, surface water run-off will be channelized through integrated drainage system;
- Sediment filters and oil-water separators will be installed to intercept run-off and remove sediment before it enters water courses;
- Fuel and lubricant drums will be stored in bunded and lined area equipped with proper spill control equipment;
- During discharge, care shall be taken to properly dispose the water in order to avoid pollution, damages to fields under cultivation and/or existing structures and interference with the traffic. The water will be subjected to adequate treatment (if required) to ensure compliance with CPCB "General Standards for Discharge of Environmental Pollutants – Inland Surface Water" prior to final discharge;
- Wastewater generated during hydrotesting of pipelines to be treated prior to its disposal.

Monitoring

- Periodic monitoring of treated runoff will be conducted in accordance with the Environment Monitoring Program;
- Regular monitoring of surface water quality will be conducted in accordance with the Environment Monitoring Program.

Mitigation Measures- Drilling, Operation of Production facilities

Site runoff control, produced water and domestic water

- Run-off from vehicular wash and chemical storage areas will be channelled through closed drainage system provided with an oil-water separator prior to silt trap and sedimentation tank to disposal to nearby drainage channels/surface water bodies;
- Drip trays will be used during preventive maintenance of vehicles and machinery;
- Hazardous chemicals and fuel drum will be stored in bunded and lined area equipped with proper spill control equipment;
- Discharge of collected run-off in the siltation chamber to nearby drainage channels will be conforming to CPCB Inland Water Discharge Standards;

- Waste water generated from the drilling activity will be treated through ETP; part of the treated water will be utilized in drilling activity and rest of treated water will be discharged into the local stream, conforming to CPCB Inland; Water Discharge Standards;
- Domestic wastewater generated from camp area will be treated through septic tank and soak pit;
- Produced water generated at the production facilities will be treated in an ETP and discharged in conformance to CPCB Inland Water Discharge Standards.

Monitoring

- Periodic monitoring of treated runoff, treated wastewater will be conducted in accordance with the Environment Monitoring Program;
- Periodic monitoring of surface water quality of local streams will be conducted in accordance with the Environment Monitoring Program.

Mitigation Measures- 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 will be mitigated in manner similar to that discussed during construction phase activities.

9.1.6 Ground Water Quality Management Plan

Scope & Purpose

The Ground Water Quality Management Plan is applicable for construction of well sites and production facilities, drilling operations, operation of production facilities and decommissioning/site closure of well sites that has the potential to adversely affect the ground water quality.

Mitigation Measures- Construction Phase

No significant impact on the ground water/potable water quality can be associated with the construction phase activities.

Mitigation Measures- Drilling

Planning, designing & procurement

- Water based mud will only be used as discussed in Section 2.7. However, eco-friendly polymer mud system may also be used if required for deeper sections after providing intimation to the Pollution Control Board..
- Selection of low toxicity chemicals/additives in the preparation of water based/eco-friendly polymer mud.

Prevention of Contamination

- Proper casing and cementing of well will be done to prevent contamination of sub-surface aquifers;
- Drip trays will be used during preventive maintenance of vehicles and machinery;
- Hazardous chemicals and fuel drum will be stored in bunded and lined area equipped with proper spill control equipment;
- Storage and disposal of drill cutting and waste mud to be made in accordance with "Solid & Hazardous Waste Management Plan".

Monitoring

- Periodic monitoring of ground water quality will be conducted in accordance with the Environment Monitoring Program.

9.1.7 Waste Management Plan

Scope

The Waste Management Plan (WMP) is applicable for all process and non-process waste streams that are generated during various phases of OIL's proposed drilling and production activities at the Khagorijan. The major waste streams covered under this plan includes drill cuttings, waste drilling mud, 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.

Purpose

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 OIL's corporate HSE Policy. The plan also outlines roles and responsibilities of both OIL and the contractors involved in the implementation of the plan.

Mitigation Measures- Drilling Waste (cuttings, spent mud and wash water), used oil and spent oil

As discussed in **Chapter 2**, the drilling project is likely to generate a considerable amount (350-400 m^3) of drill cuttings that may be non-hazardous in nature. However, OIL has planned to management the drilling waste to minimize the contamination of soil, surface water and ground water.

Planning, designing & procurement

- Use of water based mud primarily for drilling of wells; eco-friendly polymer mud system may also be used if required for deeper sections after providing intimation to the Pollution Control Board.;
- Use of low toxicity chemicals for the preparation of drilling fluid

- Barite used in the preparation of drilling fluid shall not contain Hg>1mg/kg and Cd>3 mg/kg;
- Protection of the surrounding environment of a drilling waste (cutting & spent mud) storage and disposal site can be effectively achieved by using an impermeable liner on the base and sides to prevent contamination soil and groundwater;
- The liner system for the proposed waste pit has been designed based on recommendation of the MoEFCC for construction of a non-permeable lining system at the base and wall of waste disposal site area. The liner will have, at a minimum, a composite barrier having HDPE geo-membrane.
- Design aspects of the impervious waste disposal pit will be communicated/ shared by OIL with Assam State Pollution Control Board (ASPCB).
- The drilling cuttings pit will be bunded and kept covered using tarpaulin sheets during monsoon.

Prevention of Contamination during Drilling Period

- Drill cuttings separated from drilling fluid will be adequately washed and temporarily stored and disposed in an impervious pit lined by HDPE
- Drilling wastewater will be stored in HDPE lined pit and treated prior disposal
- Recycling of drilling mud will be ensured to the maximum extent possible
- Temporary storage of drilling fluid and wash waste water will be done in an impervious pit lined with HDPE
- Disposal of drilling wash water will be achieved through necessary treatment through onsite ETP to comply with the CPCB onshore effluent discharge standard for oil and gas industry
- The waste pit after it is filled up will be covered with impervious liner over which a thick layer of native top soil with proper top slope will be provided.

Monitoring

- Periodic monitoring and analysis of drill cuttings will be undertaken to establish its nature and characteristics.

Storage and Disposal of Used oil & Spent Oil

- The hazardous waste (waste and used oil) will be managed in accordance with Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016;
- The hazardous waste will be stored in properly labelled and covered bins located in paved and bunded area;
- Necessary spill prevention measures *viz.* spill kit will be made available at the hazardous material storage area;
- Storage details of onsite hazardous waste generated will be maintained and periodically updated;

- Adequate care will be taken during storage and handling of such waste *viz*. use of proper PPEs by personnel;
- The hazardous waste so stored to be accounted and to be periodically sent to ASPCB registered used and/or waste oil recyclers/ facilities;
- Proper manifest as per Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 to be maintained during storage, transportation and disposal of hazardous waste.

Storage and Disposal of Lead Acid Batteries

- Will be recycled through the vendors supplying lead acid batteries as required under the Batteries (Management & Handling) Rules, 2001 and Batteries (Management & Handling) Amendment Rules 2010;
- Proper manifest will be maintained as per Batteries (Management & Handling) Rules, 2001.

Mitigation Measures- Domestic Waste (Kitchen Waste, Sewage)

Storage & Disposal of Kitchen Waste

- The waste will be segregated and stored in designated waste bins;
- All such waste bins will be properly labelled and covered;
- The kitchen waste will be disposed in nearest dumping site available; on a daily basis. Discussion with the local panchayat/municipality authorities in this aspect would be conducted.

Treatment & Discharge of Domestic Waste Water

- The sewage generated will be treated in a combination of septic tank and soak pit;
- Regular supervision will be undertaken for the domestic waste treatment system to report any overflows, leakage, foul odour etc.

In addition to the management measures specified for the major waste stream, OIL will prepare and update periodically a waste management inventory of all waste streams identified for the proposed project. Necessary measure will also be taken by OIL to incorporate appropriate waste management and handling procedures in the contractor work document and conduct periodic training of personnel involved in waste handling onsite to ensure proper implementation of the WMP. In this regard, necessary inspection, record keeping, training program and monitoring procedures will be established by OIL and made operational to achieve proper management of all wastes generated on site.

9.1.8 Spill Management Plan

A number of chemicals and fuel (high-speed diesel) will be stored on site, improper handling or accidents are likely to result in spills that have a

potential for contaminating the environment. OIL would develop and educate the Contractors/personnel working to prevent such spills and develop a proper spill response and management plan.

Planning, Designing and Procurement

As best practices to avoid/contain any spill, OIL would ensure:

- All chemicals will be stored in designated area and to an extent possible all such areas would away from drainage channels;
- The flooring of the area would be impervious (paved or HDPE lining) and bunding to be provide on all sides of the chemical storage areas;
- The chemical storage area to be covered to ensure it has the minimum runoff;
- All transfers of chemicals to be done with proper care and under the supervision of the Store Supervisor;

Preventive and Mitigative Measures

OIL's spill management plan would aim to control the spill to a limited area and take necessary mitigative actions. The following additional measures will be implemented for spill management:

- Once a spill incident has occurred, identify the chemical involved and check hazardous property of the chemical from the Material Safety Datasheet (MSDS);
- Person wearing required PPE will apply necessary absorbent like saw dust for a liquid spill to ensure that the spill does not spread over a wide area or reach any surface water body or drainage channels;
- Thereafter, the substance will be properly collected and stored in a separate labelled container marked "hazardous waste – do not burn"; and dispose in accordance with Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016.

9.1.9 Wildlife Management Plan

Scope

The proposed drilling and production operations in the Khagorijan Field that may impart potential impact on local flora and fauna close to the drill sites, production facilities and access roads.

Purpose

The purpose of Wildlife Management Plan is to minimize the impact on natural habitat (forest and river ecosystem) and control any adverse impact due to air and noise pollution from well drilling, storm water runoff from the well sites etc. The Management Plan details out the mitigation measures and strategies to be adopted by OIL and the contractors during each phase of the

project, at the same time establishing a monitoring network to investigate the effective implementation of the Management Plan.

Wildlife Clearance

Few wells and production facilities are located within the Ecosensitive Zone of the DSNP and BBPWLS. As per existing guidelines, a site specific Biodiversity Management Plan will be prepared and approval will be taken from Standing Committee of National Board of Wildlife (NBWL).

Wildlife Habitat Protection from Project Operation

- No temporary electric supply connection line from the grid will be laid for the proposed project activity. All electric requirements will be supplied from the internal DG/GG sets;
- Movement of heavy vehicles will be restricted at night time, as most of the mammals movement occurred during night
- Cutting of trees should be minimized as far as possible
- Cutting, uprooting and coppicing of trees present in and around the project site for cooking, burning or heating purposes by the labourers should be prohibited and suitable alternatives (fuel like kerosene shall be made available to the labourers by the contractor) for this purpose should be provided
- Care would be taken while disposal drill cutting & other drilling waste and discharge of waste water from the drilling site.
- Spillage of construction material to the adjacent agricultural land and drainage channels should be restricted.
- Other management measure as discussed in air quality management plan, noise management plan, surface water quality management plan and waste management plan to be implemented.

Reduction of Human-Wildlife Conflicts

Fencing

- The drill sites and production facilities will be properly fenced (chain-linked) to avoid straying of any well as wildlife.

Wildlife Awareness Program

All the above measures discussed are acceptable to protect wildlife habitat. But on contrary the villagers, oil & gas drilling and production workers even forest personnel working in the vicinity are to be made aware about the importance of wildlife, wildlife behaviour etc. as ecologically sensitive DSNP, BBPWLS etc. are present in vicinity of the proposed drill sites/production facilities. Forest officials may plan to educate the public through preparation of brochures in local language, film show, street drama and display of information in the board, etc.

Site Specific Wildlife Management Plan & Approval

As few wells and production facilities are located within 10 km of the DSNP and BBPWLS a site specific Biodiversity Management Plan will be prepared and approval will be taken from Standing Committee of National Board of Wildlife (NBWL).

9.1.10 Road Safety & Traffic Management Plan

Scope

The Road Safety & Traffic Management Plan is applicable to all operation pertaining to OIL and contractor vehicular movement viz. vehicle involved in the transportation of raw materials, project and contractor personnel, drilling rig and heavy equipment transportation to well sites and production facilities.

Purpose

The Road Safety & Traffic Management Plan outlines specific measures to be adopted and implemented by OIL 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, operation of production facilities and decommissioning of well sites.

Mitigation Measures

- Project vehicular movement will be restricted to defined access routes to be identified in consultation with locals and concerned authorities;
- Proper signage will be displayed at important traffic junctions along the predefined access routes to be used by construction and operational phase traffic. The signage will serve to prevent any diversion from designated routes and ensure proper speed limits are maintained near village residential areas;
- Precautions will be taken to avoid damage to the public access routes including highways during vehicular movement;
- Safe and convenient passage for vehicles, pedestrians, tea garden workers and livestock to and from side roads and property accesses connecting the project road will be provided;
- Parking of project vehicles along village access roads prohibited;
- Traffic flows will be scheduled wherever practicable during period of increased commuter movement;
- Personnel will be deployed at major traffic intersection for control of traffic;
- Clear signs, flagmen & signal will be set up at major traffic junctions and near sensitive receptors *viz.* schools in discussion with Gram Panchayat and local villagers;

- Movement of vehicles during night time will be restricted. Speed limits will be maintained by vehicles involved in transportation of raw material and drilling rig;
- A Journey Management Plan will be formulated and implemented to control construction and operational phase traffic;
- Routine maintenance of project vehicles will be ensured to prevent any abnormal emissions and high noise generation.
- Adequate training on traffic and road safety operations will be imparted to the drivers of project vehicles. Road safety awareness programs will be organized in coordination with concerned authorities to sensitize target groups viz. school children, commuters on traffic safety rules and signage.

9.1.11 Occupational Health & Safety Management Plan

Scope

The Occupation Health & Safety Management Plan (OHSMP) is applicable for all project operations that have the potential to adversely affect the health and safety of contractors' workers and onsite OIL personnel.

Purpose

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. construction of well sites, production facilities and pipelines, drilling and testing, operation of construction machinery/equipment, storage and handling of fuel and chemicals, operation of drilling rig and associated equipment.

Mitigation Measures

- All machines to be used in the construction will conform to the relevant Indian Standards (IS) codes, will be kept in good working order, will be regularly inspected and properly maintained as per IS provisions and to the satisfaction of the site Engineer;
- Contractor workers involved in the handling of construction materials viz. borrow material, cement etc. will be provided with proper PPEs viz. safety boots, nose masks etc.;
- No employee will be exposed to a noise level greater than 85 dB (A) for a duration of more than 8 hours per day. Provision of earplugs, earmuffs etc. and rotation of workers operating near high noise generating areas;
- Hazardous and risky areas, installations, materials, safety measures, emergency exits, etc. shall be appropriately marked;
- All chemicals and hazardous materials storage container will be properly labelled 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 workers and first-aid personnel;

- The workplace must be equipped with fire detectors, alarm systems and fire-fighting equipment. Equipment shall be periodically inspected and maintained to keep good working condition;
- Health problems of the workers will be taken care of by providing basic health care facilities through health centres temporarily set up for operations base camp;
- The sewage system for the camp must be properly designed, built and operated so that no health hazard occurs;
- Adequate sanitation facilities will be provided onsite for the operational workforce during both construction and operational phase of the project.
- Garbage bins will be provided in the camp and regularly emptied and the garbage disposed of in a hygienic manner;
- Training programs will be organized for the operational workforce regarding proper usage of PPEs, handling and storage of fuels and chemicals etc.

9.1.12 Management of Social Issues and Concerns

Mitigation measure have been outlined to address project related social issues and concerns in order for OIL to take proactive steps and adopt best practices, which are sensitive to the socio-cultural setting of the region. The plans will include people residing in proximity to the proposed well sites, pipeline routes, production facilities and access routes.

Providing Job Opportunities

During site construction, non- technical jobs will be generated. Most of the people employed during this stage would be semi-skilled or unskilled. People from adjoining areas would be given preference through local contractors according to the skill sets possessed.

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, tea garden workers is an important concern. During the drilling phase and for the rest of the project activities proper safety measures will be undertaken for both transportation as well as the other operations. The drill sites 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 disrupt access conditions of the inhabitants residing close to the access road. The increase in traffic will have implications on their safety too, as well as create congestion, potential delays and inconvenience for pedestrians. The mitigative measures in this regard have been discussed in detail under the Road Safety & Traffic Management Plan.

Management of Common Property Resources

During the project tenure there might be some sharing of resources viz. land, water, access routes etc. by the villagers and the contractor workforce. Prior to the commencement of the proposed activity, a consultation program will be conducted by OIL with the target groups and local authorities. The primary objective of such consultation will be to share with the concerned villagers/stakeholders the objective of the proposed project associated impacts and their mitigation. The movement of heavy vehicles and machinery might lead to conditions like disruption of electric wires and telephone wires in the site area and along transportation routes. These public utilities will be restored back to normal conditions, at the earliest. Fencing of the site may lead to in some cases the temporary loss of shortest foot track routes for the villagers to their agricultural fields. Consultation with villagers will be carried out in such cases to assist them in finding alternative foot track routes.

Corporate Social Responsibility

From inception of its activities, OIL has taken up various CSR initiatives in and around OIL's operational areas for the benefit of the residents as per the CSR Act and Rules, Govt. of India. The broad areas to be focused under the CSR plan would include;

- Health - arranging mobile health camps including eye camps, School health programmes which includes free dental awareness examination camps and free check-ups of the students; universal immunization programme etc.
- Education - Providing financial assistance to institutions towards purchasing of furniture and required amenities to school, libraries, auditoriums, teacher's common room etc.
- Funding for sports, cultural events etc.

9.2 OIL ENVIRONMENT MANAGEMENT POLICY AND SYSTEM

9.2.1 Environmental Management Organisation

OIL is committed to providing resources essential to the implementation and control of the EMP. Resources includes the appropriate human resources and specialised skills. The structure for the organisation responsible for environmental and social management and implementation of the EMP is depicted in ***Table 9.2***.

Table 9.2 Environmental Management Organisation Roles and Responsibilities

Position	Responsibility
Basin Manager	Oversee and coordinate all activities pertaining to the Project; ultimately responsible for environmental and social issues. Ensure delivery by the asset of its environmental, social and operational targets. Ensure effective communication with all stakeholders.

Position	Responsibility
Chief General Manager (Drilling)	Ensuring that the Project and subcontractors operate in accordance with applicable regulatory environmental and social requirements and plans. Monitor implementation of environmental and social protection measures, and assist with technical input into oil spill response requirements.
CSR Manager	Liaise with local communities, farmer and government regulators on the project's behalf. Implement environmental and social awareness and education programmes with communities.

9.2.2 Training and Awareness

OIL will identify, plan, monitor, and record training needs for personnel whose work may have a significant adverse impact upon the environment or social conditions. The Project recognises that it is important that employees at each relevant function and level are aware of the Project's environmental and social policy; potential effects of their activities; and roles and responsibilities in achieving conformance with the policy and procedures. This will be achieved through a formal training process. Employee training will include awareness and competency with respect to:

- Environmental and social impacts that could potentially arise from their activities;
- Necessity of conforming to the requirements of the EIA and EMP, in order to avoid or reduce those impacts; and
- Roles and responsibilities to achieve that conformity, including with regard to change management and emergency response.

The Chief General Manager (Drilling) is responsible for coordinating training, maintaining employee-training records, and ensuring that these are monitored and reviewed on a regular basis. The Chief General Manager (S&E) will also periodically verify that staff is performing competently through discussion and observation. Employees responsible for performing site inspections will receive training by drawing on external resources as necessary. Training will be coordinated by the General Manager (Learning and Development) prior to Project's implementation.

Similarly, the Project will require that each of the contractors institute training programmes for its personnel. Each contractor is responsible for site HSE awareness training for personnel working on the job sites. The contractors are also responsible for identification of any additional training requirements to maintain required competency levels.

The contractor-training program will be subject to approval by the Project and it will be audited to ensure that:

- Training programs are adequate;
- All personnel requiring training have been trained; and
- Competency is being verified.

9.2.3 Inspection & Monitoring

HSE inspections will be conducted by subcontractors on a daily basis. The results of the inspection and monitoring activities will be reported to OIL on a weekly basis or more frequently if requested by the Chief General Manager (Drilling).

Monitoring will be conducted to ensure compliance with regulatory requirements as well as to evaluate the effectiveness of operational controls and other measures intended to mitigate potential impacts.

9.2.4 Compliance Auditing

Beyond the routine inspection and monitoring activities conducted, compliance audits will be carried out internally by OIL to ensure compliance with regulatory requirements as well as their own HSE standards and policies. Audits to be conducted will also cover the subcontractor self-reported monitoring and inspection activities. The audit shall be performed by qualified staff and the results shall be communicated to the Basin Manager and management board.

The audit will include a review of compliance with the requirements of the EIA and of this EMP and include, at minimum, the following:

- Completeness of EHS documentation, including planning documents and inspection records;
- Conformance with monitoring requirements;
- Efficacy of activities to address any non-conformance with monitoring requirements; and
- Training activities and record keeping.

There will be a cycle of audits into specific areas of the Project such as waste management, and effectiveness of local content plans and discharge controls. The frequency of audits will be risk based and will vary with the stage of the project (more frequent during construction and in the early stages of the project) and will depend on the results of previous audits.

9.2.5 Corrective Action

Impacts will be identified and associated risks addressed before an incident occurs. Investigating a 'near miss' or actual incident after it occurs can be used to obtain valuable lessons and information that can be used to prevent similar or more serious occurrences in the future.

OIL will implement a formal non-compliance and corrective action tracking procedure for investigating cause and identifying corrective actions in response to accidents or environmental or social non-compliances. The Chief General Manager (Drilling) will be responsible for keeping records of

corrective actions and for overseeing the modification of environmental or social protection procedures and/or training programs to avoid repetition of non-conformances and non-compliances.

9.3 EMP BUDGET

The tentative budget for implementation of the environmental management plans for drilling of each well is calculated to be 11.22 lakhs and for each production facility (per year) would be 6.27 lakhs. Detail of cost breakup is provided at the ***Table 9.3*** and ***Table 9.4***. The budget for implementation of the above will be covered from 2% of profit from the proposed project as per CSR Plan.

Table 9.3 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 x 1 year)	1.77
b.	Maintenance of paved internal road and transport route (budgetary provision is included in operational cost of drilling)	0.00
c.	Ambient Air Quality Monitoring -3 monitoring location x 2 weeks per location x Once during site development, twice during drilling and once during decommissioning (@ Rs.7500 x 24 samples)	1.80
d.	Stack emission monitoring (@ 5000 per sample x 3 DG sets x twice during drilling) @5000 X 6 samples	0.30
2	**Noise Monitoring**	
a.	Ambient Noise Monitoring – 3 locations, once during site development, twice during drilling and once during decommissioning (@Rs. 2500 X 12 samples)	0.30
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 Monitoring**	
a.	Surface Water Quality Monitoring (@ Rs. 5000 x 2 samples from natural drainages once during site construction, once during drilling, once after decommissioning)	0.30
b.	Ground Water Quality Monitoring (@ Rs. 5000 x 3 sites once during drilling)	0.15
c.	Treated water quality (@ Rs. 5000 x 2 samples of ETP treated water ; one from oil water separator)	0.15
4	**Soil Quality Monitoring** (@ Rs. 5000 x 3 samples x once before site preparation; once during drilling and once after decommissioning/restoration)	0.45
5	**Road Safety & Traffic Management**	
a.	Signage in the transport route & its maintenance (Rs. 100,000 + Rs. 10,000)	1.10
b.	Deployment of traffic personnel in sensitive area – 10 persons (@ Rs. 6000 per month x 6 months)	3.6
6	**Surface Runoff & Soil Erosion Control**	
a.	Two chamber sedimentation tank at each drill site (Budgetary provision is already included in the infrastructure development cost)	0.0

Sl. No.	Particulars of Work	Budget (in lakh Rs.)
7	**Municipal Solid Waste**	
a.	Provision of two chambered covered 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)	0.0
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)	0.0
b.	Paved /impervious storage area for chemical storage area, fuel & lubricant storage area (Budgetary provision is already included in the infrastructure development cost)	0.0
c.	Domestic waste water treatment facility through septic tank & soak pits at the drill sites (budgetary provision in operation cost of drilling)	0.0
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)	0.0
b.	Provision of drinking water, sanitation facility for all workers (budgetary provision is included in operational cost of drilling)	0.0
c	Provision First aid facility (budgetary provision is included in operational cost of drilling)	0.0
d	Provision of Ambulance facility OIL has its own ambulance facility)	0.0
e	Regular health checkup facility provided by OIL for workers)	0.0
f	Regular occupational health & safety training	0.5
	Total COST OF IMPLEMENTATION OF EMP	**11.22**
11	**CSR Activity**	**2% of profit**

Table 9.4 ***Tentative Budget for EMP Implementation for Each Production Installation per year***

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 9 months x 1 year)	1.77
b.	Maintenance of paved internal road and transport route (budgetary provision is included in operational cost of production installations)	0.0
c.	Ambient Air Quality Monitoring -3 monitoring location x 2 weeks per location x 2 times per year (@ Rs.7500 x 12 samples)	0.9
d.	Stack emission monitoring (@ 5000 per sample x 2 GG sets x twice a year) @5000 X 4 samples	0.2
2	**Noise Monitoring**	
a.	Ambient Noise Monitoring – 3 locations, 2 times a year (@Rs. 2500 X 6 samples)	0.15
b.	Workplace noise monitoring -5 locations per facility, twice a year (@Rs.2500 per location x 5 locations x 2 times)	0.25

Sl. No.	Particulars of Work	Budget (in lakh Rs.)
3	**Water Quality Monitoring**	
a.	Surface Water Quality Monitoring (@ Rs. 5000 x 3 samples from natural drainages twice a year)	0.30
b.	Ground Water Quality Monitoring (@ Rs. 5000 x 3 samples from local villages twice a year)	0.30
c.	Treated water quality (@ Rs. 5000 x 2 samples of ETP treated water ; one sample from oil water separator; twice a year)	0.30
4	**Soil Quality Monitoring** (@ Rs. 5000 x 3 samples x twice a year)	0.3
6	**Surface Runoff & Soil Erosion Control**	
a.	Two chamber sedimentation tank at each facility (Budgetary provision is already included in the infrastructure development cost)	0
7	**Municipal Solid Waste**	
a.	Provision of two chambered covered collection bins at each site – 2 nos.	0.2
b.	Transport arrangement of waste from well sites to dumping area	1.0
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
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)	0.0
b.	Paved /impervious storage area for chemical storage area, fuel & lubricant storage area (Budgetary provision is already included in the infrastructure development cost)	0.0
c.	Domestic waste water treatment facility through septic tank & soak pits at the production sites (budgetary provision in operation cost of operations)	0.0
10	**Occupational Health & Safety Management**	
a.	Provision of appropriate PPE to all workers and its maintenance (budgetary provision is included in operational cost of operation)	0.0
b.	Provision of drinking water, sanitation facility for all workers (budgetary provision is included in operational cost of operation)	0.0
c	Provision First aid facility (budgetary provision is included in operational cost of operation)	0.0
d	Provision of Ambulance facility OIL has its own ambulance facility)	0.0
e	Regular health checkup facility provided by OIL for workers)	0.0
f	Regular occupational health & safety training	0.5
	Total COST OF IMPLEMENTATION OF EMP	**6.27**

Additionally OIL proposed to allocate 2.5 % of the total project cost for CSR activities. Detailed CSR plan would be formulated after conducting need assessment in the area.

10 SUMMARY AND CONCLUSION

OIL proposes to conduct Onshore Oil and Gas Drilling and Production Involving Onshore drilling of 54 wells, 2 production installations and laying of assorted oil & gas flowlines/delivery lines in Dibrugarh and Tinsukia districts of Assam.

The EIA study has been undertaken to assess the potential significant adverse environmental effects due to the proposed drilling and developmental activities in Khagorijan Field.

Mitigation measures have been proposed as part of EMP to minimize adverse environmental impacts, if any. Risk assessment includes Jet Fire and Vapour Cloud Explosion for blowout of wells, tank and pipeline failure etc. The existing Emergency Management Plan of OIL will be extended to this project, strengthened as necessary and implemented in the event of any emergency arising due to above mentioned risks.

The present impact assessment study indicates that the overall impact from the proposed project will be short to medium term, reversible, localised and are not expected to contribute significantly to the surrounding environment. Also, with the implementation of the pollution control and strengthen the existing environment management measures, these anticipated impacts due to proposed site preparation, drilling, construction and operation of production facilities and pipelines and decommissioning activities of the proposed project will be mitigated. Summary of impact significance without mitigation measures and with mitigation measures is presented at the table below.

Table 10.1 Summary of Impact Significance without and with Mitigation Measures

Impact	Impact significance without mitigation measures	Impact significance with mitigation measures
Aesthetic & visual	Moderate	Minor
Land Use	Minor	-
Soil Quality	Moderate	Minor
Air Quality	Moderate	Minor
Noise Quality	Major	Moderate
Road & Traffic	Moderate	Minor
Surface Water Quality	Moderate	Moderate
Ground water resource	Minor	Minor
Ground Water Quality	Moderate	Minor
Terrestrial Flora	Minor	Minor
Terrestrial Fauna	Moderate	Minor
Aquatic Ecology	Moderate	Moderate
Livelihood & Income generation	Moderate	Moderate
Conflict with local people	Moderate	Moderate
Benefit to Local Enterprises	Positive	-
Employment Generation	Positive	-
Occupational health & safety	Moderate	Minor
Community health & safety	Moderate	Minor

OIL will also ensure that the environmental performances of all the activities are monitored throughout execution of the project during site preparation, drilling and decommissioning phases. Monitoring will be carried out for ambient air quality, stack emission, noise quality, quality of treated effluents, surface and groundwater qualities, waste generated and disposed etc. and verified that they meet the prescribed standards. OIL will continue to report environmental performance and submit monitoring reports regularly to statutory authorities.

The effective management system coupled with monitoring of environmental components and efforts for continual improvements will result in satisfactory environmental performance of the proposed oil and gas drilling and development project.

11 DISCLOSURE OF CONSULTANTS

Environmental Resources Management (ERM) is the world's leading provider of environmental, health, safety, risk, social consulting and sustainability related services. With a history that spans more than four decades, ERM today has a global footprint of 160 offices in 40 counties, employing more than 5000 best-in-class professionals. In the last three years, ERM has worked with more than 50% of the Global Fortune 500 Companies.

ERM India Private Limited (ERM India) was formally established in 1995 with its headquarters in Delhi and regional office in Mumbai (Maharashtra), Bangalore (Karnataka), Ahmadabad (Gujarat) and Kolkata (West Bengal). The contact address of ERM India is as follows:

ERM India Private Limited
Building No.10
Tower A, 4th Floor
DLF Cyber City
Gurgaon -122002 India
Tel:+91-124-4170300; Fax: +91-124-4170301

11.1 ERM'S ACCREDITATION AS EIA CONSULTANT

ERM has been accredited as EIA consultant for various sectors including Offshore and Onshore Oil and Gas Exploration Development and Production National Accreditation Board for Education and Training (NABET) of Quality Council of India (QCI) under the Accreditation Scheme for EIA Consultant Organisation as per the requirement of MoEFCC.

11.2 EIA TEAM

I, hereby, certify that I was part of the EIA team in the following capacity that developed the EIA.

EIA Coordinator Name: Debanjan Bandyopadhyay

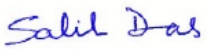
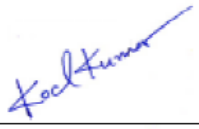
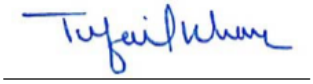
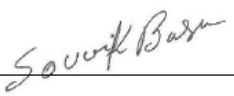
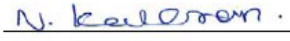
Signature and Date: 

24.09.2018

Experts contributing to the EIA "Onshore Oil & Gas development drilling and production in Khagorijan Oil and Gas Field, Dibrugarh and Tinsukia districts

under Tinsukia PML, Tinsukia Extension PML and Chabua PML. is showed in ***Table 11.1***.

Table 11.1 Professionals Engaged for the EIA Study

S.N	Functional Area	Name of the Expert	Involvement	Signature
1	EIA Coordinator	Mr. Salil Das	Coordination with experts; compilation of EIA report. QA/QC of the EIA report	
2	Air Pollution	Dr. Debanjan Bandyopadhyay	Selection of air quality monitoring stations, discussion with client on various air pollution control aspects, inputs for impact assessment from the proposed project and development of EMP.	
3	Water Pollution	Dhritiman Ray	Selection of water monitoring stations, interpretation of analysis results, , inputs for impact assessment and development of EMP,	
4.	Air Quality Modelling	Dr. Indrani Ghosh	Modelling. Model input data related to emissions and micrometeorology interpretation of modelling results and development of EMP	
5.	Noise Quality	Dr. Debanjan Bandyopadhyay Dr. Indrani Ghosh	Undertaking Noise Quality Modelling; Selection of noise sampling locations for baseline monitoring, model input data, interpretation of modelling results and development of EMP.	 
6.	Solid & Hazardous Waste	Dr. Koel Kumar	Review of existing SHW management and support for impact assessment, and development of EMP.	
7.	Socio-economic environment	Tufail Khan Souvik Basu	Support for socio economic baseline, stakeholder consultations and impact assessment.	 
8.	Ecology and Biodiversity	Dr. Abhishek Roy Goswami	Ecological survey and assessment of flora and fauna and related impact assessment and development of EMP.	
9.	Land use	Dr. Karunakaran Nagalingam Dibyendu Chakraborty	Preparation of all maps including LU/LC and impact assessment.	 

S.N	Functional Area	Name of the Expert	Involvement	Signature
10.	Risk Assessment	Debanjan Bandyopadhyay	Conducting risk assessment including frequency analysis, consequence analysis; development of Disaster Management Plan	

I, Masood Malik, hereby, confirm that the above mentioned experts prepared the EIA for Onshore Oil & Gas development drilling and production in Khagorijan Oil & Gas Field in Dibrugarh & Tinsukia District under Tinsukia PML, Tinsukia Extension PML and Chabua PML. I also confirm that the consultant organization shall be fully accountable for any misleading information mentioned in this statement.

Signature:



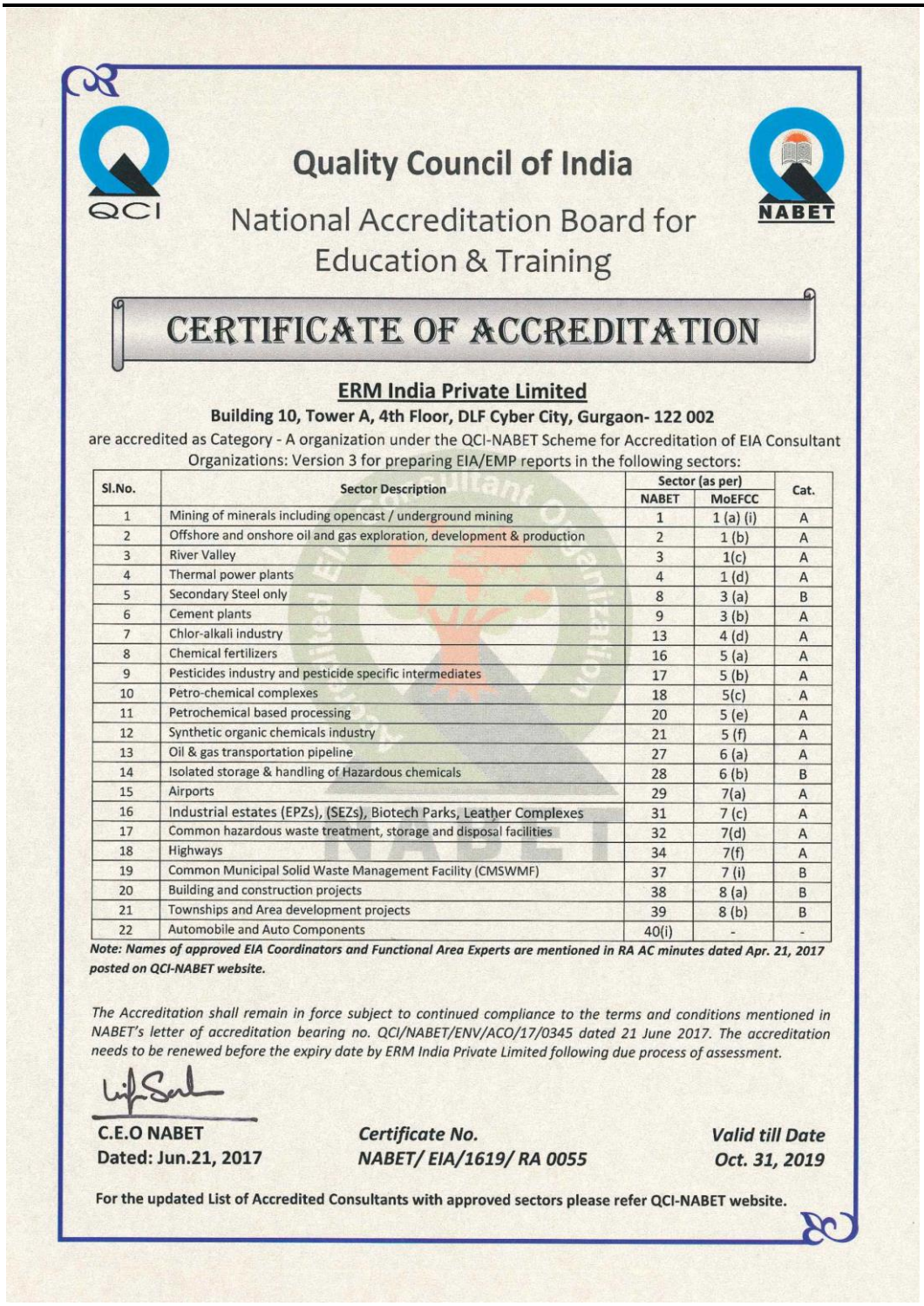
Name: Masood Mallick

Designation: Managing Director

Name of the EIA consultant organization: ERM India Private Limited

NABET Certificate No. & Issue Date: **NABET/EIA/1619/RA0055, Valid till 31 Oct, 2019**

Figure 11.1 ERM's Accreditation from NABET



Quality Council of India

National Accreditation Board for Education & Training

CERTIFICATE OF ACCREDITATION

ERM India Private Limited

Building 10, Tower A, 4th Floor, DLF Cyber City, Gurgaon- 122 002

are 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 opencast / underground mining	1	1 (a) (i)	A
2	Offshore and onshore oil and gas exploration, development & production	2	1 (b)	A
3	River Valley	3	1(c)	A
4	Thermal power plants	4	1 (d)	A
5	Secondary Steel only	8	3 (a)	B
6	Cement plants	9	3 (b)	A
7	Chlor-alkali industry	13	4 (d)	A
8	Chemical fertilizers	16	5 (a)	A
9	Pesticides industry and pesticide specific intermediates	17	5 (b)	A
10	Petro-chemical complexes	18	5(c)	A
11	Petrochemical based processing	20	5 (e)	A
12	Synthetic organic chemicals industry	21	5 (f)	A
13	Oil & gas transportation pipeline	27	6 (a)	A
14	Isolated storage & handling of Hazardous chemicals	28	6 (b)	B
15	Airports	29	7(a)	A
16	Industrial estates (EPZs), (SEZs), Biotech Parks, Leather Complexes	31	7 (c)	A
17	Common hazardous waste treatment, storage and disposal facilities	32	7(d)	A
18	Highways	34	7(f)	A
19	Common Municipal Solid Waste Management Facility (CMSWMF)	37	7 (i)	B
20	Building and construction projects	38	8 (a)	B
21	Townships and Area development projects	39	8 (b)	B
22	Automobile and Auto Components	40(i)	-	-

Note: Names of approved EIA Coordinators and Functional Area Experts are mentioned in RA AC minutes dated Apr. 21, 2017 posted on QCI-NABET website.

The Accreditation shall remain in force subject to continued compliance to the terms and conditions mentioned in NABET's letter of accreditation bearing no. QCI/NABET/ENV/ACO/17/0345 dated 21 June 2017. The accreditation needs to be renewed before the expiry date by ERM India Private Limited following due process of assessment.

C.E.O NABET
Dated: Jun.21, 2017

Certificate No.
NABET/ EIA/1619/ RA 0055

Valid till Date
Oct. 31, 2019

For the updated List of Accredited Consultants with approved sectors please refer QCI-NABET website.

Annexure 1.1

Approved TOR from MoEFCC

No.IA-J-11011/35/2018-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
11 Mar 2018

To,

M/s OIL INDIA LIMITED
Safety & Environment Department , Oil India Limited, Duliajan,
Dibrugarh-786602
Assam

Tel.No.0374-2800542; Email:ajaya_acharya@oilindia.in

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/IND2/72322/2018
2. Name of the Proposal:	Onshore Oil & Gas development drilling and production in KHAGORIJAN OIL & GAS FIELD in Dibrugarh & Tinsukia District under Tinsukia PML, Tinsukia Extension PML and Chabua PML.
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:	22 Jan 2018

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.

***

Annexure 2.1

Environmental Setting of the Wells

Sl No	Well Name	Geographical Coordinates	PML Block	Administrative Setting			Existing Land cover of wells	Accessibility (in approx)	Environmental Setting of Wells		Ecological Sensitivity		Settlement/ School within 1km
				Village	Tehsil	District			Terrain Type	Stream/ River	Forest	Sanctuary/ ESZ	
1.	Well 20	95°20'44.22" E 27°32'23.02" N	Khagorijan Oil & Gas Field	No 2 Balupara Gaon	Tinsukia	Tinsukia	Tea Estate	Small village roads join it to the Gelapukhuri Rd. which lies about 1.01km (SE)	Flat Land	NA	NA	NA	Limbuguri T.E.225/227 Nlr.Gt. , Limbuguri T.E.No-98 Nlr.Gt., Limbuguri T.E.152/149/Nlr , No-2 Balupara Gaon, Gelapukhuri T.E.No-261 Nlr.Gt.
2.	Well 21	95°20'15.00" E 27°30'51.00" N	Khagorijan Oil & Gas Field	Lezeihoola Gaon	Tinsukia	Tinsukia	Agriculture Land	Gelapukhuri Borguri Rd. Joins it to Rangagora Rd., Dohotia Chuk Rd. and Makum Bypass Rd.(0.62km N)	Flat Land	NA	NA	NA	Jariguri Gaon, Lezeihoola Gaon, Borguri Lower Primary School (W), Borguri Kali Mandir (W), Tea Estate Office 0.51km (NE).
3.	Well 23	95°19'3.15"E 27°29'2.48" N	Khagorijan Oil & Gas Field	Tinsukia	Tinsukia	Tinsukia	Agriculture Land	Small village roads connect it to the AT Rd. , VIP Rd. and	Flat Land	NA	NA	NA	Bahbari village, well LOC D10 (S), A Shiva temple (SE), Vivekananda Kendra Vidyalaya (SW).

								NH 37. Makum Bypass Rd. is located at a distance of 0.47km.					
4.	Well 17	95°17'54.00" E 27°31'19.50" N	Khagorijan Oil & Gas Field	Panitola T.E No. 111 Nlr.	Tinsukia	Tinsukia	Agriculture Land	Small village roads connect it to Makum Bypass Rd. at 2.72km (SE)	Flat Land	An unnamed stream at a distance of 0.12km E.	NA	NA	Nokhroy T.E.184/187 Nlr, Panitola Te.No-111 Nlr, Nokhroy T.E. 162/159 Nlr – 149 are the nearby villages, a tea estate office (0.59km-S), Bagbari Tea Company Pvt. Ltd. (0.75 km – SW).
5.	Well 22	95°18'19.50" E 27°33'17.25" N	Khagorijan Oil & Gas Field	Dinjan T.E 106 Nlr.	Tinsukia	Tinsukia	Tea Estate	Small village roads connects it to Rangagora Rd. (1.62km E)	Flat Land	NA	NA	NA	Khamti Gohali 106 Nlr.Gt., Dinjan T.E. 106 Nlr, Dinjan T.E. 111 1/2 Nlr are the nearby villages, a tea estate office at 0.35km NW,
6.	Well 16	95°17'23.00" E 27°33'40.00" N	Khagorijan Oil & Gas Field	Dinjan T.E 106 Nlr.	Tinsukia	Tinsukia	Tea Estate	Small village roads join it to Dinjan Guijan Rd. 0.68km NW	Flat Land	NA	NA	NA	Dinjan T.E. 106 Nlr, Panitola T.E. 108/105 Fs are the nearby villages, wells TAF and 18, the well is located within the Dinjan tea estate.

7.	Well 18	95°17'0.00"E 27°33'17.25" N	Khagorijan Oil & Gas Field	Tinsukia	Tinsukia	Tinsukia	Agriculture Land	Small village roads join it to Dulijan Guijan Rd. at a distance of 0.98km NW	Flat Land	NA	NA	NA	Dinjan T.E. 106 Nlr, Panitola T.E. 108/105 Fs, Dinjan Chapori are the nearby villages, wells 16 and TAF are in its vicinity. The well is located within the Dinajan tea estate.
8.	TAF	95°16'51.47" E 27°33'29.21" N	Khagorijan Oil & Gas Field	Tinsukia	Tinsukia	Tinsukia	Tea Estate	Small village roads join it to Dulijan Guijan Rd. at a distance of 0.52km NW	Flat Land	NA	NA	NA	Dinjan T.E. 106 Nlr, Panitola T.E. 108/105 Fs, Dinjan Chapori are the nearby villages, wells 16 and 18 are in its vicinity. The well is located within the Dinajan tea estate.
9.	Well 15	95°16'53.70" E 27°32'19.15" N	Khagorijan Oil & Gas Field	Panitola T.E. No - 105/102,75/	Tinsukia	Tinsukia	Tea Estate	Small villages join it to other villages nearby	Flat Land	NA	NA	NA	Dinjan Te. No-2, Panitola T.E. No - 105/102,75/, Baghbari Gaon, Dinjan Chapori are the villages located nearby, well 19 is in its vicinity.
10.	Well 19	95°16'36.57" E 27°32'13.62" N	Khagorijan Oil & Gas Field	Baghbari Gaon	Tinsukia	Tinsukia	Tea Estate	Small villages join it to other villages nearby	Flat Land	NA	NA	NA	Panitola T.E. No - 105/102,75/, Baghbari Gaon, Udalguri Gaon are the nearby villages, well 15

													is located in its vicinity, two well sites are located at 0.34km W and 0.91km NW.
11.	TAD	95°15'30.36" E 27°31'49.03" N	Khagorijan Oil & Gas Field	Udalguri T.E	Chabua	Dibrugarh	Exsisting Site	A small village road joins this to the Duijan Rd. at 0.37km E	Flat Land	NA	NA	NA	Kharijan T.E, Udalguri T.E, Udalguri Gaon and Kharjan Gaon, Dighali Pathar Adarsh Hindi Lp School (SE), are located nearby.
12.	Well 2	95°13'55.50" E 27°31'6.00" N	Khagorijan Oil & Gas Field	Kharjan Grant	Chabua	Dibrugarh	Homestead plantation	A road running nearby at 0.02km S connects this place to NH 37 and NH 15	Flat Land	NA	NA	NA	Kharjan T.E, Kharjan Grant are located nearby
13.	Well 24	95°15'31.50" E 27°29'13.50" N	Khagorijan Oil & Gas Field	Panitola Town	Tinsukia	Tinsukia	Agriculture Land	Panitola Baruahola PWD Rd. is at a distance of 0.65km W joins it to AT Rd. and NH37	Flat Land	NA	NA	NA	Panitola Town, Panitola Gaon and Jokai Central Hospital, Panitola Railway Station (N)
14.	CAC	95°14'55.98" E 27°28'50.59" N	Khagorijan Oil & Gas Field	Panitola T.E No.66 Fs. Gt.	Tinsukia	Tinsukia	Homestead plantation	Panitola Baruahola PWD Rd. is at 0.21km E	Flat Land	NA	NA	NA	Betioni Gaon, Panitola Te.No-66 Fs.Gt and wells CAC (Placemark), DIAV are located nearby.

15.	DIAV	95°14'38.51"E 27°29'1.21"N	Khagorijan Oil & Gas Field	Panitola T.E No.66 Fs. Gt	Tinsukia	Tinsukia	Homestead plantation		Flat Land				
16.	TAJ	95°12'1.02"E 27°33'22.98"N	Khagorijan Oil & Gas Field	Piporatoli	Chabua	Dibrugarh	Exsisting Site	Timulsingaali Rd. at 0.09km N	Flat Land	Brahmaputra river flows at 1.20km from the sites.	NA	NA	Piporatoli & Nakapur village, and the functional well site of the said wells with debri pits.
17.	TAT	95°12'0.96"E 27°33'23.54"N	Khagorijan Oil & Gas Field	Tinsukia	Tinsukia	Tinsukia	Exsisting Site		Flat Land	NA	NA	NA	NA
18.	Well 14	95°11'54.00"E 27°32'21.75"N	Khagorijan Oil & Gas Field	Raidangaon	Tinsukia	Tinsukia	Tea Estate	Small village roads connects it to other villages	Flat Land	NA	NA	NA	Piporatoli & Raidang
19.	Well 5	95°13'60.00"E 27°29'48.75"N	Khagorijan Oil & Gas Field	Kanjikhowa	Chabua	Dibrugarh	Tea Estate	Its located nearby AT Rd. which joins it to NH 37	Flat Land	NA	NA	NA	Chungichuk, Raja Chuk, Kanjikhowa Gaon and Panitola PHC (0.92km W)
20.	HLA	95°12'48.54"E 27°30'0.97"N	Khagorijan Oil & Gas Field	Dangar Chuk			Homestead plantation	AT Rd. located at 0.14km connects this area to NH 37	Flat Land	NA	NA	NA	Chungichuk, Raja Chuk, Dangar Chuk, River Valley Tea Company Private Limited (W), and Panitola PHC (0.92km E),
21.	TAC	95°11'9.56"E 27°30'11.10"N	Khagorijan Oil & Gas Field	Balijan Pani Era	Chabua	Dibrugarh	Exsisting Site	Dinjon Balian Rd. joins it to NH 37	Flat Land	NA	NA	NA	Balijan Pani Era, Dongerchuk Gaon, Dinjoy Chapori, well 4,

													an abandoned drilling site at 0.52km (NW), Dinjoy Hazarimal Higher Secondary School (0.99km N),tea estate office (0.33km SW).
22.	Well 4	95°10'45.75" E 27°30'18.75" N	Khagorijan Oil & Gas Field	Balijan Pani Era	Chabua	Dibrugarh	Tea Estate	Dinjon Balian Rd. at 0.55km E joins it to NH 37	Flat Land	An unnamed stream flows at 0.91km W	NA	NA	Balijan Pani Era, Balijan Bangali, Balijan Gaon, Dinjoy Satra, Bharalua, well TAC (0.55km SE), an abandoned drilling site at 0.27km (E), Dinjoy Hazarimal Higher Secondary School (0.75km N),tea estate office (0.62km SE).
23.	TAQ	95°10'29.85" E 27°32'51.04" N	Khagorijan Oil & Gas Field	Balijan	Chabua	Dibrugarh	Tea Estate	Dinjoy Balijan Rd. and Tamulisinga ali Rd. are at a distance of 0.89km W and 0.08km N	Flat Land	Brahmaputra river flows at 0.39km N	NA	NA	The site lies within Raidang. There is a tea estate factory at 0.96km W. wells 9 & 7 lay in its vicicnity.

								of the well site					
24.	Well 9	95°10'26.00" E 27°32'44.00" N	Khagorijan Oil & Gas Field	Balijan	Chabua	Dibrugarh	Tea Estate	Dinjoy Balijan Rd. and Timulsinga Ali Rd. lay at a distance of 0.80 W & 0.30 N respectively	Flat Land	Brahmaputra river flows at 0.54km N	NA	NA	Well site is located in Raidang. Wells TAQ & 7 are located nearby. There is a tea estate factory at 0.85km W.
25.	Well 7	95°10'37.62" E 27°32'31.62" N	Khagorijan Oil & Gas Field	Balijan	Chabua	Dibrugarh	Tea Estate	Dinjoy Balijan Rd. and Timulsinga Ali Rd. lay at a distance 1.14km W & 0.73km N respectively	Flat Land	Brahmaputra river flows at 0.98km N	NA	NA	Well site is located in Raidang. Wells TAQ & 9 are located nearby.
26.	Well 8	95° 9'59.74"E 27°32'32.67" N	Khagorijan Oil & Gas Field	Balijan	Chabua	Dibrugarh	Tea Estate	Dinjoy Balijan Rd. and Timulsinga Ali Rd. lay at a distance 0.06km W & 0.60km N respectively	Flat Land	Brahmaputra river flows at 0.86km N	NA	NA	Well site is located in Raidang and Lacachani as well as wells 13,9 & TAQ lies nearby. A tea estate factory is located at a 0.16km W & a plant nursery at 0.78km W

27.	TAP	95° 9'24.41"E 27°32'42.36" N	Khagorijan Oil & Gas Field	Balijan	Chabua	Dibrugarh	Exsisting Site	Dinjoy Balijan Rd. and Timulsinga Ali Rd. lay at a distance 0.89km E and 0.33km N approx. respectively	Flat Land	Brahmaputra river flows at 0.70km N	NA	NA	Lacachani and Raidang are the nearby villages. A tea estate factory is located at a 0.83km SE & a plant nursery at 0.26km SE. wells 13, 6, 26 and Installtion 1.E Khag.
28.	TAI	95° 9'23.72"E 27°32'43.37" N	Khagorijan Oil & Gas Field	Balijan	Chabua	Dibrugarh	Exsisting Site		Flat Land	NA	NA	NA	NA
29.	TAO	95° 9'24.12"E 27°32'42.78" N	Khagorijan Oil & Gas Field	Balijan	Chabua	Dibrugarh	Exsisting Site		Flat Land	NA	NA	NA	NA
30.	Well 13	95° 9'39.00"E 27°32'38.25" N	Khagorijan Oil & Gas Field	Balijan	Chabua	Dibrugarh	Tea Estate	Dinjoy Balijan Rd. and Timulsinga Ali Rd. lay at a distance 0.48km E and 0.42km N approx. respectively	Flat Land	Brahmaputra river flows at 0.65km N	NA	NA	Lacachani and Raidang are the nearby villages. A tea estate factory is located at a 0.39km SE & a plant nursery at 0.23km SW. Wells 8, 26, TAO,TAI, TAP and Installation 1.E Khag.
31.	Installation1.E Khag	95° 9'20.82"E 27°32'39.65" N	Khagorijan Oil & Gas Field	Balijan	Chabua	Dibrugarh	Agriculture Land	Dinjoy Balijan Rd. and Timulsinga Ali Rd. lay	Flat Land	Brahmaputra river flows at 0.68km N	NA	NA	Lacachani and Raidang are the nearby villages. A tea estate factory is located

								at a distance 0.98km E and 0.49km N approx. respectively					at a 0.87km SE & a plant nursery at 0.23km SE. Wells 6,13 26, TAO,TAI, TAP.
32.	Well 6	95° 8'60.00"E 27°32'27.00" N	Khagorijan Oil & Gas Field	Balijan	Chabua	Dibrugarh	Tea Estate	Timulsinga Ali Rd. lay at a distance 1km N	Flat Land	Brahmaputra river flows at 1.19km N	NA	NA	Lacachani and Rahmoria are the nearby villages. A plant nursery at 0.63km NE. Wells TAO,TAI, TAP (0.81km NE) and Installation1.E Khag.
33.	Well 25	95° 8'27.86"E 27°32'11.25" N	Khagorijan Oil & Gas Field	Rahmoria	Chabua	Dibrugarh	Brick Field	Small village roads connect it to Timulsinga Ali Rd. lay at a distance 1.70km N	Flat Land	NA	NA	NA	Lacachani and Rahmoria are the nearby villages. Two brick making factories are located at 0.12km and 0.53km S. Wells TAN and 6 are located nearby.
34.	Well 26	95° 9'9.72"E 27°32'54.52" N	Khagorijan Oil & Gas Field	Balijan	Chabua	Dibrugarh	Tea Estate	Timulsiga Rd. is at 0.13km which joins it to Dinjoy Balijan Rd.	Flat Land	River Brahmaputra flows at 0.27km N	NA	NA	Lacachani & Genichuk Rahmoria lay nearby. A plant nursery at 0.78km SE. Wells TAI,TAO,TAP (with debri pit)

													& Installation 1. E Khag.
35.	Well 27	95° 9'55.55"E 27°32'50.82" N	Khagorijan Oil & Gas Field	Balijan	Chabua	Dibrugarh	Tea Estate	Timulsiga Rd. is at 0.06km N which joins Dinjoy Balijan Rd. also located at 0.06km E of the well site.	Flat Land	River Brahmaputra flows at 0.34km N	NA	NA	Lacachani is located nearby. A plant nursery is located at 0.82km SW & a tea estate factory at 0.37km S. Wells 13,8,9, TAQ & TAP,TAI,TAO(with debri pits).
36.	Well 28	95°11'1.60"E 27°32'53.22" N	Khagorijan Oil & Gas Field	Balijan	Chabua	Dibrugarh	Tea Estate	Timulsiga Rd. is at 0.14km N which joins it to Dinjoy Balijan Rd.	Flat Land	River Brahmaputra flows at 0.78km N	NA	NA	Piporatoli, Raidang & Nakapur are nearby. Wells TAQ & 29.
37.	Well 29	95°11'29.51" E 27°33'4.40" N	Khagorijan Oil & Gas Field	Balijan	Chabua	Dibrugarh	Tea Estate	Timulsiga Rd. is at 0.12km N	Flat Land	River Brahmaputra flows at 0.58km N	NA	NA	Piporatoli, Raidang & Nakapur are located nearby. Wells TAT & TAJ (with debri pits) and 28.
38.	Well 30	95°12'52.11" E 27°33'25.05" N	Khagorijan Oil & Gas Field	Piporatoli	Chabua	Dibrugarh	Homestead Plantation	Timulsiga Rd. is at 0.01km N	Flat Land	River Brahmaputra flows at 0.35km N	NA	NA	Piporatoli and Nakapur are nearby.
39.	TAN	95° 7'52.80"E 27°32'8.56" N	Khagorijan Oil & Gas Field	Genichuk	Chabua	Dibrugarh	Homestead plantation	Small village roads connect it to Timulsinga Ali Rd. lay at a	Flat Land	NA	NA	NA	Well is located in Rahmoria. Two brick factories are located at 0.63km E and 0.89km S. Hahoriyaal Naamghar is located in the

								distance 1.65km N					North. Well 25 is located nearby.
40.	TAR	95° 9'10.41"E 27°30'13.38" N	Khagorijan Oil & Gas Field	Dhopabor Gaon	Chabua	Dibrugarh	Agriculture Land	An unnamed road at 0.59km W connects it to other villages	Flat Land	An unnamed stream flows at a distance of 0.68km S	NA	NA	Dhopabor Gaon, Kath Gaon and Bamuni Hiloidhar.
41.	CV	95° 8'48.38"E 27°29'16.05" N	Khagorijan Oil & Gas Field	Maricha Gaon (just beside College Rd.)	Chabua	Dibrugarh	Homestead plantation	College Rd. passes by the well site at 30m S	Flat Land	An unnamed stream flows at a distance of 0.37km N	NA	NA	Bamuni Hiloidhari, Maricha Gaon, Kath Gaon and Mohabir Bari. An abandoned well site at 0.42km NW. Few ponds located in the north.
42.	Well 3	95° 7'49.04"E 27°28'58.90" N	Khagorijan Oil & Gas Field	Hatigadhoi	Chabua	Dibrugarh	Tea estate	College Rd. passes by at 0.49km E. Small village road connects it to AT Rd. & NH 15 at 0.91km S.	Flat Land	An unnamed stream flows at a distance of 0.34km N	NA	NA	Hatigadhoi & Naduwa Gohain Gaon. Well site of wells CH, CW, CU & CX (with debri pits), Installation 2. Nadua. An office area is also included within 1km of this radius (NE).
43.	CH	95° 7'29.24"E 27°28'58.66" N	Khagorijan Oil & Gas Field	Hatigadhoi	Chabua	Dibrugarh	Exsisting Site	Small village roads join it to AT Rd. and NH 15 at 0.79km S	Flat Land	An unnamed stream flows at a distance of 0.07km N	NA	NA	Hatigadhoi, Mohabir Bari and Mekahiguri. Wells Installation 2. Nadua, 3 and CAB lay nearby.

													Kendriya Vidyalaya AFS Chabua is located at 1km SW.
44.	CU	95° 7'28.88"E 27°28'58.40" N	Khagorijan Oil & Gas Field	Hatigadhoi	Chabua	Dibrugarh	Exsisting Site		Flat Land	NA	NA	NA	NA
45.	CW	95° 7'29.10"E 27°28'58.08" N	Khagorijan Oil & Gas Field	Hatigadhoi	Chabua	Dibrugarh	Exsisting Site		Flat Land		NA	NA	NA
46.	CX	95° 7'28.96"E 27°28'57.50" N	Khagorijan Oil & Gas Field	Hatigadhoi	Chabua	Dibrugarh	Exsisting Site		Flat Land	NA	NA	NA	NA
47.	Installation 2.Nadua	95° 7'33.99"E 27°28'59.58" N	Khagorijan Oil & Gas Field	Hatigadhoi	Chabua	Dibrugarh	Tea Estate	Small village roads join it to AT Rd. and NH 15 at 0.77km S	Flat Land	An unnamed stream flows at a distance of 0.10km N	NA	NA	Hatigadhoi, Mohabir Bari and Mekahiguri. Wells CH,CW,CU &CX with debri pits,3, CAB lay nearby.
48.	CAB	95° 7'2.57"E 27°29'11.56" N	Khagorijan Oil & Gas Field	Mohabir Bari	Chabua	Dibrugarh	Tea Estate	Small village roads connect it to other villages.	Flat Land	An unnamed stream flows at a distance of 0.38km S	NA	NA	Phukanar Khat, Mekahiguri, Mohabir Bari & Hatigadhoi. Wells CH,CU,CW,CX (with debri pits) & Installation No.2 Nadua. A drilling site is located at 0.49km NW.

49.	Well 12	95° 6'40.50"E 27°31'42.00" N	Khagorijan Oil & Gas Field	Mukalbari T.E.	Chabua	Dibrugarh	Tea Estate	Village road at 0.09km N connect it to other places nearby.	Flat Land	NA	NA	NA	Mukalbari T.E, Maijan & Thanai T.E. An abandoned drilling site at 0.43km SW. Wells 10 & 11.
50.	Well 10	95° 6'39.75"E 27°31'31.50" N	Khagorijan Oil & Gas Field	Maijan	Chabua	Dibrugarh	Tea Estate	Village road at 0.41km N connect it to other places nearby.	Flat Land	NA	NA	NA	Mukalbari T.E, Maijan & Thanai T.E. An abandoned drilling site at 0.35km NW. Wells 11 & 12.
51.	Well 11	95° 6'22.50"E 27°31'24.00" N	Khagorijan Oil & Gas Field	Maijan	Chabua	Dibrugarh	Agriculture Land	An unnamed village road nearby at 0.25km W connects it with other places.	Flat Land	NA	NA	NA	Mukalbari T.E, Maijan, Garapara Konwar & Thanai T.E. An abandoned drilling site at 0.27km NW. Wells 10 & 12.
52.	Well 1	95° 6'17.33"E 27°29'23.49" N	Khagorijan Oil & Gas Field	Chengdhora T.E	Chabua	Dibrugarh	Tea Estate	An unnamed village road nearby at 0.25km W connects it with other places.	Flat Land	NA	NA	NA	Chengdhora T.E. & Phukanar Khat. Nudwa tea estate and its factory lay at 0.78km SW. A drilling site at 0.68km SE.
53.	CG	95° 4'4.52"E 27°29'59.15" N	Khagorijan Oil & Gas Field	Kanai Gaon	Dibrugarh East	Dibrugarh	Exsisting Site	An unnamed village road nearby at 0.09km E connects it	Flat Land	A nullah is present at 0.27km S	NA	NA	Kholajan Grant 34 No N.C. & Kachuwani Pathar. Mokalbari Tea Estate at 0.37km NE. A part of

								with other places.					Greenwood playground at 0.64km NW.
54.	CY	95° 2'52.34"E 27°28'54.11" N	Khagorijan Oil & Gas Field	Kandulibari Grant Gaon No.39	Dibrugarh East	Dibrugarh	Tea Estate	An unnamed village road nearby at 0.43km N connects it with other places.	Flat Land	NA	NA	NA	Garuchur Gaon & Kanai Gaon. A tea factory at 0.51km NE.
55.	Well 32	95° 0'52.66"E 27°30'54.46" N	Khagorijan Oil & Gas Field	Nagaghulie	Chabua	Dibrugarh	Agriculture Land	An unnamed village road nearby at 0.22km E connects it with other places.	Flat Land	River Brahmaputra flows at a distance of 1.24km N.	NA	NA	Longsoo Chapori & Nogaghuli 7/180 Orr. Jodhraj Khemka ME School is at 0.21km N. Assam Co. India Ltd. Greenwood Tea Estate at 0.49km S. Greenwood Tea Estate Hospital at 0.65km S. Greenwood Factory at 0.58km S.
56.	Well 31	94°59'13.04" E 27°29'34.61" N	Khagorijan Oil & Gas Field	Mothola 5/142 Orr	Dibrugarh East	Dibrugarh	Homestead Plantation	Airforce Rd. Lays at 0.12km S.	Flat Land	NA	NA	NA	Mothola 5/142 Orr & Nogaghuli 1/177 Orr.

Annexure 3.1

NABL certificate of Mitra S K Private Limited



NABL

National Accreditation Board for Testing and Calibration Laboratories

(An Autonomous Body under Department of Science & Technology, Govt. of India)

CERTIFICATE OF ACCREDITATION

MITRA S. K. PRIVATE LIMITED

has been assessed and accredited in accordance with the standard

ISO/IEC 17025:2005

"General Requirements for the Competence of Testing & Calibration Laboratories"

for its facilities at

Building No. P-48, Udayan Industrial Estate, 3, Pagladanga Road, Kolkata, West Bengal

in the discipline of

CHEMICAL TESTING

(To see the scope of accreditation of this laboratory, you may also visit NABL website www.nabl-india.org)

Certificate Number T-2303

Issue Date 18/09/2016

Valid Until 17/09/2018

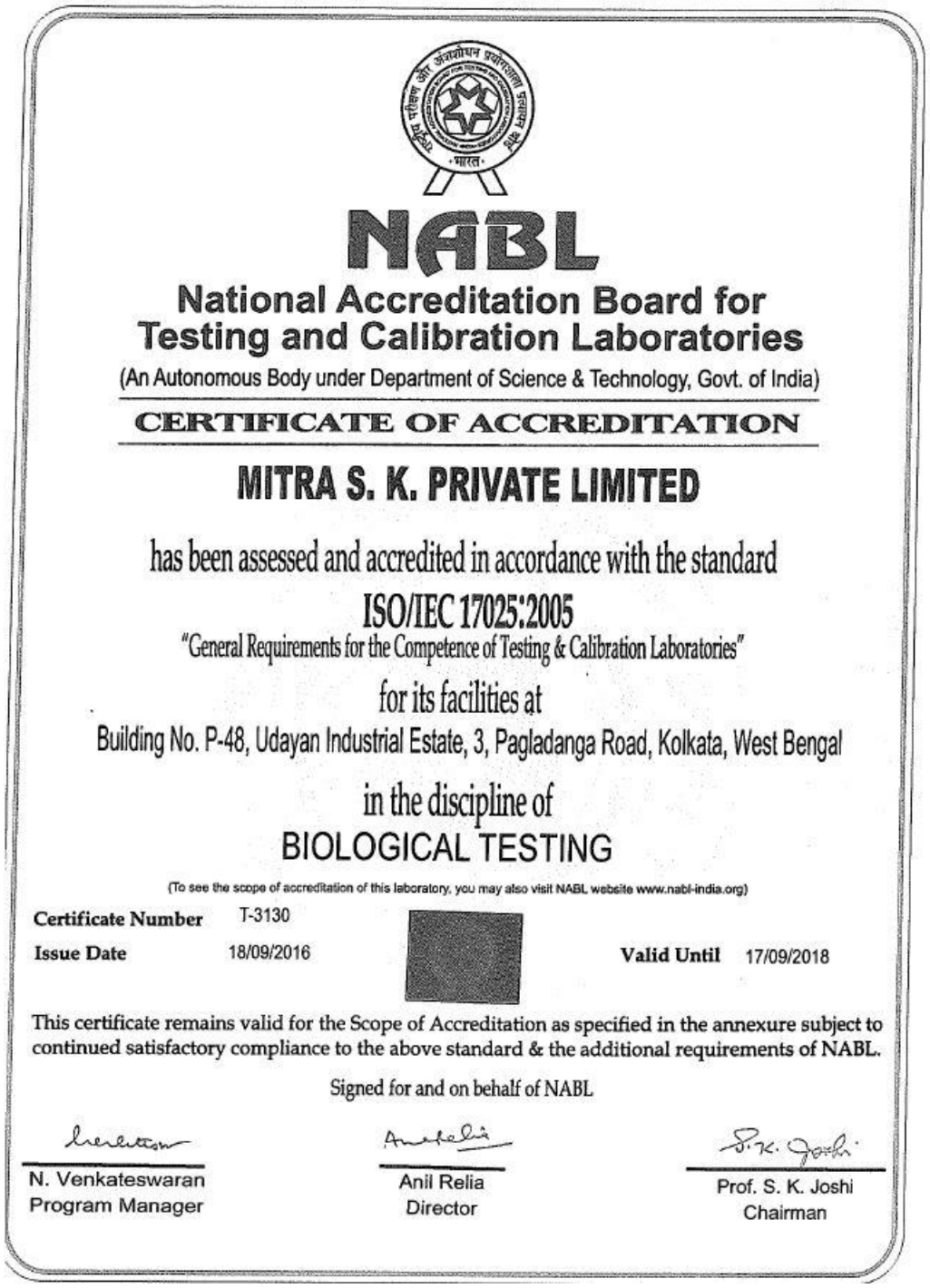
This certificate remains valid for the Scope of Accreditation as specified in the annexure subject to continued satisfactory compliance to the above standard & the additional requirements of NABL.

Signed for and on behalf of NABL

N. Venkateswaran
Program Manager

Anil Relia
Director

Prof. S. K. Joshi
Chairman



NABL

National Accreditation Board for Testing and Calibration Laboratories

(An Autonomous Body under Department of Science & Technology, Govt. of India)

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"General Requirements for the Competence of Testing & Calibration Laboratories"

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Building No. P-48, Udayan Industrial Estate, 3, Pagladanga Road, Kolkata, West Bengal

in the discipline of

BIOLOGICAL TESTING

(To see the scope of accreditation of this laboratory, you may also visit NABL website www.nabl-india.org)

Certificate Number T-3130

Issue Date 18/09/2016

Valid Until 17/09/2018

This certificate remains valid for the Scope of Accreditation as specified in the annexure subject to continued satisfactory compliance to the above standard & the additional requirements of NABL.

Signed for and on behalf of NABL

N. Venkateswaran
Program Manager

Anil Relia
Director

Prof. S. K. Joshi
Chairman

Annexure 3.2

Dutch Soil Standard

Soil Remediation Circular 2009

Table 1 Groundwater target values and soil and groundwater intervention values[9]

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

Substance	Target value groundwater[7] shallow (< 10 m –gl) (µg/l)	National background concentration groundwater (BC) deep (> 10 m –gl) (µg/l)	Target value groundwater[7] (incl. BC) deep (> 10 m –gl) (µg/l)	Intervention values soil (mg/kg d.s.)	groundwater (µg/l)
1 Metals					
Antimony	-	0.09	0.15	22	20
Arsenic	10	7	7.2	76	60
Barium	50	200	200	[8]	625
Cadmium	0.4	0.06	0.06	13	6
Chromium	1	2.4	2.5	-	30
Chromium III	-	-	-	180	-
Chromium VI	-	-	-	78	-
Cobalt	20	0.6	0.7	190	100
Copper	15	1.3	1.3	190	75
Mercury	0.05	-	0.01	-	0.3
Mercury (inorganic)	-	-	-	36	-
Mercury (organic)	-	-	-	4	-
Lead	15	1.6	1.7	530	75
Molybdenum	5	0.7	3.6	190	300
Nickel	15	2.1	2.1	100	75
Zinc	65	24	24	720	800

Annexure 3.3

Primary Meteorological Data

Date and Time	Wind Direction (degree)	Wind Speed (km/h)	Temperature (^{0}C)	Relative Humidity (%)	Rainfall (mm)
04-10-2017 09:00	293	0	27.2	74.4	0.2
04-10-2017 10:00	259	0	28.5	62.4	0.7
04-10-2017 11:00	46	5	32.3	46.4	0
04-10-2017 12:00	43	8	34.6	41.2	0
04-10-2017 13:00	52	6	35.1	41.5	0
04-10-2017 14:00	304	6	34.6	41.9	0
04-10-2017 15:00	9	5	33.7	43.8	0
04-10-2017 16:00	11	5	32.7	50.6	0
04-10-2017 17:00	15	5	29.6	67.3	0
04-10-2017 18:00	15	6	27.6	72.8	0
04-10-2017 19:00	15	5	26.5	79.6	0
04-10-2017 20:00	15	6	25.6	83.9	0
04-10-2017 21:00	15	6	25.2	85.6	0
04-10-2017 22:00	15	0	24.6	88	0
04-10-2017 23:00	15	0	24.2	89.1	0
05-10-2017 00:00	15	0	23.7	90.6	0
05-10-2017 01:00	15	0	23.6	91.9	0
05-10-2017 02:00	15	0	23.2	92.5	0
05-10-2017 03:00	15	0	23	93.6	0
05-10-2017 04:00	15	0	22.9	94.2	0
05-10-2017 05:00	15	0	22.8	94.7	0
05-10-2017 06:00	9	0	22.9	95.4	0
05-10-2017 07:00	15	0	23.6	96	0
05-10-2017 08:00	53	0.5	25.3	86.9	0
05-10-2017 09:00	57	0.8	29.6	59.3	0
05-10-2017 10:00	57	0.9	33.3	48	0
05-10-2017 11:00	196	1.2	32.9	49.4	0
05-10-2017 12:00	64	1.3	33.8	45.4	0
05-10-2017 13:00	46	0.2	36.7	39.6	0
05-10-2017 14:00	46	0	35.5	45.5	0
05-10-2017 15:00	170	0.5	36.1	40.3	0
05-10-2017 16:00	170	0.8	34.4	46.9	0
05-10-2017 17:00	170	0.9	31.6	62.4	0
05-10-2017 18:00	170	1.2	28.5	75.7	0
05-10-2017 19:00	170	1.3	27.2	79.4	0
05-10-2017 20:00	170	0.2	26.4	83.2	0
05-10-2017 21:00	170	0	25.7	85.6	0
05-10-2017 22:00	169	0	25.3	85.8	0
05-10-2017 23:00	169	0	24.8	86.6	0
06-10-2017 00:00	169	0	24.2	88.6	0
06-10-2017 01:00	169	0	23.8	89.9	0
06-10-2017 02:00	131	0	23.6	89.6	0
06-10-2017 03:00	122	0	23.3	89.5	0
06-10-2017 04:00	117	0	23.3	90.5	0
06-10-2017 05:00	64	0	23.4	92	0
06-10-2017 06:00	15	4	23.3	93.6	0
06-10-2017 07:00	48	2	23.7	92.8	0
06-10-2017 08:00	29	0	27	64.7	0
06-10-2017 09:00	39	3.3	30.6	55.2	0
06-10-2017 10:00	36	4.2	32	46	0
06-10-2017 11:00	70	4.2	32.9	40.4	0

Date and Time	Wind Direction (degree)	Wind Speed (km/h)	Temperature (^{0}C)	Relative Humidity (%)	Rainfall (mm)
06-10-2017 12:00	43	2.2	33.2	40.4	0
06-10-2017 13:00	189	1	33.9	41.2	0
06-10-2017 14:00	189	1	33.6	45.4	0
06-10-2017 15:00	189	1	32.1	54.7	0
06-10-2017 16:00	189	1	32.1	50.2	0
06-10-2017 17:00	189	0.5	30.4	67.2	0
06-10-2017 18:00	189	0.8	27.5	76.5	0
06-10-2017 19:00	189	0.9	26.3	82	0
06-10-2017 20:00	189	1.2	25.7	84.7	0
06-10-2017 21:00	189	1.3	25.3	86.5	0
06-10-2017 22:00	56	0.2	25.1	86.9	0
06-10-2017 23:00	56	0	24.7	87.6	0
07-10-2017 00:00	56	0	24.6	87.1	0
07-10-2017 01:00	56	0	24.3	87.2	0
07-10-2017 02:00	56	0	23.8	89.8	0
07-10-2017 03:00	56	0	23.4	91.2	0
07-10-2017 04:00	26	0	23.1	90.9	0
07-10-2017 05:00	26	0	22.7	90.5	0
07-10-2017 06:00	26	0	22.4	91.5	0
07-10-2017 07:00	28	0	23.4	88	0
07-10-2017 08:00	60	5	26	76.1	0
07-10-2017 09:00	156	2	27.6	69.3	0
07-10-2017 10:00	22	0	32.1	52.2	0
07-10-2017 11:00	173	0.5	33.6	49.3	0
07-10-2017 12:00	38	0.8	33.4	52.9	0
07-10-2017 13:00	183	0.9	33.9	50	0
07-10-2017 14:00	252	1.2	34.4	44.7	0
07-10-2017 15:00	251	1.3	35.1	46.6	0.7
07-10-2017 16:00	251	0.2	33.9	49.1	0
07-10-2017 17:00	251	0	30.8	66.9	0
07-10-2017 18:00	251	0	28.7	75.1	0
07-10-2017 19:00	251	0	27.8	76.9	0
07-10-2017 20:00	251	0	27.2	81.4	0
07-10-2017 21:00	251	0	26.6	84	0
07-10-2017 22:00	38	0	26.3	84.9	0
07-10-2017 23:00	93	4.2	25.9	83.2	0
08-10-2017 00:00	84	4.2	25.3	83.4	0
08-10-2017 01:00	52	3.3	24.7	81.4	0
08-10-2017 02:00	94	2.2	24.4	76.7	0
08-10-2017 03:00	107	0	24.2	79.6	0
08-10-2017 04:00	107	0	23.9	78.8	0
08-10-2017 05:00	264	0	23.9	79.9	0
08-10-2017 06:00	306	0	23.6	80.6	0
08-10-2017 07:00	25	0	23.7	74.8	0
08-10-2017 08:00	110	1	25.2	76.3	0
08-10-2017 09:00	128	0.5	27.2	68.4	0
08-10-2017 10:00	324	0.8	29.4	64.7	0
08-10-2017 11:00	307	0.9	29.8	57.8	0
08-10-2017 12:00	285	1.2	29.8	62.7	0
08-10-2017 13:00	347	1.3	30.4	64.6	0
08-10-2017 14:00	306	0.2	29.2	66.9	0

Date and Time	Wind Direction (degree)	Wind Speed (km/h)	Temperature (^{0}C)	Relative Humidity (%)	Rainfall (mm)
08-10-2017 15:00	323	0	28.6	66.8	0
08-10-2017 16:00	336	0	28.1	70.6	0
08-10-2017 17:00	343	0	27.4	74.3	0
08-10-2017 18:00	338	0	26.7	76.1	0
08-10-2017 19:00	338	0	26.4	75.7	0
08-10-2017 20:00	337	0	26.1	78.6	0
08-10-2017 21:00	328	0	26.1	82.9	0
08-10-2017 22:00	256	1	25.8	83.1	0
08-10-2017 23:00	317	1	24.9	84	0
09-10-2017 00:00	286	0	24.2	89.4	4
09-10-2017 01:00	124	0	23.2	91.5	2.5
09-10-2017 02:00	14	0	22.6	93.6	5
09-10-2017 03:00	21	0	22.2	95.1	7.6
09-10-2017 04:00	69	1	21.9	95.7	11.4
09-10-2017 05:00	21	0	21.7	95.9	2.5
09-10-2017 06:00	63	0	21.6	96.6	2.2
09-10-2017 07:00	94	0	21.7	96.5	1.2
09-10-2017 08:00	77	0	21.8	96	0.5
09-10-2017 09:00	43	0	22.1	95	0.7
09-10-2017 10:00	80	0.5	22.7	91.3	0
09-10-2017 11:00	145	0.8	23.1	89.8	0.5
09-10-2017 12:00	91	0.9	23.2	89.5	0.2
09-10-2017 13:00	80	1.2	23.5	88.1	0
09-10-2017 14:00	125	1.3	23.6	86.9	0
09-10-2017 15:00	66	0.2	23.6	88	0.5
09-10-2017 16:00	66	8	23.6	90.3	0.5
09-10-2017 17:00	66	9	23.3	92.1	1.5
09-10-2017 18:00	90	2	22.9	93.6	1.2
09-10-2017 19:00	90	1	22.6	94.8	1.5
09-10-2017 20:00	90	0	22.6	95.6	1.2
09-10-2017 21:00	108	2	22.3	95.7	2
09-10-2017 22:00	103	2	21.9	96	2
09-10-2017 23:00	125	2	21.7	96.5	2
10-10-2017 00:00	124	0	21.6	96.6	2
10-10-2017 01:00	132	0	21.6	96.9	1.7
10-10-2017 02:00	103	0	21.3	96.8	1.5
10-10-2017 03:00	96	1	21.1	96.3	1.2
10-10-2017 04:00	103	3	21.2	94.1	1.2
10-10-2017 05:00	80	3	21.3	94.7	1
10-10-2017 06:00	103	1	21.2	95.4	0.7
10-10-2017 07:00	67	3	21.3	95.9	0.7
10-10-2017 08:00	77	3	21.3	93.1	0.7
10-10-2017 09:00	93	3	21.6	93.1	1
10-10-2017 10:00	63	6	21.7	92.9	0.5
10-10-2017 11:00	84	3	21.8	91.8	0.7
10-10-2017 12:00	97	3	22.1	89	0.7
10-10-2017 13:00	149	3	23	81.7	0.5
10-10-2017 14:00	111	1	23.7	81.3	0.5
10-10-2017 15:00	230	0.5	24.3	76.1	0
10-10-2017 16:00	216	0.8	24.3	77.4	0
10-10-2017 17:00	217	0.9	23.5	82.2	0

Date and Time	Wind Direction (degree)	Wind Speed (km/h)	Temperature (^{0}C)	Relative Humidity (%)	Rainfall (mm)
10-10-2017 18:00	18	1.2	22.9	87.1	0
10-10-2017 19:00	62	1.3	22.3	90.8	0
10-10-2017 20:00	91	0.2	22.1	92.8	0
10-10-2017 21:00	91	0	22.1	93.1	0
10-10-2017 22:00	91	0	22.1	93.5	0
10-10-2017 23:00	91	0	22.1	94.2	0
11-10-2017 00:00	91	0	22.1	94.7	0
11-10-2017 01:00	91	0	22.1	95	0
11-10-2017 02:00	91	0	22	95.3	0
11-10-2017 03:00	91	0	21.9	95.7	0
11-10-2017 04:00	91	0	21.9	96	0
11-10-2017 05:00	91	0	21.9	96.2	0
11-10-2017 06:00	91	0	22	96.6	0
11-10-2017 07:00	91	0	22.4	97	0
11-10-2017 08:00	96	0	23.9	87.5	0
11-10-2017 09:00	320	0	24.8	78.8	0
11-10-2017 10:00	319	5	25.4	75.5	0
11-10-2017 11:00	340	4	26.2	72.1	0
11-10-2017 12:00	45	6	26.2	80.4	0
11-10-2017 13:00	19	8	25.9	71.1	0
11-10-2017 14:00	302	8	28.1	65.1	0.2
11-10-2017 15:00	40	8	27.2	71.3	0
11-10-2017 16:00	25	9	26.6	71.9	0
11-10-2017 17:00	225	0.5	25.6	80.6	0
11-10-2017 18:00	297	0.8	23.8	87.9	0.5
11-10-2017 19:00	276	0.9	22.9	92	1
11-10-2017 20:00	276	1.2	22.9	93.6	1
11-10-2017 21:00	218	1.3	22.8	94.6	0.7
11-10-2017 22:00	225	0.2	22.7	95.1	0.7
11-10-2017 23:00	225	0	22.6	95.4	1
12-10-2017 00:00	129	0	22.4	95.6	1.2
12-10-2017 01:00	98	0	22.1	95.7	0.7
12-10-2017 02:00	160	0	21.8	95.9	0.7
12-10-2017 03:00	114	0	21.7	96	0.5
12-10-2017 04:00	111	0	21.7	96	0.5
12-10-2017 05:00	156	0	21.6	95.8	0.5
12-10-2017 06:00	118	0	21.6	95.8	0.2
12-10-2017 07:00	155	0	21.9	96	0.2
12-10-2017 08:00	288	0	22.5	93.4	0.2
12-10-2017 09:00	45	0	22.8	92.5	0
12-10-2017 10:00	59	1	24.5	75.5	0.2
12-10-2017 11:00	86	3	26.9	63.4	0
12-10-2017 12:00	145	3	28.1	61.9	0
12-10-2017 13:00	115	2	28.7	60.1	0.2
12-10-2017 14:00	112	3	29	57.5	0
12-10-2017 15:00	134	5	29.7	53.6	0
12-10-2017 16:00	108	6	29.1	58.9	0
12-10-2017 17:00	108	6	26.5	75.3	0
12-10-2017 18:00	108	8	25.2	81.8	0
12-10-2017 19:00	108	9	24.5	85.4	0
12-10-2017 20:00	108	9	24.3	86.9	0

Date and Time	Wind Direction (degree)	Wind Speed (km/h)	Temperature (^{0}C)	Relative Humidity (%)	Rainfall (mm)
12-10-2017 21:00	108	9	24.2	86.9	0
12-10-2017 22:00	63	2	23.7	84.8	0
12-10-2017 23:00	101	1	23.3	80	0
13-10-2017 00:00	101	2	22.6	85.5	0
13-10-2017 01:00	67	2	22	86.6	0
13-10-2017 02:00	77	2	21.7	90.3	0
13-10-2017 03:00	118	2	21.6	91.9	0
13-10-2017 04:00	118	4	21.3	93.2	0
13-10-2017 05:00	118	1	21.3	93.1	0
13-10-2017 06:00	118	2	21.4	93.1	0
13-10-2017 07:00	344	2	21.6	92.4	0
13-10-2017 08:00	57	5	22.5	73.6	0
13-10-2017 09:00	24	6	24.1	66.5	0
13-10-2017 10:00	19	6	25.8	61.4	0
13-10-2017 11:00	80	6	27.2	57	0
13-10-2017 12:00	40	6	26.8	56.9	0
13-10-2017 13:00	14	6	26.7	58.1	0
13-10-2017 14:00	343	7	28.2	54.8	0
13-10-2017 15:00	4	2	28.2	57.6	0
13-10-2017 16:00	21	3	26.9	62	0
13-10-2017 17:00	21	6	25.3	73.6	0
13-10-2017 18:00	21	6	23.9	82.4	0
13-10-2017 19:00	21	2	23.1	85.3	0
13-10-2017 20:00	21	1	22.6	86	0
13-10-2017 21:00	21	2	22.1	87.6	0
13-10-2017 22:00	63	0	21.7	76.5	0
13-10-2017 23:00	101	0	21.4	79	0
14-10-2017 00:00	70	0	20.9	82	0
14-10-2017 01:00	70	0	20.4	84.3	0
14-10-2017 02:00	70	0	20.2	87.8	0
14-10-2017 03:00	36	0	20.1	88.6	0
14-10-2017 04:00	36	0	20	90.5	0
14-10-2017 05:00	36	0	19.7	92.2	0
14-10-2017 06:00	94	0	19.7	93.7	0
14-10-2017 07:00	107	0	20.5	94.7	0
14-10-2017 08:00	107	0	21.8	92.3	0
14-10-2017 09:00	225	0	23.8	73.5	0
14-10-2017 10:00	122	2	28	57.7	0
14-10-2017 11:00	128	2	28.3	59.4	0
14-10-2017 12:00	355	5	29.1	51.5	0
14-10-2017 13:00	285	0	29.6	50.1	0
14-10-2017 14:00	300	0.5	31.1	45.9	0
14-10-2017 15:00	29	0.8	31	47.5	0
14-10-2017 16:00	16	0.9	29.9	54	0
14-10-2017 17:00	16	1.2	26.9	69.7	0
14-10-2017 18:00	16	1.3	25.1	77.2	0
14-10-2017 19:00	16	0.2	24.1	81.3	0
14-10-2017 20:00	16	0	23.3	84.3	0
14-10-2017 21:00	16	0	22.7	86	0
14-10-2017 22:00	16	0	22.1	87.4	0
14-10-2017 23:00	16	0	21.7	89.2	0

Date and Time	Wind Direction (degree)	Wind Speed (km/h)	Temperature (^{0}C)	Relative Humidity (%)	Rainfall (mm)
15-10-2017 00:00	16	0	21.2	91	0
15-10-2017 01:00	16	0	21	92.3	0
15-10-2017 02:00	16	0	20.7	92.7	0
15-10-2017 03:00	98	2	20.2	94	0
15-10-2017 04:00	98	2	20.2	94.7	0
15-10-2017 05:00	98	2	19.9	95.4	0
15-10-2017 06:00	98	0	19.7	96.4	0
15-10-2017 07:00	98	0	20.2	96.2	0
15-10-2017 08:00	46	0	20.6	96.1	0
15-10-2017 09:00	100	0	22.1	88.6	0
15-10-2017 10:00	187	0.5	25.1	69.2	0
15-10-2017 11:00	87	0.8	28.6	53.4	0
15-10-2017 12:00	81	0.9	29.1	46.8	0
15-10-2017 13:00	302	1.2	29.8	46.4	0
15-10-2017 14:00	28	1.3	30.7	44.9	0
15-10-2017 15:00	124	0.2	31.1	43.4	0
15-10-2017 16:00	55	0.5	29.5	53.8	0
15-10-2017 17:00	86	0.8	26.6	68.1	0
15-10-2017 18:00	86	0.7	24.6	76.4	0
15-10-2017 19:00	86	2.1	23.4	81.7	0
15-10-2017 20:00	86	2	22.9	84.3	0
15-10-2017 21:00	86	0	22.3	85.8	0
15-10-2017 22:00	86	0	21.9	85.5	0
15-10-2017 23:00	86	0	21.4	87	0
16-10-2017 00:00	86	0	21.1	88.1	0
16-10-2017 01:00	86	0	20.6	91.5	0
16-10-2017 02:00	86	0	20.4	92.3	0
16-10-2017 03:00	86	0	20	93.2	0
16-10-2017 04:00	86	0	19.7	93.9	0
16-10-2017 05:00	86	0	19.4	94.4	0
16-10-2017 06:00	86	0	19.6	95.7	0
16-10-2017 07:00	110	0	19.9	96.2	0.2
16-10-2017 08:00	107	0	21	94.9	0
16-10-2017 09:00	115	0	23.3	75.4	0
16-10-2017 10:00	107	0	27.1	58.5	0
16-10-2017 11:00	96	0	29.6	52.2	0
16-10-2017 12:00	345	0	30.7	51.4	0
16-10-2017 13:00	88	0	31.3	42.5	0
16-10-2017 14:00	245	0	31.9	42.9	0
16-10-2017 15:00	107	2	32.3	42.6	0
16-10-2017 16:00	115	5	31	49.9	0
16-10-2017 17:00	115	0.6	27.7	68.1	0
16-10-2017 18:00	115	0.2	25.3	76.1	0
16-10-2017 19:00	115	6	24.2	81.4	0
16-10-2017 20:00	115	6	23.5	83.4	0
16-10-2017 21:00	80	0	23.1	84	0
16-10-2017 22:00	125	0	22.7	84.3	0
16-10-2017 23:00	125	0	22.3	86.2	0
17-10-2017 00:00	125	0	22	87.5	0
17-10-2017 01:00	42	0	21.4	89.8	0
17-10-2017 02:00	36	0	20.9	87.5	0

Date and Time	Wind Direction (degree)	Wind Speed (km/h)	Temperature (^{0}C)	Relative Humidity (%)	Rainfall (mm)
17-10-2017 03:00	36	0	20.7	87.8	0
17-10-2017 04:00	36	0	20.4	86.9	0
17-10-2017 05:00	36	0	20.2	87.9	0
17-10-2017 06:00	72	0	20	86.8	0
17-10-2017 07:00	112	5	20.5	84.8	0
17-10-2017 08:00	120	6	22.1	77.4	0
17-10-2017 09:00	101	6	23.5	74.6	0
17-10-2017 10:00	134	6	24.5	66.6	0
17-10-2017 11:00	142	6	27	48.2	0
17-10-2017 12:00	247	0	28.2	46.1	0
17-10-2017 13:00	186	0	28.7	44.8	0
17-10-2017 14:00	189	0	29.1	49.6	0
17-10-2017 15:00	303	0	28.4	54.3	0
17-10-2017 16:00	353	0	27.2	58.9	0
17-10-2017 17:00	353	0	25.6	72.4	0
17-10-2017 18:00	353	0	24.2	79.2	0
17-10-2017 19:00	353	0	23.4	81.9	0
17-10-2017 20:00	353	0.2	22.9	83.5	0
17-10-2017 21:00	353	0.3	22.6	85.2	0
17-10-2017 22:00	353	0	22.2	86.9	0
17-10-2017 23:00	360	0	21.9	87.7	0
18-10-2017 00:00	351	0	21.7	88.6	0
18-10-2017 01:00	79	0	21.4	90.1	0
18-10-2017 02:00	76	0.5	21.4	91	0
18-10-2017 03:00	76	0.6	21.3	91.7	0
18-10-2017 04:00	77	0	21.2	92	0
18-10-2017 05:00	204	0	21.1	93	0
18-10-2017 06:00	73	0	20.9	94.1	0
18-10-2017 07:00	15	0	20.9	89.7	0
18-10-2017 08:00	115	1	21.3	85.7	0
18-10-2017 09:00	146	1	22.4	74	0
18-10-2017 10:00	254	0.5	24.9	61.3	0
18-10-2017 11:00	242	0.8	24.2	70.9	0
18-10-2017 12:00	230	0.9	24.7	63.5	0
18-10-2017 13:00	234	1.2	25.9	58.7	0
18-10-2017 14:00	234	1.3	25.2	66	0
18-10-2017 15:00	323	0.2	23.5	75.5	0
18-10-2017 16:00	323	0.5	22.9	81.3	0
18-10-2017 17:00	251	0.8	22.3	86.1	0
18-10-2017 18:00	288	0.9	21	87	0.5
18-10-2017 19:00	288	1.2	20.7	90	0
18-10-2017 20:00	288	1.3	20.5	90.6	0.5
18-10-2017 21:00	343	0.2	20.3	91.6	0.5
18-10-2017 22:00	19	0	20.2	92.3	0.2
18-10-2017 23:00	271	0	20	93.9	0.2
19-10-2017 00:00	271	0	19.9	94.3	0.2
19-10-2017 01:00	268	0	19.8	94.8	0
19-10-2017 02:00	134	0	19.6	95.1	0.2
19-10-2017 03:00	125	0	19.2	95.5	0
19-10-2017 04:00	19	0	19.1	95.9	0
19-10-2017 05:00	138	0	18.9	96.2	0.2

Date and Time	Wind Direction (degree)	Wind Speed (km/h)	Temperature (^{0}C)	Relative Humidity (%)	Rainfall (mm)
19-10-2017 06:00	138	0	18.7	96.6	0
19-10-2017 07:00	112	0	19.1	96.9	0
19-10-2017 08:00	112	0	20.5	89.1	0.5
19-10-2017 09:00	60	3	21.9	75.6	0
19-10-2017 10:00	128	1	23.6	62.5	0
19-10-2017 11:00	125	2	25.7	54.6	0
19-10-2017 12:00	135	5	27.3	51	0
19-10-2017 13:00	125	5	27.9	48.8	0
19-10-2017 14:00	245	6	28.8	45.1	0
19-10-2017 15:00	112	6	29.5	50.3	0
19-10-2017 16:00	111	0	28.1	55.3	0
19-10-2017 17:00	62	0	25.2	68.7	0
19-10-2017 18:00	77	0	23.9	73.6	0
19-10-2017 19:00	77	0	22.9	77.2	0
19-10-2017 20:00	77	0	22.1	80.7	0
19-10-2017 21:00	110	0	21.3	79.6	0
19-10-2017 22:00	110	0	20.8	82.2	0
19-10-2017 23:00	110	0	20.1	86.3	0
20-10-2017 00:00	110	0	19.7	87.3	0
20-10-2017 01:00	110	0	19.6	87.5	0
20-10-2017 02:00	110	0	19.4	88	0
20-10-2017 03:00	88	0	18.9	88.9	0
20-10-2017 04:00	88	0	18.7	89.7	0
20-10-2017 05:00	88	0	18.3	92	0
20-10-2017 06:00	88	0	18.2	93.1	0
20-10-2017 07:00	94	0	18.9	89.8	0
20-10-2017 08:00	193	0	22.3	68.7	0
20-10-2017 09:00	105	0	25.8	53.5	0
20-10-2017 10:00	19	0	27.9	46.9	0
20-10-2017 11:00	29	0	29.4	44.8	0
20-10-2017 12:00	230	0.5	30.7	41.2	0
20-10-2017 13:00	304	0.8	31	42.3	0
20-10-2017 14:00	264	0.9	31.1	38.9	0
20-10-2017 15:00	247	1.2	31.6	39.1	0
20-10-2017 16:00	227	1.3	30.9	44.1	0
20-10-2017 17:00	227	0.2	27.1	63.8	0
20-10-2017 18:00	227	0	24.4	73.5	0
20-10-2017 19:00	227	0	23.1	79.9	0
20-10-2017 20:00	227	0	22.3	83	0
20-10-2017 21:00	227	0	21.8	84	0
20-10-2017 22:00	67	0	21.1	85.3	0
20-10-2017 23:00	67	0	20.6	87.6	0
21-10-2017 00:00	67	0	20.1	88.2	0
21-10-2017 01:00	67	0	19.6	89.5	0
21-10-2017 02:00	67	0	19.2	93.1	0
21-10-2017 03:00	67	0	18.8	93.1	0
21-10-2017 04:00	67	0	18.5	93.9	0
21-10-2017 05:00	67	0	18.5	94.5	0
21-10-2017 06:00	67	0	18.5	95.6	0
21-10-2017 07:00	77	0	19	95	0
21-10-2017 08:00	135	0	21.5	75.5	0

Date and Time	Wind Direction (degree)	Wind Speed (km/h)	Temperature (^{0}C)	Relative Humidity (%)	Rainfall (mm)
21-10-2017 09:00	142	0	25.2	61.2	0
21-10-2017 10:00	86	1	27.7	55.6	0
21-10-2017 11:00	48	0	29.1	45.4	0
21-10-2017 12:00	96	0	28.9	45.3	0
21-10-2017 13:00	225	0	30.7	36	0
21-10-2017 14:00	88	1	31.2	35	0
21-10-2017 15:00	104	0	30.4	38.5	0
21-10-2017 16:00	59	0	29.6	45.5	0
21-10-2017 17:00	59	0	26.3	63	0
21-10-2017 18:00	59	0	23.6	72.7	0
21-10-2017 19:00	59	0	22.3	78.2	0
21-10-2017 20:00	59	0	21.6	81.5	0
21-10-2017 21:00	59	0	21	83.1	0
21-10-2017 22:00	59	0	20.4	84.3	0
21-10-2017 23:00	59	0	19.7	86.6	0
22-10-2017 00:00	59	0	19.4	87.3	0
22-10-2017 01:00	59	0	19.1	89.4	0
22-10-2017 02:00	59	0	18.7	92.2	0
22-10-2017 03:00	120	0	18.4	93.2	0
22-10-2017 04:00	120	0	18.1	94.4	0
22-10-2017 05:00	120	0	17.8	94.9	0
22-10-2017 06:00	49	0.5	17.4	95.4	0
22-10-2017 07:00	49	0.8	18.2	95.9	0
22-10-2017 08:00	49	0.9	21.8	70.3	0
22-10-2017 09:00	49	1.2	26.1	53.5	0
22-10-2017 10:00	49	1.3	28	44.9	0
22-10-2017 11:00	49	0.2	30.5	34.9	0
22-10-2017 12:00	49	0	31.7	34.5	0
22-10-2017 13:00	49	1	31.4	34.4	0
22-10-2017 14:00	49	1	31.1	34.6	0
22-10-2017 15:00	118	1	31.1	38.1	0
22-10-2017 16:00	100	0	30.1	38.9	0
22-10-2017 19:00	100	0	22.1	76.9	0
22-10-2017 20:00	100	0	21.7	80.2	0
22-10-2017 21:00	100	0	21.1	83.1	0
22-10-2017 22:00	49	0	20.6	81.5	0
22-10-2017 23:00	49	0	20.2	84.8	0
23-10-2017 00:00	49	0	19.4	86.9	0
23-10-2017 01:00	49	0	19	87.9	0
23-10-2017 02:00	49	0	18.7	90.2	0
23-10-2017 03:00	49	0	18.2	92.4	0
23-10-2017 04:00	81	0	17.8	93.1	0
23-10-2017 05:00	49	0	17.5	94	0
23-10-2017 06:00	49	0.5	17.2	93.9	0
23-10-2017 07:00	49	0.8	18	89	0
23-10-2017 08:00	49	0.9	21.9	60.1	0
23-10-2017 09:00	49	1.2	25.5	48.2	0
23-10-2017 10:00	49	1.3	27.8	38.7	0
23-10-2017 11:00	49	0.2	29.7	33.3	0
23-10-2017 12:00	49	0	31.4	32.9	0
23-10-2017 13:00	49	1	31.8	32	0

Date and Time	Wind Direction (degree)	Wind Speed (km/h)	Temperature (^{0}C)	Relative Humidity (%)	Rainfall (mm)
23-10-2017 14:00	49	0.5	32.7	29.1	0
23-10-2017 15:00	49	0.8	32.6	28.7	0
23-10-2017 16:00	49	0.9	32.4	34.6	0
23-10-2017 17:00	49	1.2	27.6	59	0
23-10-2017 18:00	49	1.3	24.6	68.9	0
23-10-2017 19:00	49	0.2	23.3	74.7	0
23-10-2017 20:00	49	0	22.4	77.9	0
23-10-2017 21:00	49	0	21.6	77.8	0
23-10-2017 22:00	111	0	21	80.1	0
23-10-2017 23:00	52	0	20.4	82.4	0
24-10-2017 00:00	52	0	19.9	84.9	0
24-10-2017 01:00	52	0	19.2	86.6	0
24-10-2017 02:00	52	0	18.6	88.2	0
24-10-2017 03:00	73	0	18.3	88.9	0
24-10-2017 04:00	97	0	17.9	90.5	0
24-10-2017 05:00	97	0	17.7	92.3	0
24-10-2017 06:00	97	0	17.4	93.5	0
24-10-2017 07:00	49	0	18.1	87	0
24-10-2017 08:00	49	0.5	21.9	56.4	0
24-10-2017 09:00	49	0.8	25.2	47.6	0
24-10-2017 10:00	49	0.9	27.5	39.3	0
24-10-2017 11:00	49	1.2	30.3	33.5	0
24-10-2017 12:00	49	1.3	31.4	29.8	0
24-10-2017 13:00	49	0.2	32.8	29	0
24-10-2017 14:00	49	0	33.1	32.4	0
24-10-2017 15:00	49	0	32.8	33.2	0
24-10-2017 16:00	256	0	32.2	37.2	0
24-10-2017 17:00	256	0	27.3	60.1	0
24-10-2017 18:00	256	0	24.2	70.1	0
24-10-2017 19:00	256	0	22.7	76	0
24-10-2017 20:00	256	0	21.7	79.2	0
24-10-2017 21:00	112	0	20.9	83.2	0
24-10-2017 22:00	112	0	20.4	81.8	0
24-10-2017 23:00	112	0	19.9	84.3	0
25-10-2017 00:00	112	0	19.1	86.6	0
25-10-2017 01:00	112	0	18.7	87.5	0
25-10-2017 02:00	112	0	18.3	88.3	0
25-10-2017 03:00	112	0	17.8	89.1	0
25-10-2017 04:00	112	0	17.3	90.4	0
25-10-2017 05:00	112	0	16.9	92.5	0
25-10-2017 06:00	112	0	16.7	93.5	0
25-10-2017 07:00	168	0	17.4	94.1	0
25-10-2017 08:00	121	0	20.5	74.2	0.2
25-10-2017 09:00	80	0	25	56.9	0
25-10-2017 10:00	139	1	27.3	45.5	0
25-10-2017 11:00	186	0	29.9	35.8	0
25-10-2017 12:00	273	0	31.6	34	0
25-10-2017 13:00	241	0	32.6	29.4	0
25-10-2017 14:00	230	0	32.7	32.7	0
25-10-2017 15:00	158	0	32.9	32.1	0
25-10-2017 16:00	107	0	31.4	41.2	0

Date and Time	Wind Direction (degree)	Wind Speed (km/h)	Temperature (^{0}C)	Relative Humidity (%)	Rainfall (mm)
25-10-2017 17:00	107	0	26.8	60	0
25-10-2017 18:00	107	0	23.8	72.7	0
25-10-2017 19:00	107	0	22.4	76.4	0
25-10-2017 20:00	107	0	21.4	79.5	0
25-10-2017 21:00	107	0	20.7	81.7	0
25-10-2017 22:00	43	0	20.1	84.2	0
25-10-2017 23:00	43	0	19.6	85.5	0
26-10-2017 00:00	43	0.8	18.7	87.1	0
26-10-2017 01:00	43	0.5	18.2	87.8	0
26-10-2017 02:00	43	0.5	17.8	89.1	0
26-10-2017 03:00	43	1.2	17.3	91.7	0
26-10-2017 04:00	45	2.3	16.9	93.9	0
26-10-2017 05:00	115	2.2	16.6	94.7	0
26-10-2017 06:00	118	2.2	16.4	94.7	0
26-10-2017 07:00	112	0	17.2	93.7	0
26-10-2017 08:00	93	0	21.1	67.6	0
26-10-2017 09:00	120	1	24.7	55.1	0
26-10-2017 10:00	107	0	27.5	47.6	0
26-10-2017 11:00	21	0	29.5	42.2	0
26-10-2017 12:00	98	0	31.2	36.6	0
26-10-2017 13:00	313	0	32.2	34.1	0
26-10-2017 14:00	237	0	32.5	33.2	0
26-10-2017 15:00	179	0	32.9	31.6	0
26-10-2017 16:00	192	0	32.2	38.6	0
26-10-2017 17:00	192	0	27.4	61.1	0
26-10-2017 18:00	192	0	24.2	70.3	0
26-10-2017 19:00	192	0	22.9	76.3	0
26-10-2017 20:00	192	0	22	79.3	0
26-10-2017 21:00	62	0	21.2	84.1	0
26-10-2017 22:00	62	2.3	20.6	83	0
26-10-2017 23:00	62	3.3	20.1	85	0
27-10-2017 00:00	62	5.5	19.5	85.7	0
27-10-2017 01:00	62	6.6	18.7	87.8	0
27-10-2017 02:00	62	6.6	18.3	89.8	0
27-10-2017 03:00	62	5.5	17.8	91.1	0
27-10-2017 04:00	62	0	17.4	92.9	0
27-10-2017 05:00	62	0	17.2	93.9	0
27-10-2017 06:00	62	0	16.8	94.4	0
27-10-2017 07:00	62	0	17.3	94.7	0
27-10-2017 08:00	214	0	21.1	68.5	0
27-10-2017 09:00	168	0	25.4	57.5	0
27-10-2017 10:00	84	0	27.6	46.1	0
27-10-2017 11:00	81	0	29.9	36.7	0
27-10-2017 12:00	60	0	31.1	33.3	0
27-10-2017 13:00	97	0	31.9	31.9	0
27-10-2017 14:00	21	0	31.9	33	0
27-10-2017 15:00	330	0	31.8	33.9	0
27-10-2017 16:00	304	0	31.4	40.8	0
27-10-2017 17:00	304	0	27.4	59.8	0
27-10-2017 18:00	304	0	24.6	70.2	0
27-10-2017 19:00	304	0	23.1	75.1	0

Date and Time	Wind Direction (degree)	Wind Speed (km/h)	Temperature (^{0}C)	Relative Humidity (%)	Rainfall (mm)
27-10-2017 20:00	304	0	22	80.7	0
27-10-2017 21:00	304	5.2	21.2	82.4	0
27-10-2017 22:00	304	2.2	20.6	84	0
27-10-2017 23:00	304	2.2	20.1	85.5	0
28-10-2017 00:00	304	0	19.4	86.9	0
28-10-2017 01:00	304	0	18.9	87.9	0
28-10-2017 02:00	304	0	18.4	89	0
28-10-2017 03:00	304	0	18.1	90.9	0
28-10-2017 04:00	304	0	17.8	92.8	0
28-10-2017 05:00	304	0	17.6	93.9	0
28-10-2017 06:00	304	2.2	17.3	94.7	0
28-10-2017 07:00	49	2.3	17.8	94.9	0
28-10-2017 08:00	49	5.5	20.8	81.3	0.2
28-10-2017 09:00	49	5.2	24.7	64.5	0
28-10-2017 10:00	49	5.5	26	55.5	0
28-10-2017 10:00	49	6.6	27.6	52.2	0
28-10-2017 12:00	49	1	29.2	45.1	0
28-10-2017 13:00	49	0.6	30.6	43.8	0
28-10-2017 14:00	49	0.5	30.6	42.2	0
28-10-2017 15:00	49	5	30.9	41.2	0
28-10-2017 16:00	18	2	29.9	48.1	0
28-10-2017 17:00	18	4	27	64.6	0
28-10-2017 18:00	18	3	24.4	73.7	0
28-10-2017 19:00	18	6	23.1	78.4	0
28-10-2017 20:00	18	6	22.3	81.2	0
28-10-2017 21:00	18	1	21.4	84.3	0
28-10-2017 22:00	18	1	20.9	84.9	0
28-10-2017 23:00	18	1	20.3	86.5	0
29-10-2017 00:00	18	1	19.8	87.3	0
29-10-2017 01:00	18	1	19.2	88.8	0
29-10-2017 02:00	18	0	19	91.2	0
29-10-2017 03:00	18	0	18.7	91.9	0
29-10-2017 04:00	18	0	18.1	93.1	0
29-10-2017 05:00	50	0	17.7	94.6	0
29-10-2017 06:00	77	0	17.2	95.1	0
29-10-2017 07:00	77	0	17.9	95.9	0
29-10-2017 08:00	100	0	19.5	94.7	0
29-10-2017 09:00	184	0	22.1	76.1	0
29-10-2017 10:00	245	0.3	27.2	58.1	0
29-10-2017 11:00	112	0.2	29.9	43.6	0
29-10-2017 12:00	259	0.5	31.7	36.6	0
29-10-2017 13:00	256	0	32.4	34.8	0
29-10-2017 14:00	136	0	32.8	32.6	0
29-10-2017 15:00	76	0	31.6	35.5	0
29-10-2017 16:00	115	0	30.1	42.7	0
29-10-2017 17:00	115	0	26.8	62.5	0
29-10-2017 18:00	115	0	24.2	71.1	0
29-10-2017 19:00	115	0	22.8	76.5	0
29-10-2017 20:00	115	0	21.9	80.6	0
29-10-2017 21:00	94	0	21.2	79.4	0
29-10-2017 22:00	94	0	20.6	82.6	0

Date and Time	Wind Direction (degree)	Wind Speed (km/h)	Temperature (^{0}C)	Relative Humidity (%)	Rainfall (mm)
29-10-2017 23:00	94	0	20	84.8	0
30-10-2017 00:00	94	0	19.2	87.3	0
30-10-2017 01:00	94	0	18.6	88.2	0
30-10-2017 02:00	94	0	18.2	89.8	0
30-10-2017 03:00	94	0	17.9	92.1	0
30-10-2017 04:00	94	0	17.5	92.4	0
30-10-2017 05:00	94	0	17	93.7	0
30-10-2017 06:00	87	0	16.8	94.7	0.2
30-10-2017 07:00	87	0	17.1	95.2	0
30-10-2017 08:00	132	0	18.5	92.3	0
30-10-2017 09:00	127	0	23.7	60	0
30-10-2017 10:00	232	0	27	55	0
30-10-2017 11:00	134	0	29.4	43.1	0
30-10-2017 12:00	103	0	30.4	34.8	0
30-10-2017 13:00	87	0	30.9	36.7	0
30-10-2017 14:00	285	0.6	31.9	33.2	0
30-10-2017 15:00	245	0	32.3	33.2	0
31-10-2017 13:00	238	0	31	28.6	0
31-10-2017 14:00	129	0	30.3	29.2	0
31-10-2017 15:00	1	0	30.6	26.4	0
31-10-2017 16:00	114	0	28.7	36.9	0
31-10-2017 17:00	114	0	24.2	58.6	0
31-10-2017 18:00	114	0	21.1	70.3	0
31-10-2017 19:00	114	0	19.9	75.6	0
31-10-2017 20:00	114	0	18.9	78.5	0
31-10-2017 21:00	110	0	18.2	80.3	0
31-10-2017 22:00	110	0	17.5	82.1	0
31-10-2017 23:00	110	0	17	84.3	0
01-11-2017 00:00	110	0	16.7	86	0
01-11-2017 01:00	110	0	16.2	88	0
01-11-2017 02:00	112	0	15.8	89.8	0
01-11-2017 03:00	112	0	15.6	89.8	0
01-11-2017 04:00	112	0	15.2	91.9	0
01-11-2017 05:00	112	0	14.6	92.8	0
01-11-2017 06:00	112	0	14.1	93.9	0
01-11-2017 07:00	112	0	14.8	93.9	0.2
01-11-2017 08:00	115	0	18.7	74.3	0
01-11-2017 09:00	115	0	22.9	56.2	0
01-11-2017 10:00	98	0	25.9	45.3	0
01-11-2017 11:00	111	0	26.9	38.9	0
01-11-2017 12:00	97	0	27.9	34.8	0
01-11-2017 13:00	91	0	28.5	34.3	0
01-11-2017 14:00	93	0	28.7	36	0
01-11-2017 15:00	117	0	28.4	37.1	0
01-11-2017 16:00	115	0	27	45.9	0
01-11-2017 17:00	115	0	24.1	63.8	0
01-11-2017 18:00	115	0	21.6	73.4	0
01-11-2017 19:00	115	0	20.4	77.5	0
01-11-2017 20:00	115	0	19.6	81.2	0
01-11-2017 21:00	74	0	18.8	82.3	0
01-11-2017 22:00	74	0	17.9	84.2	0

Date and Time	Wind Direction (degree)	Wind Speed (km/h)	Temperature (^{0}C)	Relative Humidity (%)	Rainfall (mm)
01-11-2017 23:00	74	0	17.7	85.2	0
02-11-2017 00:00	74	0	17.2	87.2	0
02-11-2017 01:00	74	0	16.7	88.2	0
02-11-2017 02:00	74	0	16.3	90.6	0
02-11-2017 03:00	74	0	15.9	92.1	0
02-11-2017 04:00	74	0	15.7	92.6	0
02-11-2017 05:00	74	0	15.2	94.3	0
02-11-2017 06:00	74	0	15.1	94.8	0
02-11-2017 07:00	74	0	15.9	94.7	0.2
02-11-2017 08:00	74	0	18.2	79.2	0
02-11-2017 09:00	125	0	21.7	63.6	0
02-11-2017 10:00	179	0	24.6	46.4	0
02-11-2017 11:00	104	1	26.9	44.5	0
02-11-2017 12:00	183	0	27.4	39.1	0
02-11-2017 13:00	128	0	28.9	37.2	0
02-11-2017 14:00	129	0	29.7	32	0
02-11-2017 15:00	115	0	29.1	36.6	0
02-11-2017 16:00	122	0	26.8	47.7	0
02-11-2017 17:00	122	0	24.4	56.3	0
02-11-2017 18:00	122	0	23.1	65.5	0
02-11-2017 19:00	122	0	22.3	68.3	0
02-11-2017 20:00	114	0	21.5	76.1	0
02-11-2017 21:00	114	0	21	77.5	0
02-11-2017 22:00	114	0	20.3	81.7	0
02-11-2017 23:00	114	0	20.2	82.6	0
03-11-2017 00:00	114	0	20	83.7	0
03-11-2017 01:00	77	0	19.7	73.7	0
03-11-2017 02:00	88	0	20	71	0
03-11-2017 03:00	88	0	19.6	76.4	0
03-11-2017 04:00	88	0	19.3	78.9	0
03-11-2017 05:00	88	0	18.8	83.5	0
03-11-2017 06:00	88	0	18.6	84.8	0
03-11-2017 07:00	111	0	18.8	80	0
03-11-2017 08:00	64	0	19.5	81.5	0
03-11-2017 09:00	139	0	21.6	70.2	0
03-11-2017 10:00	117	0	24.4	55.6	0
03-11-2017 11:00	235	0	25.3	54.3	0
03-11-2017 12:00	328	0	27.2	46.4	0
03-11-2017 13:00	43	0	26.2	53	0
03-11-2017 14:00	118	0	26.2	50.5	0
03-11-2017 15:00	124	0	26.4	52.2	0
03-11-2017 16:00	124	0	25.4	59.2	0
03-11-2017 17:00	124	0	23.7	70.2	0
03-11-2017 18:00	124	0	22.7	74.7	0
03-11-2017 19:00	124	0	22.3	78.1	0
03-11-2017 20:00	124	0	21.7	81.6	0
03-11-2017 21:00	124	0	21.3	82.4	0
03-11-2017 22:00	124	0	21.2	83.8	0
03-11-2017 23:00	124	0	20.9	85.7	0
04-11-2017 00:00	124	0	20.6	87	0
04-11-2017 01:00	94	0	20.4	86.9	0

Date and Time	Wind Direction (degree)	Wind Speed (km/h)	Temperature (^{0}C)	Relative Humidity (%)	Rainfall (mm)
04-11-2017 02:00	117	1	19.8	81.5	0
04-11-2017 04:00	66	0	19.7	68	0
04-11-2017 04:00	88	0	19.6	72.9	0
04-11-2017 05:00	90	0	19.1	79.3	0
04-11-2017 06:00	90	0	18.8	80.8	0
04-11-2017 07:00	163	0	19.3	81.5	0
04-11-2017 08:00	131	0	20.3	79.8	0
04-11-2017 09:00	108	0	22.7	63	0
04-11-2017 10:00	19	0	26.2	54.2	0
04-11-2017 11:00	67	1	26.9	47.2	0
04-11-2017 12:00	348	0	26.8	49.1	0
04-11-2017 13:00	86	0	26.8	46	0
04-11-2017 14:00	57	0	27.4	42.8	0
04-11-2017 15:00	12	0	28.3	41.9	0
04-11-2017 16:00	312	0	27.2	51.2	0
04-11-2017 17:00	312	2	24.6	62.3	0
04-11-2017 18:00	312	3	23.7	69	0
04-11-2017 19:00	312	5	23.4	72.1	0
04-11-2017 20:00	312	6	23.1	73.4	0
04-11-2017 21:00	312	0	22.7	75.3	0
04-11-2017 22:00	312	0	22.3	77	0
04-11-2017 23:00	49	0	22	80.7	0
05-11-2017 00:00	49	0	21.6	81.5	0
05-11-2017 01:00	49	0	21.2	83.8	0
05-11-2017 02:00	49	0	20.4	86.5	0
05-11-2017 03:00	49	0	20	88.2	0
05-11-2017 04:00	49	0	19.4	89.7	0
05-11-2017 05:00	49	0	19	91.8	0
05-11-2017 06:00	49	0	19.1	92.1	0
05-11-2017 07:00	49	0	19.6	92.3	0
05-11-2017 08:00	138	0	21.4	83.4	0
05-11-2017 09:00	80	1	24.1	61.8	0
05-11-2017 10:00	5	1	26.2	49	0
05-11-2017 11:00	19	0	27.7	46.5	0
05-11-2017 12:00	324	0	29.5	42.7	0
05-11-2017 13:00	11	0	30.8	40	0
05-11-2017 14:00	238	0	31.5	36.9	0
05-11-2017 15:00	238	0	31.4	39.4	0
05-11-2017 16:00	118	0	30.8	48.1	0
05-11-2017 17:00	118	0	27	61.5	0
05-11-2017 18:00	118	0	25.1	68.5	0
05-11-2017 19:00	118	0	23.9	74.1	0
05-11-2017 20:00	118	0	23	77.7	0
05-11-2017 21:00	93	0	22.8	77	0
05-11-2017 22:00	96	0	22.7	74.9	0
05-11-2017 23:00	96	0	22.2	77.1	0
06-11-2017 00:00	96	0	21.4	81.7	0
06-11-2017 01:00	96	0	21.6	80.7	0
06-11-2017 02:00	96	0	21.7	81.4	0
06-11-2017 03:00	96	0	20.9	85.6	0
06-11-2017 04:00	91	0	20.5	87.8	0

Date and Time	Wind Direction (degree)	Wind Speed (km/h)	Temperature (^{0}C)	Relative Humidity (%)	Rainfall (mm)
06-11-2017 05:00	91	0	19.9	89	0
06-11-2017 06:00	91	0	19.7	89.8	0
06-11-2017 07:00	91	0	20.2	87.9	0
06-11-2017 08:00	112	0	22.9	72.6	0
06-11-2017 09:00	208	0	27.2	59.9	0
06-11-2017 10:00	104	0	29.4	50.3	0
06-11-2017 11:00	72	0	27.5	58.4	0
06-11-2017 12:00	50	0	30.7	46	0
06-11-2017 13:00	7	0	29.1	47.4	0
06-11-2017 14:00	131	0	32.1	39.3	0
06-11-2017 15:00	249	0	32.1	40.3	0
06-11-2017 16:00	249	0	31	49.9	0
06-11-2017 17:00	249	0	27.3	64.7	0
06-11-2017 18:00	249	0	25.1	73.2	0
06-11-2017 19:00	249	0	24	77.3	0
06-11-2017 20:00	249	0	23.2	80.6	0
06-11-2017 21:00	249	0	22.5	83	0
06-11-2017 22:00	249	0	21.7	85.5	0
06-11-2017 23:00	249	0	21.3	86.8	0
07-11-2017 00:00	249	0	20.9	86.6	0
07-11-2017 01:00	162	0	20.2	88.1	0
07-11-2017 02:00	141	0	19.8	91.9	0
07-11-2017 03:00	112	0	19.4	93.9	0
07-11-2017 04:00	112	0	19.5	93.9	0
07-11-2017 05:00	114	0	19.5	93.9	0
07-11-2017 06:00	360	0	19.6	93.9	0
07-11-2017 07:00	111	0	20.1	92.2	0
07-11-2017 08:00	151	0	22.1	74.4	0
07-11-2017 09:00	296	0	25.1	56.3	0
07-11-2017 10:00	327	0	26.9	61.1	0
07-11-2017 11:00	4	0	27.8	52.2	0
07-11-2017 12:00	15	1	28.4	49.3	0
07-11-2017 13:00	69	0	27.5	52.2	0
07-11-2017 14:00	73	1	27.8	48.6	0
07-11-2017 15:00	93	0	29.1	47.1	0
07-11-2017 16:00	121	0	28.4	55.3	0
07-11-2017 17:00	121	0	26	68.1	0
07-11-2017 18:00	121	0	24.3	73.7	0
07-11-2017 19:00	121	0	23.1	77.1	0
07-11-2017 20:00	121	0	22.3	81.8	0
07-11-2017 21:00	121	0	21.4	84.3	0
07-11-2017 22:00	121	0	20.8	86.7	0
07-11-2017 23:00	121	0	20.7	86.6	0
08-11-2017 00:00	121	0	20.2	87.7	0
08-11-2017 01:00	121	0	19.6	89	0
08-11-2017 02:00	121	0	19.7	89.9	0
08-11-2017 03:00	90	0	19.5	91.4	0
08-11-2017 04:00	90	0	19.1	93.1	0
08-11-2017 05:00	120	1	18.9	93.9	0
08-11-2017 06:00	124	0	18.6	94.8	0
08-11-2017 07:00	112	0	19.1	94.5	0

Date and Time	Wind Direction (degree)	Wind Speed (km/h)	Temperature (^{0}C)	Relative Humidity (%)	Rainfall (mm)
08-11-2017 08:00	110	1	20.8	84.8	0
08-11-2017 09:00	120	0	23.8	63	0
08-11-2017 10:00	15	0	24.7	65.5	0
08-11-2017 11:00	48	0	24.8	63.6	0
08-11-2017 12:00	297	0	25.9	61.1	0
08-11-2017 13:00	360	0	25.8	59.2	0
08-11-2017 14:00	8	0	26.7	54.5	0
08-11-2017 15:00	289	0.2	26.1	62.7	0
08-11-2017 16:00	288	1.2	24.7	68.9	0
08-11-2017 17:00	288	1.2	23.6	77.2	0
08-11-2017 18:00	288	1.2	22.6	80.4	0
08-11-2017 19:00	288	2.2	22	83	0
08-11-2017 20:00	288	2.2	21	86.3	0
08-11-2017 21:00	288	0	20.3	87.8	0
08-11-2017 22:00	288	0	19.7	89	0
08-11-2017 23:00	288	0	19.3	90	0
09-11-2017 00:00	288	2.2	19.2	91.6	0
09-11-2017 01:00	288	0.6	18.9	93.1	0
09-11-2017 02:00	288	0	18.4	93.6	0
09-11-2017 03:00	21	0	18.1	95.2	0
09-11-2017 04:00	21	0	17.9	95.6	0
09-11-2017 05:00	21	0	17.4	95.8	0
09-11-2017 06:00	21	0	16.9	96.4	0
09-11-2017 07:00	21	0	17.4	97.1	0
09-11-2017 08:00	105	0	18.1	97	0
09-11-2017 09:00	105	0	21.1	80.3	0
09-11-2017 10:00	104	0	26.6	53.7	0
09-11-2017 11:00	124	1	27.9	46.5	0
09-11-2017 12:00	32	2	29.2	42	0
09-11-2017 13:00	60	0	28.9	37.9	0
09-11-2017 14:00	93	4	30.3	35.6	0
09-11-2017 15:00	87	2	30.4	34.9	0
09-11-2017 16:00	87	3	29.2	46.8	0
09-11-2017 17:00	87	0	25.2	65	0
09-11-2017 18:00	87	0	22.9	72.6	0
09-11-2017 19:00	87	0	21.6	78.6	0
09-11-2017 20:00	87	0	20.6	81.8	0
09-11-2017 21:00	87	0	20.2	82.3	0
09-11-2017 22:00	87	0.2	19.6	85	0
09-11-2017 23:00	87	1.2	19.2	86.2	0
10-11-2017 00:00	87	1.2	18.8	88	0
10-11-2017 01:00	87	1.2	18.3	89.8	0
10-11-2017 02:00	87	2.2	17.7	91.2	0
10-11-2017 03:00	87	2.2	17.1	92.6	0
10-11-2017 04:00	87	0	16.5	93.7	0
10-11-2017 05:00	87	0	16.1	93.9	0
10-11-2017 06:00	88	0	15.7	94.5	0.2
10-11-2017 07:00	88	0	16	95	0
10-11-2017 08:00	159	0	17.8	92.2	0
10-11-2017 09:00	254	0	22.2	65.3	0
10-11-2017 10:00	118	0	25.4	59	0

Date and Time	Wind Direction (degree)	Wind Speed (km/h)	Temperature (^{0}C)	Relative Humidity (%)	Rainfall (mm)
10-11-2017 11:00	7	0	27.2	53.8	0
10-11-2017 12:00	83	0	27.5	47.7	0
10-11-2017 13:00	40	0	28.3	44.3	0
10-11-2017 14:00	268	0	29.8	41.6	0
10-11-2017 15:00	234	0	30.2	43	0
10-11-2017 16:00	234	0	28.8	50.2	0
10-11-2017 17:00	234	0	24.7	68.3	0
10-11-2017 18:00	234	0	22.4	76.1	0
10-11-2017 19:00	234	0	21.3	81.2	0
10-11-2017 20:00	234	0	20.6	82.7	0
10-11-2017 21:00	31	0	20.1	84.2	0
10-11-2017 22:00	31	0	19.4	85.7	0
10-11-2017 23:00	31	0	18.9	85.5	0
11-11-2017 00:00	108	0	18.7	85.7	0
11-11-2017 01:00	108	0	18.8	87.6	0
11-11-2017 02:00	108	0	18.1	89.6	0
11-11-2017 03:00	108	0	17.4	93.2	0
11-11-2017 04:00	108	0	16.9	94.1	0
11-11-2017 05:00	108	0	16.8	94.6	0
11-11-2017 06:00	108	0	16.6	94.7	0
11-11-2017 07:00	125	0	16.9	95.4	0
11-11-2017 08:00	21	0	17.8	95.3	0
11-11-2017 09:00	334	0.2	19.4	88.1	0
11-11-2017 10:00	2	1.2	22.2	75.2	0
11-11-2017 11:00	22	1.2	25.7	52.6	0
11-11-2017 12:00	56	1.2	27.5	44.2	0
11-11-2017 13:00	77	2.2	28.7	43.9	0
11-11-2017 14:00	62	2.2	28.7	41.8	0
11-11-2017 15:00	55	0	28	38.7	0
11-11-2017 16:00	77	0.2	27.2	45	0
11-11-2017 17:00	77	1.2	24.1	62.7	0
11-11-2017 18:00	77	1.2	21.8	72.5	0
11-11-2017 19:00	77	1.2	20.4	79.2	0
11-11-2017 20:00	77	2.2	19.7	80.9	0
11-11-2017 21:00	77	2.2	18.9	83.5	0
11-11-2017 22:00	77	0	18.1	86.1	0
11-11-2017 23:00	77	0	17.8	87.7	0
12-11-2017 00:00	77	0	17.4	89.5	0
12-11-2017 01:00	77	0	16.9	91.1	0
12-11-2017 02:00	77	0	16.6	91.1	0
12-11-2017 03:00	77	0	16.4	89.8	0
12-11-2017 04:00	77	0	15.7	90.6	0
12-11-2017 05:00	77	0	15.3	92.6	0.2
12-11-2017 06:00	77	0	15	93.5	0
12-11-2017 07:00	77	0	15.2	93.9	0
12-11-2017 08:00	98	0	18.3	76	0
12-11-2017 09:00	93	0	22.1	63.2	0
12-11-2017 10:00	84	0	24.3	51	0
12-11-2017 11:00	129	0	27.4	41.4	0
12-11-2017 12:00	240	0	28.8	40.8	0
12-11-2017 13:00	238	0	29.9	34.6	0

Date and Time	Wind Direction (degree)	Wind Speed (km/h)	Temperature (^{0}C)	Relative Humidity (%)	Rainfall (mm)
12-11-2017 14:00	306	0	30.4	28.6	0
12-11-2017 15:00	208	0	30.3	32.9	0
12-11-2017 16:00	227	0	29.2	41.8	0
12-11-2017 17:00	227	0	24.3	62.1	0
12-11-2017 18:00	227	0	21.4	73.1	0
12-11-2017 19:00	227	0	20.2	77	0
12-11-2017 20:00	227	0	19.2	80.5	0
12-11-2017 21:00	227	0	18.4	82.3	0
12-11-2017 22:00	139	0	17.8	81.6	0
12-11-2017 23:00	115	0	17.2	84.8	0
13-11-2017 00:00	115	0	16.7	86.8	0
13-11-2017 01:00	83	0	16.2	89	0
13-11-2017 02:00	107	0	15.7	89.8	0
13-11-2017 03:00	107	0	15.3	90.6	0
13-11-2017 04:00	107	0	14.9	91.5	0
13-11-2017 05:00	107	0	14.4	92.9	0
13-11-2017 06:00	107	0	14.1	94.6	0
13-11-2017 07:00	107	0	14.6	94	0
13-11-2017 08:00	107	0	18.6	70.1	0
13-11-2017 09:00	134	0	22.8	57.5	0
13-11-2017 10:00	96	0	24.8	46.8	0
13-11-2017 11:00	135	0	27	40	0
13-11-2017 12:00	108	1	28.2	34.1	0
13-11-2017 13:00	290	0	29.3	33.4	0
13-11-2017 14:00	197	0	30.5	32.2	0
13-11-2017 15:00	111	0.2	29.1	39.6	0
13-11-2017 16:00	69	1.2	27.6	45.7	0
13-11-2017 17:00	69	1.2	24.2	62.7	0
13-11-2017 18:00	69	1.2	21.7	72.5	0
13-11-2017 19:00	69	2.2	20.5	77.9	0
13-11-2017 20:00	69	2.2	19.7	80.3	0
13-11-2017 21:00	69	0	19.1	82.5	0
13-11-2017 22:00	69	1	18.6	83.1	0
13-11-2017 23:00	69	0	18.5	82.3	0.2
14-11-2017 00:00	14	0	18.2	85.1	0
14-11-2017 01:00	43	0	17.5	86.6	0
14-11-2017 02:00	43	0	17.4	88.2	0
14-11-2017 03:00	292	0	17.3	89	0
14-11-2017 04:00	76	0	17.4	88.2	0.2
14-11-2017 05:00	235	0	17.3	87.7	0.2
14-11-2017 06:00	228	0	17.1	88.2	0.2
14-11-2017 07:00	111	0	17.3	89	0
14-11-2017 08:00	80	1	18.2	85.7	0.2
14-11-2017 09:00	110	1	20.6	67.3	0
14-11-2017 10:00	217	0	23.5	57.2	0
14-11-2017 11:00	245	0	24.5	52.2	0
14-11-2017 12:00	244	0	26	47.3	0
14-11-2017 13:00	248	0	26.2	45.8	0
14-11-2017 14:00	108	0	26.3	45.2	0
14-11-2017 15:00	240	0	26.3	44.7	0
14-11-2017 16:00	139	0	25.5	52.2	0

Date and Time	Wind Direction (degree)	Wind Speed (km/h)	Temperature (^{0}C)	Relative Humidity (%)	Rainfall (mm)
15-11-2017 20:00	275	0	16.8	83.1	0
15-11-2017 21:00	275	0	16.6	85.4	0
15-11-2017 22:00	38	0	16	86.9	0
15-11-2017 23:00	38	0	15.8	87.8	0
16-11-2017 00:00	38	0	15.1	89.7	0
16-11-2017 01:00	38	0	14.6	90.6	0
16-11-2017 02:00	38	0	14.1	92	0
16-11-2017 03:00	38	0	13.6	93.3	0
16-11-2017 04:00	38	0	13.1	95.3	0
16-11-2017 05:00	38	0	13.2	95.4	0
16-11-2017 06:00	38	0	13.7	95.4	0
16-11-2017 07:00	39	0	14.2	95.8	0
16-11-2017 08:00	39	0	16.7	82.5	0
16-11-2017 09:00	203	0	20.8	62	0
16-11-2017 10:00	317	0	23.1	51.7	0
16-11-2017 11:00	112	1	24.6	42.9	0
16-11-2017 12:00	48	0	27.3	33.5	0
16-11-2017 13:00	211	0	27.2	32.6	0
16-11-2017 14:00	80	0	28.8	29.5	0
16-11-2017 15:00	173	0	28.3	32.4	0
16-11-2017 16:00	127	0	27.3	40.4	0
16-11-2017 17:00	127	0	22.3	62.1	0
16-11-2017 18:00	127	0	19.8	71.9	0
16-11-2017 19:00	127	0	18.6	75.5	0
16-11-2017 20:00	127	0	17.5	80.6	0
16-11-2017 21:00	32	0	16.9	83.2	0
16-11-2017 22:00	32	0	16.4	84	0
16-11-2017 23:00	32	0	15.8	86.1	0
17-11-2017 00:00	32	0	15.1	87.3	0
17-11-2017 01:00	32	0	14.5	89.3	0
17-11-2017 02:00	33	0	14.1	90.1	0
17-11-2017 03:00	33	0	13.7	90.6	0
17-11-2017 04:00	33	0	13.4	91.7	0
17-11-2017 05:00	33	0	13.4	94.7	0
17-11-2017 06:00	35	0	13.5	95.2	0
17-11-2017 07:00	35	0	13.8	95.4	0
17-11-2017 08:00	35	0	15	94.7	0
17-11-2017 09:00	64	0	19.7	63.9	0
17-11-2017 10:00	225	0	22.9	54	0
17-11-2017 11:00	168	0	25.6	45	0
17-11-2017 12:00	132	0	27.3	40.1	0
17-11-2017 13:00	224	0	28.2	35.3	0
17-11-2017 14:00	148	0	29.3	33.2	0
17-11-2017 15:00	231	0	28.9	34.8	0
17-11-2017 16:00	125	0	27.4	46.1	0
17-11-2017 17:00	125	0	23.1	61.7	0
17-11-2017 18:00	114	0	20.7	70.2	0
17-11-2017 19:00	114	0	19.4	76.5	0
17-11-2017 20:00	114	0	18.3	80.5	0
17-11-2017 21:00	114	0	17.5	83.5	0
17-11-2017 22:00	114	0	16.8	85.9	0

Date and Time	Wind Direction (degree)	Wind Speed (km/h)	Temperature (^{0}C)	Relative Humidity (%)	Rainfall (mm)
17-11-2017 23:00	53	0	16.1	86.1	0
18-11-2017 00:00	53	0	15.2	87.3	0
18-11-2017 01:00	53	0	14.6	88.9	0
18-11-2017 02:00	53	0	14.1	90.9	0
18-11-2017 03:00	53	0	13.8	91.8	0
18-11-2017 04:00	53	0	13.4	93.1	0
18-11-2017 05:00	53	0	12.9	94.2	0.2
18-11-2017 06:00	53	0	12.5	95.1	0
18-11-2017 07:00	56	0	13.1	94.7	0
18-11-2017 08:00	77	0	16.3	75.7	0
18-11-2017 09:00	182	0	21.4	57.7	0
18-11-2017 10:00	152	0	24	47.5	0
18-11-2017 11:00	107	0	26.7	38.1	0
18-11-2017 12:00	235	0	28.2	33.3	0
18-11-2017 13:00	211	0	28.7	31.3	0
18-11-2017 14:00	227	0	29.3	30.5	0
18-11-2017 15:00	186	0	29.7	29.9	0
18-11-2017 16:00	201	0	28.1	41.1	0
18-11-2017 17:00	201	0	23.1	62	0
18-11-2017 18:00	201	0	20.4	71.1	0
18-11-2017 19:00	201	0	19.1	76.8	0
18-11-2017 20:00	201	0	18.1	80.2	0
18-11-2017 21:00	117	0	17.1	84	0
18-11-2017 22:00	117	0	16.4	86.1	0
18-11-2017 23:00	117	0	15.6	86.9	0
19-11-2017 00:00	117	0	14.8	88	0
19-11-2017 01:00	117	0	14.2	89.5	0
19-11-2017 02:00	117	0	13.8	91.5	0
19-11-2017 03:00	117	0	13.6	92.6	0
19-11-2017 04:00	149	0	13.1	93.3	0
19-11-2017 05:00	132	0	12.5	95	0
19-11-2017 06:00	132	0	12.6	95.4	0
19-11-2017 07:00	132	0	12.7	94.7	0
19-11-2017 08:00	100	0	15.4	81.2	0
19-11-2017 09:00	166	0	20.8	55.8	0
19-11-2017 10:00	183	0	23.3	49.9	0
19-11-2017 11:00	218	0	25	43.3	0
19-11-2017 12:00	264	0	26.7	35.6	0
19-11-2017 13:00	276	0	27.3	36.8	0
19-11-2017 14:00	15	0	27.2	36.3	0
19-11-2017 15:00	272	0	28.2	34.9	0
19-11-2017 16:00	5	0	25.9	46.4	0
19-11-2017 17:00	7	0	22.5	65.3	0
19-11-2017 18:00	7	0	20.1	73.5	0
19-11-2017 19:00	7	0	18.8	78.5	0
19-11-2017 20:00	7	0	17.9	81.2	0
19-11-2017 21:00	88	0	17.1	84	0
19-11-2017 22:00	88	0	16.5	85.6	0
19-11-2017 23:00	88	0	15.9	86.9	0
20-11-2017 00:00	88	0	15.3	88.2	0
20-11-2017 01:00	88	0	14.7	89.6	0

Date and Time	Wind Direction (degree)	Wind Speed (km/h)	Temperature (^{0}C)	Relative Humidity (%)	Rainfall (mm)
20-11-2017 02:00	88	0	14	90	0
20-11-2017 03:00	88	0	13.5	90.9	0
20-11-2017 04:00	88	0	13.1	92.7	0
20-11-2017 05:00	88	0	12.9	93.7	0
20-11-2017 06:00	88	0	12.7	94.3	0
20-11-2017 07:00	88	0	12.7	94.5	0
20-11-2017 08:00	88	0	14.7	87.9	0
20-11-2017 09:00	183	0	20.2	63.2	0
20-11-2017 10:00	218	0	23.5	51.2	0
20-11-2017 11:00	225	0	25.4	40.5	0
20-11-2017 12:00	70	0	27	39.4	0
20-11-2017 13:00	138	0	27.7	38.2	0
20-11-2017 14:00	224	0	28.3	35.8	0
20-11-2017 15:00	163	0	28	36.5	0
20-11-2017 16:00	163	0	26.1	51.4	0
20-11-2017 17:00	186	0	22.2	66.1	0
20-11-2017 18:00	186	0	20.2	74.7	0
20-11-2017 19:00	186	0	18.8	79	0
20-11-2017 20:00	186	0	17.8	82.4	0
20-11-2017 21:00	63	0	17	85.6	0
20-11-2017 22:00	63	0	16.3	86.6	0
20-11-2017 23:00	63	0	15.4	88.2	0
21-11-2017 00:00	63	0	14.8	89	0
21-11-2017 01:00	63	0	14.2	89.8	0
21-11-2017 02:00	63	0	14.2	90.9	0
21-11-2017 03:00	63	0	13.9	90.9	0
21-11-2017 04:00	63	0	12.9	92.5	0
21-11-2017 05:00	73	0	12.6	93.9	0.2
21-11-2017 06:00	73	0	12.2	94.1	0
21-11-2017 07:00	73	0	12.5	93.9	0
21-11-2017 08:00	131	0	15.8	73.7	0
21-11-2017 09:00	122	0	20.3	60.5	0
21-11-2017 10:00	52	0	22.4	46.6	0
21-11-2017 11:00	183	0	25.5	34.3	0
21-11-2017 12:00	172	0	27	32.9	0
21-11-2017 13:00	146	0	28.2	28.9	0
21-11-2017 14:00	131	0	29.4	26.2	0
21-11-2017 15:00	208	0	29.3	27	0
21-11-2017 16:00	272	0	26.9	38.4	0
21-11-2017 17:00	309	0	22.7	56.8	0
21-11-2017 18:00	309	0	19.9	69.4	0
21-11-2017 19:00	309	0	18.3	75.9	0
21-11-2017 20:00	328	0	17.4	79.8	0
21-11-2017 21:00	328	0	16.4	83.3	0
21-11-2017 22:00	5	0	15.6	84.8	0
21-11-2017 23:00	124	0	14.8	86.9	0
22-11-2017 00:00	124	0	14.2	87.3	0
22-11-2017 01:00	124	0	13.8	88.2	0
22-11-2017 02:00	124	0	13.4	90.6	0
22-11-2017 03:00	124	0	12.9	90.6	0
22-11-2017 04:00	124	0	12.4	91.5	0

Date and Time	Wind Direction (degree)	Wind Speed (km/h)	Temperature (^{0}C)	Relative Humidity (%)	Rainfall (mm)
22-11-2017 05:00	124	0	12.1	92.3	0
22-11-2017 06:00	124	0	11.8	92.9	0
22-11-2017 07:00	124	0	12.1	92.4	0
22-11-2017 08:00	149	0	15.6	76.7	0
22-11-2017 09:00	139	0	20.3	58.4	0
22-11-2017 10:00	101	0	23.3	46.4	0
22-11-2017 11:00	213	0	26	37.6	0
22-11-2017 12:00	7	0	27	34.3	0
22-11-2017 13:00	199	0	27.9	32.2	0
22-11-2017 14:00	128	0	27.9	31.3	0
22-11-2017 15:00	39	0	29.1	29.5	0
22-11-2017 16:00	42	0	26.8	38.9	0
22-11-2017 17:00	42	8	22.5	58.1	0
22-11-2017 18:00	42	9	19.8	69	0
22-11-2017 19:00	42	9	18.4	74.9	0
22-11-2017 20:00	42	6	17.6	79.8	0
22-11-2017 21:00	43	2	16.8	82.6	0
22-11-2017 22:00	42	1	16.2	84.3	0
22-11-2017 23:00	42	1	15.6	86.6	0
23-11-2017 00:00	43	1	15	86.9	0
23-11-2017 01:00	48	1	14.2	88.3	0
23-11-2017 02:00	48	1	13.6	89.8	0
23-11-2017 03:00	49	1	13.3	92.3	0
23-11-2017 04:00	50	2	13.2	93.1	0
23-11-2017 05:00	50	0	12.8	94	0
23-11-2017 06:00	50	0	12.4	94.2	0.2
23-11-2017 07:00	84	0	12.7	94.7	0
23-11-2017 08:00	96	0	15.9	75.6	0
23-11-2017 09:00	160	0	21.6	49.6	0
23-11-2017 10:00	103	0	24.3	41.5	0
23-11-2017 11:00	86	0	26.3	35.4	0
23-11-2017 12:00	124	0	27.5	33.9	0
23-11-2017 13:00	108	0	28.7	30.5	0
23-11-2017 14:00	135	0	29.4	28	0
23-11-2017 15:00	182	0	29.8	28.9	0
23-11-2017 16:00	93	0	28.6	38.1	0
23-11-2017 17:00	93	0	22.9	59.9	0
23-11-2017 18:00	93	0	19.9	70.2	0
23-11-2017 19:00	93	0	18.5	76.2	0
23-11-2017 20:00	93	0	17.7	79.6	0
23-11-2017 21:00	73	0	16.8	81.5	0
23-11-2017 22:00	73	0	16	84.6	0
23-11-2017 23:00	73	0	15.5	86.4	0
24-11-2017 00:00	73	0	15.1	86.8	0
24-11-2017 01:00	73	0	14.3	88.2	0
24-11-2017 02:00	73	0	14	88.9	0
24-11-2017 03:00	73	0	13.6	90.2	0
24-11-2017 04:00	73	0	13.2	91.9	0
24-11-2017 05:00	73	0	12.9	92.7	0
24-11-2017 06:00	74	0	12.6	94.4	0
24-11-2017 07:00	86	0	12.9	94.4	0

Date and Time	Wind Direction (degree)	Wind Speed (km/h)	Temperature (^{0}C)	Relative Humidity (%)	Rainfall (mm)
24-11-2017 08:00	98	0	15.6	78.1	0
24-11-2017 09:00	79	0	19.8	60.8	0
24-11-2017 10:00	70	0	22.5	51.9	0
24-11-2017 11:00	160	0	25.2	37.6	0
24-11-2017 12:00	87	0	27.8	31.2	0
24-11-2017 13:00	247	0	29.3	28.7	0
24-11-2017 14:00	108	0	29.8	28.1	0
24-11-2017 15:00	221	0	29.8	30.2	0
24-11-2017 16:00	221	0	28.5	39.5	0
24-11-2017 17:00	221	0	23.1	58.9	0
24-11-2017 18:00	221	0	20.4	70.7	0
24-11-2017 19:00	221	0	18.8	76.8	0
24-11-2017 20:00	221	0	17.9	80.1	0
24-11-2017 21:00	160	0	17.1	81.5	0
24-11-2017 22:00	160	0	16.2	84.6	0
24-11-2017 23:00	107	0	15.6	87	0
25-11-2017 00:00	107	0	15	87.3	0
25-11-2017 01:00	107	0	14.6	87.5	0
25-11-2017 02:00	107	0	14.1	88.1	0
25-11-2017 03:00	107	0	13.6	89.8	0
25-11-2017 04:00	107	0	13.1	91.5	0
25-11-2017 05:00	107	0	13	92.3	0
25-11-2017 06:00	107	0	12.7	92.3	0
25-11-2017 07:00	105	0	13.1	93.7	0
25-11-2017 08:00	76	0	15.1	84	0
25-11-2017 09:00	81	1	18.2	65	0
25-11-2017 10:00	110	0	22.3	44.5	0
25-11-2017 11:00	86	0	24.8	41.9	0
25-11-2017 12:00	16	0	25.8	37.9	0
25-11-2017 13:00	187	0	27.9	32.2	0
25-11-2017 14:00	28	0	28.2	36.1	0
25-11-2017 15:00	158	0	27.8	32.9	0
25-11-2017 16:00	158	0	26.3	47.2	0
25-11-2017 17:00	158	0	22.3	62.4	0
25-11-2017 18:00	158	0	20.6	70.8	0
25-11-2017 19:00	158	0	19.6	75.1	0
25-11-2017 20:00	158	0	18.6	80.4	0
25-11-2017 21:00	158	0	17.7	82.9	0
25-11-2017 22:00	158	0	17	85.2	0
25-11-2017 23:00	158	0	16.2	86.6	0
26-11-2017 00:00	158	0	15.8	86.9	0
26-11-2017 01:00	158	0	15.5	87.8	0
26-11-2017 02:00	158	0	15.3	88.1	0
26-11-2017 03:00	158	0	15.1	89.8	0
26-11-2017 04:00	158	0	14.6	90.8	0
26-11-2017 05:00	158	0	14.3	90.7	0
26-11-2017 06:00	64	0	13.8	90.9	0
26-11-2017 07:00	91	0	13.6	91.9	0
26-11-2017 08:00	64	0	14.5	91.3	0
26-11-2017 09:00	115	0	16.6	85	0
26-11-2017 10:00	139	0	19.6	70.6	0

Date and Time	Wind Direction (degree)	Wind Speed (km/h)	Temperature (^{0}C)	Relative Humidity (%)	Rainfall (mm)
26-11-2017 11:00	84	0	23	52.9	0
26-11-2017 12:00	292	0	26.3	43.7	0
26-11-2017 13:00	79	0	27.7	39.5	0
26-11-2017 14:00	70	0.2	27.9	40.5	0
26-11-2017 15:00	81	1.2	27.3	42	0
26-11-2017 16:00	81	1.2	25.2	57.9	0
26-11-2017 17:00	81	1.2	21.9	70.8	0
26-11-2017 18:00	81	2.2	20.3	77.1	0
26-11-2017 19:00	81	2.2	19.3	80.4	0
26-11-2017 20:00	81	0	18.5	83.2	0
26-11-2017 21:00	81	0	17.6	85.7	0
26-11-2017 22:00	81	0	16.9	86.6	0
26-11-2017 23:00	81	0	16.4	87.4	0
27-11-2017 00:00	81	0	16.1	88.3	0
27-11-2017 01:00	81	0	15.7	89	0
27-11-2017 02:00	81	0	15.8	88	0
27-11-2017 03:00	81	0	16	88.2	0
27-11-2017 04:00	81	0	15.7	89.5	0
27-11-2017 05:00	81	0	14.8	91.5	0
27-11-2017 06:00	96	0	14.2	94.7	0
27-11-2017 07:00	107	0	14.5	96.2	0
27-11-2017 08:00	100	0	15.7	96.1	0
27-11-2017 09:00	66	0	17.9	86.7	0
27-11-2017 10:00	211	0	23.9	48.2	0
27-11-2017 11:00	124	0	26.9	38.8	0
27-11-2017 12:00	240	0	28.8	34.1	0
27-11-2017 13:00	90	0	29.5	33	0
27-11-2017 14:00	101	0	30.4	32.2	0
27-11-2017 15:00	67	0	29.8	38	0
27-11-2017 16:00	344	0.2	27.4	46.9	0
27-11-2017 17:00	344	1.2	24.3	59.2	0
27-11-2017 18:00	344	1.2	22.6	66.2	0
27-11-2017 19:00	344	1.2	22.2	71	0
27-11-2017 20:00	344	2.2	21.9	72.4	0
27-11-2017 21:00	96	2.2	21.2	72.7	0
27-11-2017 22:00	96	0	20.7	72.5	0
27-11-2017 23:00	96	0	20.1	76.3	0
28-11-2017 00:00	234	0	19.7	77.8	0
28-11-2017 01:00	207	0	19.2	82.3	0
28-11-2017 02:00	207	0	18.1	85.8	0
28-11-2017 03:00	207	0	17.2	88	0.2
28-11-2017 04:00	207	0	16.7	87.7	0
28-11-2017 05:00	62	0	16.6	85.7	0
28-11-2017 06:00	62	0	16.1	88.5	0
28-11-2017 07:00	57	0	16.7	87	0
28-11-2017 08:00	56	0	17.9	77.4	0
28-11-2017 09:00	67	0	19.9	63.8	0
28-11-2017 10:00	292	0	23.4	50.4	0
28-11-2017 11:00	306	0	25.7	41.4	0
28-11-2017 12:00	53	1	26.4	37.6	0
28-11-2017 13:00	333	0	27.5	37.4	0

Date and Time	Wind Direction (degree)	Wind Speed (km/h)	Temperature (^{0}C)	Relative Humidity (%)	Rainfall (mm)
28-11-2017 14:00	350	1	26.8	40.1	0
28-11-2017 15:00	310	0	27.2	40.1	0
28-11-2017 16:00	268	0	26.8	46.3	0
28-11-2017 17:00	268	0	24.1	61.2	0
28-11-2017 18:00	268	0	22.4	68.9	0
28-11-2017 19:00	268	0	21.9	69.7	0
28-11-2017 20:00	268	0	21.7	74.4	0
28-11-2017 21:00	268	0	20.6	77.3	0
28-11-2017 22:00	87	0	19.7	82.6	0
28-11-2017 23:00	87	0	18.8	84.8	0
29-11-2017 00:00	84	0	18.4	86.1	0
29-11-2017 01:00	84	0	18.3	86.7	0
29-11-2017 02:00	88	0	18.2	87.8	0
29-11-2017 03:00	97	0	18.3	87.8	0
29-11-2017 04:00	333	0	18.1	88.2	0
29-11-2017 05:00	355	0	18.1	89.8	0
29-11-2017 06:00	331	0	18	91.1	0
29-11-2017 07:00	331	0	18.1	90.6	0
29-11-2017 08:00	43	0	19	84.5	0
29-11-2017 09:00	155	0	21.7	68.8	0
29-11-2017 10:00	108	0	23.8	56.7	0
29-11-2017 11:00	210	0	26.8	50.6	0
29-11-2017 12:00	163	0	27.6	48.4	0
29-11-2017 13:00	101	0	28.2	44.9	0
29-11-2017 14:00	228	0	27.2	51.5	0
29-11-2017 15:00	208	0	25.9	53.6	0
29-11-2017 16:00	210	0	25.2	60.6	0
29-11-2017 17:00	208	0	23.2	69.8	0
29-11-2017 18:00	208	0	21.7	76.7	0
29-11-2017 19:00	208	0	20.7	79.7	0
29-11-2017 20:00	208	0	20.2	82.2	0
29-11-2017 21:00	104	0	19.6	86.6	0
29-11-2017 22:00	104	0	19.1	87.8	0
29-11-2017 23:00	104	0	18.7	88.4	0
30-11-2017 00:00	104	0	18.1	89.8	0
30-11-2017 01:00	104	0	17.5	91.2	0
30-11-2017 02:00	104	0	16.9	92.9	0
30-11-2017 03:00	104	0	16.4	93.7	0
30-11-2017 04:00	104	0	15.9	93.9	0
30-11-2017 05:00	104	0	15.5	94.7	0
30-11-2017 06:00	104	0	15.2	94.7	0
30-11-2017 07:00	104	0	15.2	94.5	0
30-11-2017 08:00	104	0	16.9	89.8	0
30-11-2017 09:00	278	0	20.2	71.8	0
30-11-2017 10:00	345	0	22.5	59.5	0
30-11-2017 11:00	292	0	24.4	54.7	0
30-11-2017 12:00	117	0	26.1	46	0
30-11-2017 13:00	333	0	26.8	43.4	0
30-11-2017 14:00	80	0	27.1	43.9	0
30-11-2017 15:00	36	4	26.2	48.7	0
30-11-2017 16:00	36	5	24.9	58.2	0

Date and Time	Wind Direction (degree)	Wind Speed (km/h)	Temperature (^{0}C)	Relative Humidity (%)	Rainfall (mm)
30-11-2017 17:00	36	5	22.4	70.8	0
30-11-2017 18:00	36	5	20.7	78.7	0
30-11-2017 19:00	36	0	19.8	81.8	0
30-11-2017 20:00	36	0	19.1	83.8	0
30-11-2017 21:00	36	0	18.8	84.9	0
30-11-2017 22:00	36	0	18.6	85.9	0
30-11-2017 23:00	36	0	18.6	86.6	0
01-12-2017 00:00	36	0	18.6	87.1	0
01-12-2017 01:00	36	0	18.4	87.8	0
01-12-2017 02:00	36	0	18.2	88.9	0
01-12-2017 03:00	36	0	17.9	89.8	0
01-12-2017 04:00	36	0	17.5	92.3	0
01-12-2017 05:00	36	0	16.9	93.9	0
01-12-2017 06:00	36	0	16.7	94.7	0
01-12-2017 07:00	36	0	16.9	94.7	0
01-12-2017 08:00	101	0	17.1	93.2	0
01-12-2017 09:00	101	0	18.4	86.6	0
01-12-2017 10:00	72	0	19.3	82.3	0
01-12-2017 11:00	86	0	21.2	69.3	0
01-12-2017 12:00	4	0	23.8	59.4	0
01-12-2017 13:00	101	0	25.1	48.7	0
01-12-2017 14:00	120	0	25.6	47.7	0
01-12-2017 15:00	107	0	24.9	51.3	0
01-12-2017 16:00	107	0	23.8	59.6	0
01-12-2017 17:00	107	0	21.4	73.7	0
01-12-2017 18:00	107	0	19.9	79.6	0
01-12-2017 19:00	107	0	19.2	82.2	0
01-12-2017 20:00	107	0	18.5	85.2	0
01-12-2017 21:00	107	0	18	86.1	0
01-12-2017 22:00	107	0	17.3	88.7	0
01-12-2017 23:00	107	0	16.9	89.7	0
02-12-2017 00:00	107	0	16.3	90.6	0
02-12-2017 01:00	91	0	15.8	91.7	0
02-12-2017 02:00	91	0	15.4	93	0
02-12-2017 03:00	101	0	14.7	94.7	0
02-12-2017 04:00	101	0	14.6	95.4	0
02-12-2017 05:00	101	0	14.7	95.9	0
02-12-2017 06:00	101	0	14.3	96.2	0
02-12-2017 07:00	96	0	14.1	96.6	0.2
02-12-2017 08:00	103	0	14.7	97.1	0
02-12-2017 09:00	103	0	17.9	84.9	0
02-12-2017 10:00	72	0	21.7	66.1	0
02-12-2017 11:00	204	0	24.3	57.4	0
02-12-2017 12:00	57	0	24.7	58	0
02-12-2017 13:00	63	0	25.9	47.4	0
02-12-2017 14:00	91	0	27.2	43.4	0
02-12-2017 15:00	103	0	26.7	44.7	0
02-12-2017 16:00	103	0	25.4	53.3	0
02-12-2017 17:00	103	0	22.2	71.3	0
02-12-2017 18:00	103	0	20.1	78.6	0
02-12-2017 19:00	103	0	19.1	82.6	0

Date and Time	Wind Direction (degree)	Wind Speed (km/h)	Temperature (^{0}C)	Relative Humidity (%)	Rainfall (mm)
02-12-2017 20:00	84	0	18.4	83.9	0
02-12-2017 21:00	80	0	17.6	86.3	0
02-12-2017 22:00	80	0	16.9	87.6	0
02-12-2017 23:00	80	0	16.3	89.7	0
03-12-2017 00:00	80	0	15.7	90.8	0
03-12-2017 01:00	80	0	15	92	0
03-12-2017 02:00	80	0	14.4	93.9	0
03-12-2017 03:00	80	0	14.4	94.8	0
03-12-2017 04:00	84	0	14.8	95.4	0
03-12-2017 05:00	208	0	15.1	96.2	0
03-12-2017 06:00	213	0	15.3	96.1	0
03-12-2017 07:00	213	0	15.9	97	0
03-12-2017 08:00	213	0	16.7	97.1	0
03-12-2017 09:00	162	0	17.1	97.1	0
03-12-2017 10:00	162	0	17.8	95.4	0
03-12-2017 11:00	282	0	19.3	78.9	0
03-12-2017 12:00	49	0	23.3	59.8	0
03-12-2017 13:00	56	0	24.7	55.8	0
03-12-2017 14:00	261	0	25.1	50	0
03-12-2017 15:00	312	0	25.6	54.5	0
03-12-2017 16:00	299	0	24.1	63.2	0
03-12-2017 17:00	300	0	21.4	75.9	0
03-12-2017 18:00	300	0	19.5	82.4	0
03-12-2017 19:00	300	0	18.6	84.5	0
03-12-2017 20:00	300	0	17.7	86.4	0
03-12-2017 21:00	300	0	17.1	87.8	0
03-12-2017 22:00	300	0	16.7	89.8	0
03-12-2017 23:00	300	0	16	90.5	0
04-12-2017 00:00	70	0	15.4	93.9	0
04-12-2017 01:00	70	0	14.9	94.9	0
04-12-2017 02:00	70	0	14.6	95.2	0
04-12-2017 03:00	70	0	14.3	95.4	0
04-12-2017 04:00	70	0	13.9	95.4	0
04-12-2017 05:00	70	0	13.3	95.4	0
04-12-2017 06:00	74	0	12.8	96.2	0.2
04-12-2017 07:00	100	0	12.4	97.1	0
04-12-2017 08:00	94	0	14.1	95.4	0
04-12-2017 09:00	112	0	18.8	68.7	0
04-12-2017 10:00	60	0	21.7	60.3	0
04-12-2017 11:00	94	0	24.3	49.6	0
04-12-2017 12:00	100	0	25.8	45.8	0
04-12-2017 13:00	76	0	26.8	44.6	0
04-12-2017 14:00	97	0	27.3	43.7	0
04-12-2017 15:00	72	0	26.8	43.4	0
04-12-2017 16:00	66	0	24.5	56.7	0
04-12-2017 17:00	66	0	21.6	70.5	0
04-12-2017 18:00	66	0	19.6	78.4	0
04-12-2017 19:00	66	0	18.4	83	0
04-12-2017 20:00	66	0	17.7	85.2	0
04-12-2017 21:00	66	0	17.1	86.6	0
04-12-2017 22:00	66	0	16.4	88	0

Date and Time	Wind Direction (degree)	Wind Speed (km/h)	Temperature (^{0}C)	Relative Humidity (%)	Rainfall (mm)
04-12-2017 23:00	66	0	16	89	0
05-12-2017 00:00	66	0	15.4	90.1	0
05-12-2017 01:00	66	0	14.8	90.6	0
05-12-2017 02:00	66	0	14.2	91.3	0
05-12-2017 03:00	66	0	13.8	92.2	0
05-12-2017 04:00	66	0	13.3	94.6	0
05-12-2017 05:00	67	0	12.7	95.8	0
05-12-2017 06:00	67	0	12.5	96.5	0
05-12-2017 07:00	67	0	12.8	96.2	0.2
05-12-2017 08:00	86	0	14.4	94.1	0
05-12-2017 09:00	84	0	18.9	66.3	0
05-12-2017 10:00	93	0	22.6	54.8	0
05-12-2017 11:00	105	1	24.3	45.9	0
05-12-2017 12:00	53	1	25.8	39.9	0
05-12-2017 13:00	5	0	27.2	39.1	0
05-12-2017 14:00	220	0	28.6	33.2	0
05-12-2017 15:00	98	0	28.4	33.9	0
05-12-2017 16:00	105	0	26.6	45.7	0
05-12-2017 17:00	105	0	22.3	62.9	0
05-12-2017 18:00	105	0	19.9	73.5	0
05-12-2017 19:00	105	0	18.6	78.7	0
05-12-2017 20:00	105	0	17.4	83	0
05-12-2017 21:00	105	0	16.8	84	0
05-12-2017 22:00	105	0	16.2	85	0
05-12-2017 23:00	105	0	15.3	86.9	0
06-12-2017 00:00	105	0	14.6	90	0
06-12-2017 01:00	105	0	14.3	90.6	0
06-12-2017 02:00	105	0	13.8	90.6	0
06-12-2017 03:00	105	0	13.2	92.3	0
06-12-2017 04:00	105	0	12.8	92.3	0
06-12-2017 05:00	94	0	12.5	93.1	0
06-12-2017 06:00	94	0	12.2	93.9	0
06-12-2017 07:00	94	0	12.1	95.4	0
06-12-2017 08:00	84	0	14.9	86.1	0
06-12-2017 09:00	128	0	20.9	54.7	0
06-12-2017 10:00	120	0	24.2	43.4	0
06-12-2017 11:00	218	0	26.2	38.9	0
06-12-2017 12:00	108	0	27.4	35.3	0
06-12-2017 13:00	240	0	28.4	31.7	0
06-12-2017 14:00	230	0	29.1	27.8	0
06-12-2017 15:00	275	0	28.6	30.1	0
06-12-2017 16:00	351	0	26.8	39.8	0
06-12-2017 17:00	351	0	22.9	59.6	0
06-12-2017 18:00	351	0	20.2	70.1	0
06-12-2017 19:00	360	0	18.9	75.8	0
06-12-2017 20:00	360	0	18.2	79	0
06-12-2017 21:00	94	0	17.2	81.9	0
06-12-2017 22:00	94	0	16.7	83.8	0
06-12-2017 23:00	94	0	16.1	86.1	0
07-12-2017 00:00	94	0	15.4	88.2	0
07-12-2017 01:00	94	0	14.9	88.8	0

Date and Time	Wind Direction (degree)	Wind Speed (km/h)	Temperature (^{0}C)	Relative Humidity (%)	Rainfall (mm)
07-12-2017 02:00	94	0	14.3	89.8	0
07-12-2017 03:00	94	0	13.8	90.6	0
07-12-2017 04:00	94	0	13.6	90.6	0
07-12-2017 05:00	94	0	13.2	92.3	0
07-12-2017 06:00	94	0	12.6	93.1	0
07-12-2017 07:00	94	0	12.8	93.9	0
07-12-2017 08:00	94	0	15.6	84.1	0
07-12-2017 09:00	192	0	20.3	58.3	0
07-12-2017 10:00	117	0	22.9	46.5	0
07-12-2017 11:00	160	0	25.4	41.3	0
07-12-2017 12:00	43	0	26.6	39.2	0
07-12-2017 13:00	269	0	27.4	35.7	0
07-12-2017 14:00	256	0	27.4	35.6	0
07-12-2017 15:00	172	0	28.2	34.5	0
07-12-2017 16:00	170	0	27.6	41.1	0
07-12-2017 17:00	170	0	23.1	61.8	0
07-12-2017 18:00	170	0	20.2	70.7	0
07-12-2017 19:00	170	0	18.9	76.6	0
07-12-2017 20:00	170	0	17.9	79.9	0
07-12-2017 21:00	170	0	17	83.5	0
07-12-2017 22:00	170	0	16.3	86.6	0
07-12-2017 23:00	170	0	15.9	87	0
08-12-2017 00:00	170	0	15.2	88.2	0
08-12-2017 01:00	170	0	14.7	89.8	0
08-12-2017 02:00	170	0	14.3	90.3	0
08-12-2017 03:00	170	0	13.9	91.1	0
08-12-2017 04:00	170	0	13.3	93.1	0
08-12-2017 05:00	170	0	12.9	94.7	0
08-12-2017 06:00	170	0	12.8	95.2	0
08-12-2017 07:00	122	0	12.8	95.1	0
08-12-2017 08:00	101	0	14.5	89	0
08-12-2017 09:00	231	0	19.3	65.2	0
08-12-2017 10:00	81	0	22.2	56.4	0
08-12-2017 11:00	190	0	24.4	49.8	0
08-12-2017 12:00	276	0	25.4	45	0
08-12-2017 13:00	5	0	26.2	43.5	0
08-12-2017 14:00	345	0	26.6	38.4	0
08-12-2017 15:00	40	0	26.6	41.3	0
08-12-2017 16:00	4	0	24.8	49	0
08-12-2017 17:00	4	0	22.2	64.1	0
08-12-2017 18:00	4	0	20.3	71.9	0
08-12-2017 19:00	4	0	19.7	75.3	0
08-12-2017 20:00	4	0	18.9	79.7	0
08-12-2017 21:00	4	0	18.2	82.6	0
08-12-2017 22:00	4	0	17.3	86.1	0
08-12-2017 23:00	4	0	16.6	87.4	0
09-12-2017 00:00	4	0	15.7	88.5	0
09-12-2017 01:00	4	0	15.1	90.5	0
09-12-2017 02:00	4	0	14.6	91.4	0
09-12-2017 03:00	4	0	14.3	92.8	0
09-12-2017 04:00	4	0	14	93.9	0

Date and Time	Wind Direction (degree)	Wind Speed (km/h)	Temperature (^{0}C)	Relative Humidity (%)	Rainfall (mm)
09-12-2017 05:00	79	0	13.5	94.9	0.2
09-12-2017 06:00	104	0	12.8	96.2	0
09-12-2017 07:00	104	0	13.1	96	0
09-12-2017 08:00	114	0	14.6	94.7	0
09-12-2017 09:00	104	0	18.4	73.5	0
09-12-2017 10:00	112	0	22.8	54.4	0
09-12-2017 11:00	240	0	24.7	46.2	0
09-12-2017 12:00	283	0	26.8	39.3	0
09-12-2017 13:00	282	0	26.9	40	0
09-12-2017 14:00	265	0	27.2	39.4	0
09-12-2017 15:00	347	0	27.1	38.5	0
09-12-2017 16:00	357	0	25.4	49.2	0
09-12-2017 17:00	357	0	22.7	63.6	0
09-12-2017 18:00	357	0	20.3	72.2	0
09-12-2017 19:00	357	0	18.9	77.3	0
09-12-2017 20:00	357	0	17.9	81.2	0
09-12-2017 21:00	357	0	17.2	83.5	0
09-12-2017 22:00	357	0	16.6	86.2	0
09-12-2017 23:00	357	0	16	86.9	0
10-12-2017 00:00	357	0	15.4	89.2	0
10-12-2017 01:00	357	0	14.8	90.4	0
10-12-2017 02:00	357	0	14.3	91	0
10-12-2017 03:00	357	0	13.9	91.5	0
10-12-2017 04:00	357	0	13.4	93.1	0
10-12-2017 05:00	90	0	12.9	95.1	0
10-12-2017 06:00	90	0	12.6	95.4	0
10-12-2017 07:00	90	0	12.7	95.4	0
10-12-2017 08:00	90	0	14.6	93.7	0
10-12-2017 09:00	81	0	19.1	69.1	0
10-12-2017 10:00	242	0	22.7	55.3	0
10-12-2017 11:00	107	0	23.8	47.5	0
10-12-2017 12:00	136	0	25.3	43.4	0
10-12-2017 13:00	101	1	26.7	39.2	0
10-12-2017 14:00	62	1	26.5	39.5	0
10-12-2017 15:00	125	0	26.6	37.5	0
10-12-2017 16:00	64	0	25.4	44.2	0
10-12-2017 17:00	64	0	22.3	62.4	0
10-12-2017 18:00	64	0	19.8	71.4	0
10-12-2017 19:00	64	0	18.4	77.8	0
10-12-2017 20:00	64	0	17.4	81.2	0
10-12-2017 21:00	64	0	16.7	84.2	0
10-12-2017 22:00	64	0	15.8	86.1	0
10-12-2017 23:00	64	0	15.1	86.9	0
11-12-2017 00:00	64	0	14.6	88.1	0
11-12-2017 01:00	64	0	14.1	89.5	0
11-12-2017 02:00	64	0	13.7	90.6	0
11-12-2017 03:00	64	0	13.3	92.3	0
11-12-2017 04:00	64	0	12.7	93.1	0
11-12-2017 05:00	76	0	12.4	95.1	0.2
11-12-2017 06:00	94	0	12.1	95.8	0
11-12-2017 07:00	79	0	12.1	96.2	0

Date and Time	Wind Direction (degree)	Wind Speed (km/h)	Temperature (^{0}C)	Relative Humidity (%)	Rainfall (mm)
11-12-2017 08:00	94	0	14.3	90.6	0
11-12-2017 09:00	138	0	19.9	56.6	0
11-12-2017 10:00	31	0	23.1	47.4	0
11-12-2017 11:00	114	0	25.1	39	0
11-12-2017 12:00	59	0	26.8	34.7	0
11-12-2017 13:00	242	0	27.9	32.2	0
11-12-2017 14:00	230	0	28.9	30	0
11-12-2017 15:00	289	0	27.8	33.5	0
11-12-2017 16:00	289	0	27.5	35.1	0
11-12-2017 17:00	289	0	22.9	58	0
11-12-2017 18:00	289	0	19.7	68.7	0
11-12-2017 19:00	289	0	18.3	75.4	0
11-12-2017 20:00	289	0	17.2	79.5	0
11-12-2017 21:00	289	0	16.5	82	0
11-12-2017 22:00	70	0	15.6	85.5	0
11-12-2017 23:00	70	0	15.1	86.6	0
12-12-2017 00:00	70	0	14.7	86.9	0
12-12-2017 01:00	70	0	13.9	87.8	0
12-12-2017 02:00	70	0	13.3	90.6	0
12-12-2017 03:00	70	0	12.7	91.5	0
12-12-2017 04:00	70	0	12.2	92.3	0
12-12-2017 05:00	70	0	11.6	93.2	0
12-12-2017 06:00	76	0	11.9	95.1	0
12-12-2017 07:00	76	0	12.2	95.8	0
12-12-2017 08:00	76	0	12.9	95.6	0
12-12-2017 09:00	77	0	17.7	71.7	0
12-12-2017 10:00	261	0	21.9	58.7	0
12-12-2017 11:00	225	0	24.5	46.9	0
12-12-2017 12:00	69	0	25.7	49.3	0
12-12-2017 13:00	1	0	26	41.8	0
12-12-2017 14:00	180	0	27.9	34.2	0
12-12-2017 15:00	66	0	28.6	34.9	0
12-12-2017 16:00	94	5	26.6	42	0
12-12-2017 17:00	94	6	22.7	61.7	0
12-12-2017 18:00	94	6	19.7	72.3	0
12-12-2017 19:00	94	0	18.3	78.1	0
12-12-2017 20:00	94	6	17.4	80.9	0
12-12-2017 21:00	94	0	16.4	84.3	0
12-12-2017 22:00	94	0	15.7	86.6	0
12-12-2017 23:00	94	0	15.2	87.3	0
13-12-2017 00:00	94	0	14.6	88.1	0
13-12-2017 01:00	94	0	14	89.2	0
13-12-2017 02:00	94	0	13.5	91.5	0
13-12-2017 03:00	94	0	13.2	91.8	0
13-12-2017 04:00	94	0	12.6	92.5	0
13-12-2017 05:00	94	0	12.3	94.8	0
13-12-2017 06:00	94	0	11.5	96.2	0
13-12-2017 07:00	115	0	11.4	97.1	0
13-12-2017 08:00	79	0	13.4	95.4	0
13-12-2017 09:00	206	0	18.4	66.3	0
13-12-2017 10:00	59	0	23.1	49	0

Date and Time	Wind Direction (degree)	Wind Speed (km/h)	Temperature (^{0}C)	Relative Humidity (%)	Rainfall (mm)
13-12-2017 11:00	223	0	24.4	44.6	0
13-12-2017 12:00	293	0	25.1	41.6	0
13-12-2017 13:00	101	0	26.6	41.2	0
13-12-2017 14:00	103	0	26.8	37	0
13-12-2017 15:00	104	0	27.9	36	0
13-12-2017 16:00	148	0	27.1	40.2	0
13-12-2017 17:00	148	0	22.4	64.5	0
13-12-2017 18:00	148	0	19.5	70.9	0
13-12-2017 19:00	148	0	18.4	77.5	0
13-12-2017 20:00	148	0	17.2	81.8	0
13-12-2017 21:00	148	0	16.4	84.6	0
13-12-2017 22:00	148	0	15.8	86.6	0
13-12-2017 23:00	148	0	15.2	88.6	0
14-12-2017 00:00	148	0	14.7	89.6	0
14-12-2017 01:00	148	0	14.1	90.6	0
14-12-2017 02:00	148	0	13.8	92.1	0
14-12-2017 03:00	112	0	13.5	93.8	0.2
14-12-2017 04:00	104	0	12.9	95.4	0
14-12-2017 05:00	93	0	12.6	95.4	0
14-12-2017 06:00	94	0	12.4	90.8	0
14-12-2017 07:00	94	0	12.2	91.2	0
14-12-2017 08:00	60	1	14.4	71.5	0
14-12-2017 09:00	100	1	18.7	55.4	0
14-12-2017 10:00	224	0	23.3	44	0
14-12-2017 11:00	60	0	24.9	37.6	0
14-12-2017 12:00	80	1	26.3	32.5	0
14-12-2017 13:00	184	0	28.2	28.9	0
14-12-2017 14:00	48	0	28.2	26.9	0
14-12-2017 15:00	347	0	27.3	27.3	0
14-12-2017 16:00	56	4	26.7	30.2	0
14-12-2017 17:00	56	5	23.1	49.2	0
14-12-2017 18:00	56	2	19.8	61.7	0
14-12-2017 19:00	56	3	18.1	69.4	0
14-12-2017 20:00	56	6	16.9	76	0
14-12-2017 21:00	49	8	16	80.4	0
14-12-2017 22:00	49	9	14.9	83.5	0
14-12-2017 23:00	49	8	14.3	85	0
15-12-2017 00:00	49	0	13.8	86.5	0
15-12-2017 01:00	49	8	13.2	87.8	0
15-12-2017 02:00	49	8	12.6	89	0
15-12-2017 03:00	49	7	12.1	89.8	0
15-12-2017 04:00	49	8	11.5	90.5	0
15-12-2017 05:00	49	0	11.1	92.3	0
15-12-2017 06:00	53	0	11.4	94.7	0
15-12-2017 07:00	55	0	11.7	95.4	0
15-12-2017 08:00	86	0	13.1	90.6	0
15-12-2017 09:00	100	0	18.1	64	0
15-12-2017 10:00	84	0	21.8	48.4	0
15-12-2017 11:00	80	0	25.2	39.8	0
15-12-2017 12:00	283	0	25.6	38.1	0
15-12-2017 13:00	87	0	27.1	33.7	0

Date and Time	Wind Direction (degree)	Wind Speed (km/h)	Temperature (^{0}C)	Relative Humidity (%)	Rainfall (mm)
15-12-2017 14:00	67	0	27.7	31.7	0
15-12-2017 15:00	73	0	27.6	33.5	0
15-12-2017 16:00	48	0	26.3	38.4	0
15-12-2017 17:00	48	5	22.8	57.7	0
15-12-2017 18:00	48	3	19.7	69.8	0
15-12-2017 19:00	48	3	18.1	75.6	0
15-12-2017 20:00	48	6	16.9	80.4	0
15-12-2017 21:00	73	2	16	83.8	0
15-12-2017 22:00	73	4	15.4	84.4	0
15-12-2017 23:00	73	2	14.9	85.7	0
16-12-2017 00:00	73	3	14.2	86.9	0
16-12-2017 01:00	73	0	13.5	89	0
16-12-2017 02:00	73	0	12.8	90.6	0
16-12-2017 03:00	73	0	12.2	92.3	0
16-12-2017 04:00	96	0	11.8	93.1	0
16-12-2017 05:00	87	0	11.4	93.9	0
16-12-2017 06:00	87	0	11.2	95	0.2
16-12-2017 07:00	87	0	11.3	95.7	0
16-12-2017 08:00	96	0	12.7	90.3	0
16-12-2017 09:00	80	0	16.4	69.3	0
16-12-2017 10:00	199	0	19.2	56.6	0
16-12-2017 11:00	94	0	21.3	44.3	0
16-12-2017 12:00	227	0	25.4	34.6	0
16-12-2017 13:00	127	0	27	29.3	0
16-12-2017 14:00	108	0	27.8	27.8	0
16-12-2017 15:00	207	0	27.9	27.4	0
16-12-2017 16:00	207	0	27.6	32.9	0
16-12-2017 17:00	207	0	22.8	53.7	0
16-12-2017 18:00	206	0	19.1	65.2	0
16-12-2017 19:00	206	0	17.3	73.9	0
16-12-2017 20:00	206	0	16.3	77.2	0
16-12-2017 21:00	206	0	15.5	80.6	0
16-12-2017 22:00	206	0	14.7	82.3	0
16-12-2017 23:00	206	0	14	84.8	0
17-12-2017 00:00	108	0	13.3	86.5	0
17-12-2017 01:00	108	0	12.6	88.2	0
17-12-2017 02:00	108	0	12.3	90.8	0
17-12-2017 03:00	108	0	11.8	92.3	0
17-12-2017 04:00	108	0	11.6	93.1	0
17-12-2017 05:00	108	0	11.1	93.9	0
17-12-2017 06:00	108	0	10.8	94.4	0
17-12-2017 07:00	108	0	10.8	95	0
17-12-2017 08:00	97	0	13.4	88.5	0
17-12-2017 09:00	77	0	19.8	52.4	0
17-12-2017 10:00	67	0	22.2	45.8	0
17-12-2017 11:00	128	1	24.8	33.1	0
17-12-2017 12:00	94	0	26.4	27.7	0
17-12-2017 13:00	201	0	27.8	27	0
17-12-2017 14:00	76	6	28.7	25.5	0
17-12-2017 15:00	69	6	29.4	27.5	0
17-12-2017 16:00	28	5	26.7	32.1	0

Date and Time	Wind Direction (degree)	Wind Speed (km/h)	Temperature (^{0}C)	Relative Humidity (%)	Rainfall (mm)
17-12-2017 17:00	28	12	23.5	47.5	0
17-12-2017 18:00	28	12	20.6	57.5	0
17-12-2017 19:00	28	10	19.6	63.8	0
17-12-2017 20:00	86	4	18.7	63.8	0
17-12-2017 21:00	86	6	18.3	65.7	0
17-12-2017 22:00	86	6	17.5	70.9	0
17-12-2017 23:00	86	6	16.7	75.3	0
18-12-2017 00:00	304	0	16	77.4	0
18-12-2017 01:00	345	0	15.2	79.2	0
18-12-2017 02:00	345	0	14.6	81.8	0
18-12-2017 03:00	4	0	13.9	83.5	0
18-12-2017 04:00	35	0	13.7	86.7	0
18-12-2017 05:00	35	0	13.4	87.2	0
18-12-2017 06:00	35	0	12.8	90	0
18-12-2017 07:00	35	0	12.4	91.3	0
18-12-2017 08:00	57	0	13.7	86.9	0
18-12-2017 09:00	60	0	18.3	64.6	0
18-12-2017 10:00	97	0	22	48.7	0
18-12-2017 11:00	241	0	23.9	41.9	0
18-12-2017 12:00	217	0	25.9	35.1	0
18-12-2017 13:00	213	0	26.9	36.1	0
18-12-2017 14:00	244	0	27.5	34.1	0
18-12-2017 15:00	269	0	27.4	33.9	0
18-12-2017 16:00	269	0	26.4	41.7	0
18-12-2017 17:00	269	0	22.5	60.1	0
18-12-2017 18:00	269	0	19.9	69.5	0
18-12-2017 19:00	269	0	18.7	74.3	0
18-12-2017 20:00	269	0	17.6	78.7	0
18-12-2017 21:00	269	0	16.8	81.5	0
18-12-2017 22:00	269	0	16.2	83.9	0
18-12-2017 23:00	269	0	15.9	85.1	0
19-12-2017 00:00	269	0	15.6	86.1	0
19-12-2017 01:00	232	0	15.2	87.5	0
19-12-2017 02:00	232	0	15	89.2	0
19-12-2017 03:00	131	0	14.7	90	0
19-12-2017 04:00	131	0	14.3	90.6	0
19-12-2017 05:00	131	0	13.9	91.4	0
19-12-2017 06:00	131	0	13.6	92.9	0
19-12-2017 07:00	131	0	13.7	93.5	0
19-12-2017 08:00	131	0	14.9	86.9	0
19-12-2017 09:00	91	0	16.7	74.6	0
19-12-2017 10:00	107	1	18.7	59.9	0
19-12-2017 11:00	90	0	23.3	41.7	0
19-12-2017 12:00	1	0	24.8	38.9	0
19-12-2017 13:00	242	0	23.2	45	0
19-12-2017 14:00	242	0	22.9	45.7	0
19-12-2017 15:00	242	0	21.9	56.8	0
19-12-2017 16:00	295	0	20.2	69.7	0
19-12-2017 17:00	295	0	19.1	77.3	0
19-12-2017 18:00	295	0	18.2	81.6	0
19-12-2017 19:00	9	0	17.6	84.2	0.2

Date and Time	Wind Direction (degree)	Wind Speed (km/h)	Temperature (^{0}C)	Relative Humidity (%)	Rainfall (mm)
19-12-2017 20:00	4	0	17.1	87.2	0
19-12-2017 21:00	273	0	16.9	87.9	0
19-12-2017 22:00	258	0	16.6	89.1	0.2
19-12-2017 23:00	258	0	16.5	90.2	0
20-12-2017 00:00	91	0	16.3	91	0
20-12-2017 01:00	66	0	15.9	92.6	0
20-12-2017 02:00	84	0	15.8	93.9	0
20-12-2017 03:00	93	0	15.6	93.8	0
20-12-2017 04:00	93	0	15.3	94.7	0
20-12-2017 05:00	93	0	14.9	94.9	0
20-12-2017 06:00	93	0	14.8	95.4	0
20-12-2017 07:00	93	0	14.7	96.2	0
20-12-2017 08:00	93	0	15.6	95.4	0
20-12-2017 09:00	97	0	16.8	88.2	0
20-12-2017 10:00	93	0	18.4	74.7	0
20-12-2017 11:00	105	0	21.4	51.3	0
20-12-2017 12:00	76	0	24.1	46.3	0
20-12-2017 13:00	80	1	24.8	42	0
20-12-2017 14:00	230	0	25.6	40.3	0
20-12-2017 15:00	275	0	25.3	41	0
20-12-2017 16:00	199	0	24.8	44.7	0
20-12-2017 17:00	199	0	21.6	63	0
20-12-2017 18:00	199	0	19	73.8	0
20-12-2017 19:00	139	0	17.8	78.5	0
20-12-2017 20:00	139	0	17.2	81.5	0
20-12-2017 21:00	139	0	16.9	83.5	0
20-12-2017 22:00	84	1	16.2	80.1	0
20-12-2017 23:00	87	0	15.9	81.7	0
21-12-2017 00:00	73	0	14.9	84.6	0
21-12-2017 01:00	235	0	15.2	82.6	0
21-12-2017 02:00	49	0	14.9	84.3	0
21-12-2017 03:00	170	0	14	86.9	0
21-12-2017 04:00	104	0	13.7	89.8	0
21-12-2017 05:00	84	0	13.3	91.5	0
21-12-2017 06:00	77	0	12.8	92.4	0
21-12-2017 07:00	122	1	12.9	91.5	0
21-12-2017 08:00	94	0	14.9	75.9	0
21-12-2017 09:00	77	0	19.6	52.8	0
21-12-2017 10:00	100	1	22	44.1	0
21-12-2017 11:00	179	0	23.9	39.5	0
21-12-2017 12:00	151	1	25.2	34.2	0
21-12-2017 13:00	69	0	26.3	31	0
21-12-2017 14:00	91	0	26.5	28.3	0
21-12-2017 15:00	25	0	27.1	28.3	0
21-12-2017 16:00	39	0	25.6	32.4	0
21-12-2017 17:00	39	0	22.3	49.4	0
21-12-2017 18:00	39	0	19.1	61.1	0
21-12-2017 19:00	39	0	17.3	70.1	0
21-12-2017 20:00	53	0	16.3	75.8	0
21-12-2017 21:00	53	0	15.3	79.6	0
21-12-2017 22:00	53	0	14.6	78	0

Date and Time	Wind Direction (degree)	Wind Speed (km/h)	Temperature (^{0}C)	Relative Humidity (%)	Rainfall (mm)
21-12-2017 23:00	53	0	13.9	82	0
22-12-2017 00:00	53	0	13.2	85.1	0
22-12-2017 01:00	55	0	12.8	87.3	0
22-12-2017 02:00	55	0	12.3	87.8	0
22-12-2017 03:00	55	0	11.7	91.5	0
22-12-2017 04:00	55	0	11.3	92.6	0
22-12-2017 05:00	55	0	10.9	93.1	0
22-12-2017 06:00	55	0	10.4	94.7	0
22-12-2017 07:00	55	0	10.7	95.5	0
22-12-2017 08:00	208	0	11.7	96	0
22-12-2017 09:00	201	0	13.3	93.5	0
22-12-2017 10:00	59	0	15.2	83.5	0
22-12-2017 11:00	255	0	19.1	56.3	0
22-12-2017 12:00	340	0	23.6	44.2	0
22-12-2017 13:00	251	0	25.6	36.3	0
22-12-2017 14:00	234	0	25.9	34.2	0
22-12-2017 15:00	176	0	26.4	33.4	0
22-12-2017 16:00	227	0	26.5	35.2	0
22-12-2017 17:00	227	0	22.2	57.3	0
22-12-2017 18:00	227	0	18.6	69.6	0
22-12-2017 19:00	227	0	17.1	75.6	0
22-12-2017 20:00	227	0	15.9	80.4	0
22-12-2017 21:00	46	0	15.2	83.6	0
22-12-2017 22:00	46	0	14.4	85.3	0
22-12-2017 23:00	46	0	13.8	86.9	0
23-12-2017 00:00	46	0	13.6	87.4	0
23-12-2017 01:00	46	0	13.2	88.7	0
23-12-2017 02:00	46	0	13.1	90.8	0
23-12-2017 03:00	50	0	13.1	90.5	0
23-12-2017 04:00	50	0	12.6	91.3	0
23-12-2017 05:00	50	0	12.1	92.5	0
23-12-2017 06:00	50	0	11.7	93.9	0
23-12-2017 07:00	115	0	11.8	95.1	0
23-12-2017 08:00	115	0	13	93.8	0
23-12-2017 09:00	115	0	15.1	84	0
23-12-2017 10:00	358	0	17	73	0
23-12-2017 11:00	4	3	18.6	63.9	0
23-12-2017 12:00	67	6	20.1	47	0
23-12-2017 13:00	76	4	21.7	40.4	0
23-12-2017 14:00	70	3	22.3	37.3	0
23-12-2017 15:00	72	5	22.6	36.6	0
23-12-2017 16:00	42	5	21.7	39.7	0
23-12-2017 17:00	36	6	19.2	46.2	0
23-12-2017 18:00	62	6	17.4	56.8	0
23-12-2017 19:00	55	1	16.4	61.7	0
23-12-2017 20:00	62	0	15.6	64.4	0
23-12-2017 21:00	70	0	14.8	67.8	0
23-12-2017 22:00	70	0	13.6	75.8	0
23-12-2017 23:00	70	0	12.5	82.2	0
24-12-2017 00:00	70	0	11.9	85.2	0
24-12-2017 01:00	70	0	11.2	86.8	0

Date and Time	Wind Direction (degree)	Wind Speed (km/h)	Temperature (^{0}C)	Relative Humidity (%)	Rainfall (mm)
24-12-2017 02:00	79	0	11.1	87.9	0
24-12-2017 03:00	80	0	11.6	86.6	0
24-12-2017 04:00	80	0	11.9	86.4	0
24-12-2017 05:00	283	0	12.3	88.1	0
24-12-2017 06:00	279	0	12.2	92.3	0
24-12-2017 07:00	69	0	12.1	92.4	0
24-12-2017 08:00	283	0	12.7	92.3	0.2
24-12-2017 09:00	293	0	12.8	93.8	0
24-12-2017 10:00	344	0	13.1	95.1	0
24-12-2017 11:00	64	1	14.7	80.2	0.2
24-12-2017 12:00	59	0	16.2	75.1	0
24-12-2017 13:00	98	1	16.9	71.1	0.2
24-12-2017 14:00	223	0	17	68	0
24-12-2017 15:00	153	0	18.3	59	0.2
24-12-2017 16:00	139	0	18.9	65.5	0
24-12-2017 17:00	139	0	15.8	79.2	0.2
24-12-2017 18:00	139	0	13.7	86.7	0
24-12-2017 19:00	139	0	12.9	89	0
24-12-2017 20:00	139	0	12.1	92.1	0.2
24-12-2017 21:00	139	0	11.5	93.5	0
24-12-2017 22:00	139	0	11	94.5	0
24-12-2017 23:00	139	0	10.3	95.5	0
25-12-2017 00:00	139	0	10	96.8	0.2
25-12-2017 01:00	142	0	9.7	97.1	0
25-12-2017 02:00	142	0	9.2	97.7	0
25-12-2017 03:00	142	0	8.7	97.9	0
25-12-2017 04:00	107	0	8.4	98.1	0.2
25-12-2017 05:00	107	0	8.3	98.7	0
25-12-2017 06:00	4	0	7.8	98.7	0
25-12-2017 07:00	4	0	7.4	99.6	0
25-12-2017 08:00	286	0	8.7	99.5	0
25-12-2017 09:00	94	0	11.3	98.5	0
25-12-2017 10:00	70	0	17.1	64.9	0.2
25-12-2017 11:00	87	0	19.6	50.4	0
25-12-2017 12:00	29	0	21.6	41.6	0
25-12-2017 13:00	190	0	22.5	35.3	0
25-12-2017 14:00	96	0	22.6	33.2	0.2
25-12-2017 15:00	73	0	23.9	32.1	0
25-12-2017 16:00	52	0	23.7	33.3	0
25-12-2017 17:00	52	0	19.7	56.8	0
25-12-2017 18:00	52	0	16.4	69.2	0
25-12-2017 19:00	52	0	14.8	77	0
25-12-2017 20:00	52	0	13.7	81.7	0
25-12-2017 21:00	360	0	13	85	0
25-12-2017 22:00	360	0	12.2	86.6	0
25-12-2017 23:00	360	0	11.4	88.3	0
26-12-2017 00:00	360	0	10.8	90	0
26-12-2017 01:00	360	0	10.2	92.3	0
26-12-2017 02:00	360	0	9.9	93.1	0
26-12-2017 03:00	360	0	9.3	93.9	0
26-12-2017 04:00	360	0	8.7	94.7	0

Date and Time	Wind Direction (degree)	Wind Speed (km/h)	Temperature (^{0}C)	Relative Humidity (%)	Rainfall (mm)
26-12-2017 05:00	360	0	8.2	95.4	0
26-12-2017 06:00	360	0	7.6	95.4	0
26-12-2017 07:00	70	0	7.3	97.9	0
26-12-2017 08:00	56	0	8.2	98.2	0
26-12-2017 09:00	96	0	10.8	95.4	0
26-12-2017 10:00	313	0	16.2	61.8	0
26-12-2017 11:00	1	0	18.8	54	0
26-12-2017 12:00	244	0	21.5	38.5	0
26-12-2017 13:00	4	0	22.9	37.3	0
26-12-2017 14:00	255	0	23.6	34.1	0
26-12-2017 15:00	248	0	24.6	33.1	0
26-12-2017 16:00	230	0	24.7	34.5	0
26-12-2017 17:00	230	0	20.6	54.8	0
26-12-2017 18:00	230	0	17.3	67.9	0
26-12-2017 19:00	228	0	15.7	75.9	0
26-12-2017 20:00	228	0	14.8	79.8	0
26-12-2017 21:00	228	0	13.9	83.6	0
26-12-2017 22:00	228	0	12.9	86.1	0
26-12-2017 23:00	228	0	12.3	87.6	0
27-12-2017 00:00	228	0	11.7	88.7	0
27-12-2017 01:00	228	0	11.1	91.5	0
27-12-2017 02:00	228	0	10.5	92.4	0
27-12-2017 03:00	228	0	10	93.8	0
27-12-2017 04:00	228	0	9.5	94.7	0
27-12-2017 05:00	228	0	8.9	95.7	0
27-12-2017 06:00	228	0	8.3	96.6	0.2
27-12-2017 07:00	115	0	7.9	97.1	0
27-12-2017 08:00	115	0	8.9	97.5	0
27-12-2017 09:00	4	0	12.7	86.8	0
27-12-2017 10:00	204	0	17	61.6	0
27-12-2017 11:00	262	0	19.9	54.6	0
27-12-2017 12:00	321	0	21.6	44.8	0
27-12-2017 13:00	105	1	23.5	39.4	0
27-12-2017 14:00	74	0	25	34.9	0
27-12-2017 15:00	4	0	24.7	33.8	0
27-12-2017 16:00	57	2.2	25.1	34.1	0
27-12-2017 17:00	57	2	21	55.9	0
27-12-2017 18:00	57	2	17.7	67.4	0
27-12-2017 19:00	57	3	16.1	75.4	0
27-12-2017 20:00	57	4	15.1	79.6	0
27-12-2017 21:00	57	5	14.1	82.6	0
27-12-2017 22:00	57	2	13.3	85.2	0
27-12-2017 23:00	57	3	12.6	87.1	0
28-12-2017 00:00	57	2	11.8	88.1	0
28-12-2017 01:00	57	1.6	11.2	89.1	0
28-12-2017 02:00	57	2	10.7	90.6	0
28-12-2017 03:00	57	2	10.3	92.3	0
28-12-2017 04:00	57	3	9.9	93.1	0
28-12-2017 05:00	57	5	9.4	94	0
28-12-2017 06:00	57	5	9.2	94.8	0
28-12-2017 07:00	57	0	8.9	95.6	0

Date and Time	Wind Direction (degree)	Wind Speed (km/h)	Temperature (^{0}C)	Relative Humidity (%)	Rainfall (mm)
28-12-2017 08:00	57	0	10.2	95.7	0
28-12-2017 09:00	76	0	15.7	69	0
28-12-2017 10:00	293	0	20.1	51	0
28-12-2017 11:00	4	0	21.7	47.5	0
28-12-2017 12:00	350	0	23	40.1	0
28-12-2017 13:00	94	0	24.6	34.4	0
28-12-2017 14:00	87	0	25.5	34	0
28-12-2017 15:00	108	0	25.3	32.9	0
28-12-2017 16:00	5	0	24.4	39	0
28-12-2017 17:00	1	0	20.9	52.2	0
28-12-2017 18:00	1	0	18.1	64.9	0
28-12-2017 19:00	1	0	16.4	73.7	0
28-12-2017 20:00	1	0	15.2	79.1	0
28-12-2017 21:00	1	0	14.2	82.2	0
28-12-2017 22:00	1	0	13.2	84.8	0
28-12-2017 23:00	1	0	12.3	86.7	0
29-12-2017 00:00	1	0	11.8	87.8	0
29-12-2017 01:00	1	0	11.1	88.6	0
29-12-2017 02:00	1	0	10.4	90.9	0
29-12-2017 03:00	1	0	10	92.3	0
29-12-2017 04:00	4	0	9.7	94.2	0
29-12-2017 05:00	5	0	9.6	95.4	0
29-12-2017 06:00	4	0	9.9	97.1	0
29-12-2017 07:00	4	0	9.8	97.1	0
29-12-2017 08:00	323	0	12.1	94.4	0
29-12-2017 09:00	39	0	16.8	68.6	0
29-12-2017 10:00	124	0	19.4	56.2	0
29-12-2017 11:00	114	0	22.1	42.1	0
29-12-2017 12:00	91	0	24.4	35.9	0
29-12-2017 13:00	60	1	24.8	33.2	0
29-12-2017 14:00	67	0	26.1	32.5	0
29-12-2017 15:00	108	0	26.7	27.6	0
29-12-2017 16:00	66	4	25.4	30.3	0
29-12-2017 17:00	66	2	22.6	43.6	0
29-12-2017 18:00	66	3	18.8	59	0
29-12-2017 19:00	66	2	17.6	65.3	0
29-12-2017 20:00	66	2	17.6	69	0
29-12-2017 21:00	66	2	16.9	73.8	0
29-12-2017 22:00	66	2	15.6	79.6	0
29-12-2017 23:00	66	2	14.6	82.3	0
30-12-2017 00:00	66	2	13.9	84.8	0
30-12-2017 01:00	66	0	13.4	86.7	0
30-12-2017 02:00	66	0	12.9	87.5	0
30-12-2017 03:00	66	0	12.3	89.8	0
30-12-2017 04:00	66	0	11.7	91.3	0
30-12-2017 05:00	66	0	11.1	91.5	0
30-12-2017 06:00	66	0	10.9	92.6	0
30-12-2017 07:00	66	0	11	93.1	0
30-12-2017 08:00	66	0	11.7	92.4	0
30-12-2017 09:00	103	0	14.8	77.3	0
30-12-2017 10:00	351	0	19.9	62.3	0

Annexure 3.4

Primary Air Monitoring Data Collected for the Study

Sl. No.	Date of Monitoring	Concentration of Pollutants							
		PM_{10} (µg/m³)	$PM_{2.5}$ (µg/m³)	SO_2 (µg/m³)	NO_2 (µg/m³)	CO (mg/m³)	Hydrocarbon (ppm)	Hydrocarbon (as Non-Methane) ppm	VOC (µg/m³)
AAQ-1, Bagaltoli 1no Balipara									
1	17/10/4	76	42	4.8	21.8	0.25	0.78	<0.5	<2.08
2	17/10/8	128	70	7.2	26.5	0.54	1.35	<0.5	2.47
3	17/10/12	95	54	6.5	27.6	0.42	0.97	<0.5	<2.08
4	17/10/16	92	52	5.7	22.8	0.57	0.63	<0.5	<2.08
5	17/10/19	98	57	6.5	25.3	0.68	0.83	<0.5	<2.08
6	17/10/24	89	41	5.5	17.8	0.33	1.22	<0.5	<2.08
7	17/10/27	58	27	5.2	23.3	0.42	1.22	<0.5	2.25
8	17/10/30	87	48	5.6	22.3	0.75	0.87	<0.5	<2.08
9	17/11/3	58	27	4.8	21.4	0.66	0.68	<0.5	<2.08
10	17/11/7	92	53	6.2	26.3	0.22	0.95	<0.5	<2.08
11	17/11/11	125	72	7.4	28.3	0.24	1.24	<0.5	2.69
12	17/11/15	97	53	6.8	25.9	0.32	0.96	<0.5	<2.08
13	17/11/18	76	30	5.2	24.3	0.58	1.45	<0.5	<2.08
14	17/11/23	96	52	6.5	27.4	0.32	0.95	<0.5	2.37
15	17/11/26	75	42	4.7	23.5	0.58	1.23	<0.5	<2.08
16	17/11/29	65	32	4.2	19.6	0.42	1.22	<0.5	<2.08
17	17/12/3	92	53	7.5	25.0	0.52	1.24	1.66	2.31
18	17/12/7	68	32	6.2	23.0	0.42	0.95	<0.5	<2.08
19	17/12/11	93	51	7.2	25.3	0.63	1.32	1.88	<2.08
20	17/12/15	82	45	6.3	22.5	0.21	0.98	<0.5	<2.08
21	17/12/18	97	53	5.8	22.4	0.52	0.92	1.33	<2.08
22	17/12/23	134	73	7.4	26.3	0.22	0.84	<0.5	2.65
23	17/12/26	92	51	6.2	28.7	0.24	0.78	<0.5	<2.08
24	17/12/29	77	40	5.6	23.3	0.32	0.92	<0.5	<2.08
AAQ-2, Guijan LG Road									
1	17/10/4	95	53	6.3	23.2	0.45	0.93	1.22	<2.08
2	17/10/8	70	38	4.5	16.6	0.52	0.86	<0.5	<2.08
3	17/10/12	87	48	5.8	20.2	0.62	0.94	<0.5	<2.08
4	17/10/16	68	42	5.7	23.8	0.55	0.65	<0.5	<2.08
5	17/10/19	75	38	6.3	25.3	0.67	0.72	<0.5	<2.08
6	17/10/24	83	40	5.5	16.6	0.26	1.11	<0.5	<2.08
7	17/10/27	96	55	5.5	25.4	0.32	1.24	<0.5	<2.08
8	17/10/30	89	48	5.8	12.2	0.53	0.98	<0.5	<2.08
9	17/11/3	77	38	6.3	16.6	0.41	1.27	<0.5	<2.08
10	17/11/7	80	42	5.2	27.5	0.62	0.96	<0.5	<2.08
11	17/11/11	76	42	4.8	19.6	0.22	1.22	<0.5	<2.08
12	17/11/15	96	55	6.3	23.5	0.15	0.89	<0.5	<2.08
13	17/11/18	132	74	5.5	16.5	0.24	1.35	<0.5	2.53
14	17/11/23	89	52	4.2	22.3	0.62	1.33	<0.5	<2.08

Sl. No.	Date of Monitoring	Concentration of Pollutants							
		PM_{10} ($\mu g/m^3$)	$PM_{2.5}$ ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	CO (mg/m^3)	Hydrocarbon (ppm)	Hydrocarbon (as Non-Methane) ppm	VOC ($\mu g/m^3$)
15	17/11/26	94	55	6.5	21.2	0.45	0.95	<0.5	<2.08
16	17/11/29	70	34	5.2	26.5	0.33	1.24	<0.5	<2.08
17	17/12/3	92	51	4.2	15.2	0.65	0.98	<0.5	2.35
18	17/12/7	77	38	5.4	17.5	0.54	0.87	1.66	<2.08
19	17/12/11	95	56	6.7	24.5	0.25	0.86	1.88	<2.08
20	17/12/15	54	32	5.3	16.6	0.65	0.78	<0.5	<2.08
21	17/12/18	92	52	4.8	26.3	0.54	0.98	<0.5	<2.08
22	17/12/23	70	34	5.4	21.2	0.25	1.55	1.88	<2.08
23	17/12/26	78	37	6.3	23.7	0.55	0.95	<0.5	2.78
24	17/12/29	86	48	4.6	18.5	0.47	1.22	<0.5	<2.08
AAQ-3, Dhekiajuli Bengali									
1	17/10/5	77	41	5.2	18.5	0.41	0.69	<0.5	<2.08
2	17/10/9	65	35	5.8	16.6	0.33	1.06	<0.5	<2.08
3	17/10/13	87	51	6.5	17.5	0.60	0.92	<0.5	<2.08
4	17/10/17	97	56	6.8	26.6	0.67	0.75	<0.5	<2.08
5	17/10/21	89	51	6.2	24.7	0.58	0.63	<0.5	<2.08
6	17/10/25	85	42	5.7	18.5	0.41	1.02	<0.5	<2.08
7	17/10/28	74	40	5.4	20.2	0.48	0.70	<0.5	<2.08
8	17/11/1	80	44	6.4	22.9	0.55	0.91	<0.5	<2.08
9	17/11/5	71	37	5.6	16.5	0.25	1.22	<0.5	<2.08
10	17/11/9	102	55	6	20.2	0.33	0.98	<0.5	<2.08
11	17/11/12	79	42	6.2	12.2	0.52	1.33	<0.5	<2.08
12	17/11/16	86	46	6.8	24.6	0.15	1.22	<0.5	<2.08
13	17/11/20	122	58	5.7	19.9	0.49	0.80	<0.5	2.66
14	17/11/24	70	36	5.2	18.2	0.45	0.72	<0.5	<2.08
15	17/11/27	78	40	5.9	13.3	0.50	0.82	<0.5	<2.08
16	17/12/1	95	52	6.2	16.9	0.16	0.90	<0.5	<2.08
17	17/12/5	87	50	6.5	24.7	0.21	0.95	<0.5	<2.08
18	17/12/9	65	35	5.4	20.6	0.53	0.76	<0.5	<2.08
19	17/12/12	91	53	7.1	16.6	0.69	1.14	<0.5	<2.08
20	17/12/16	72	37	5.8	19.6	0.48	0.89	<0.5	<2.08
21	17/12/20	134	65	6.6	21.5	0.57	0.96	<0.5	<2.08
22	17/12/24	75	38	4.5	18.2	0.49	0.81	<0.5	<2.08
23	17/12/27	84	46	6.0	15.8	0.56	0.73	<0.5	<2.08
24	17/12/31	105	58	5.7	20.2	0.45	0.78	<0.5	2.36
AAQ-4, Dhupabor Maijan									
1	17/10/6	54	34	5.5	16.6	0.15	1.75	<0.5	<2.08
2	17/10/17	45	25	5.8	21.2	0.24	1.32	<0.5	<2.08
3	17/10/10	36	20	6.6	16.3	0.16	1.05	<0.5	<2.08
4	17/10/14	86	53	6.5	25.2	0.67	0.74	<0.5	<2.08

Sl. No.	Date of Monitoring	Concentration of Pollutants							
		PM_{10} (µg/m³)	$PM_{2.5}$ (µg/m³)	SO_2 (µg/m³)	NO_2 (µg/m³)	CO (mg/m³)	Hydrocarbon (ppm)	Hydrocarbon (as Non-Methane) ppm	VOC (µg/m³)
5	17/10/21	79	46	6	23.9	0.63	0.72	<0.5	<2.08
6	17/10/25	82	52	5.7	21.8	0.54	0.67	<0.5	<2.08
7	17/10/28	81	56	7.3	24.5	0.68	0.82	<0.5	<2.08
8	17/11/1	78	48	5.3	21.5	0.45	0.64	<0.5	<2.08
9	17/11/5	75	38	5.2	21.2	0.21	2.44	<0.5	<2.08
10	17/11/9	54	26	6.6	16.2	0.15	3.02	<0.5	<2.08
11	17/11/12	63	31	7.5	12.2	0.18	1.89	<0.5	<2.08
12	17/11/16	72	37	5.6	13.3	0.31	0.98	<0.5	<2.08
13	17/11/20	70	36	4.5	15.5	0.24	1.03	<0.5	<2.08
14	17/11/24	54	29	6.2	16.6	0.19	1.22	<0.5	<2.08
15	17/11/27	46	22	7.8	20.2	0.32	1.45	<0.5	<2.08
16	17/12/1	38	20	8.5	12.2	0.17	1.63	<0.5	<2.08
17	17/12/5	46	20	4.6	16.6	0.12	1.34	<0.5	<2.08
18	17/12/9	51	27	5.2	21.2	0.19	1.66	<0.5	<2.08
19	17/12/12	50	26	9.6	24	0.34	1.24	<0.5	<2.08
20	17/12/16	62	34	7.5	18.5	0.41	1.08	<0.5	<2.08
21	17/12/20	76	40	4.2	16.6	0.25	1.88	<0.5	<2.08
22	17/12/24	85	46	6.2	10.2	0.26	2.31	<0.5	<2.08
23	17/12/27	95	54	4.5	13.3	0.41	2.01	<0.5	<2.08
24	17/12/31	65	38	4.6	15.5	0.31	1.55	<0.5	<2.08
AAQ-5, Kanjikhowa									
1	17/10/6	78	30	7.2	15.5	0.45	0.97	<0.5	<2.08
2	17/10/10	48	25	8.3	16.6	0.5	0.95	<0.5	<2.08
3	17/10/14	62	37	4.5	20.2	0.48	1.22	<0.5	<2.08
4	17/10/17	70	37	5.8	24.6	0.58	0.67	<0.5	<2.08
5	17/10/21	68	36	5.2	23.7	0.53	0.72	<0.5	<2.08
6	17/10/25	82	48	6.7	25.8	0.67	0.78	<0.5	<2.08
7	17/10/28	79	45	6.3	22.7	0.65	0.75	<0.5	<2.08
8	17/11/1	62	37	5.2	19.6	0.45	0.62	<0.5	<2.08
9	17/11/5	72	38	5.8	16.6	0.32	2.22	<0.5	<2.08
10	17/11/9	81	45	5.5	17.5	0.18	1.66	<0.5	<2.08
11	17/11/12	54	27	4.2	18.5	0.24	1.55	<0.5	<2.08
12	17/11/16	46	24	4.6	12	0.26	1.20	<0.5	<2.08
13	17/11/20	55	27	6.5	24	0.32	2.30	<0.5	<2.08
14	17/11/24	42	23	4.8	21.2	0.24	2.15	<0.5	<2.08
15	17/11/27	58	30	5.7	16.6	0.45	1.55	<0.5	<2.08
16	17/12/1	64	35	4.8	24.5	0.32	1.60	<0.5	<2.08
17	17/12/5	75	37	5.2	20.2	0.25	1.20	<0.5	<2.08
18	17/12/9	68	36	6.2	23.3	0.24	1.55	<0.5	<2.08
19	17/12/12	52	27	7.5	16.6	0.31	1.54	<0.5	3.6

Sl. No.	Date of Monitoring	Concentration of Pollutants							
		PM_{10} (µg/m³)	$PM_{2.5}$ (µg/m³)	SO_2 (µg/m³)	NO_2 (µg/m³)	CO (mg/m³)	Hydrocarbon (ppm)	Hydrocarbon (as Non-Methane) ppm	VOC (µg/m³)
20	17/12/16	48	24	8.2	28.5	0.27	1.02	<0.5	<2.08
21	17/12/20	67	30	6.6	19.6	0.54	1.20	<0.5	<2.08
22	17/12/24	50	26	8.5	20.2	0.5	0.98	<0.5	<2.08
23	17/12/27	48	26	7.5	16.6	0.24	0.87	<0.5	<2.08
24	17/12/31	54	28	6.6	24.2	0.33	0.98	<0.5	<2.08
AAQ-6 Haribari Konwargaon									
1	17/10/5	48	26	5.8	14.5	0.20	1.25	<0.5	<2.08
2	17/10/9	42	23	6.4	13.6	0.21	2.03	<0.5	<2.08
3	17/10/13	36	20	4.9	18.0	0.32	1.96	<0.5	<2.08
4	17/10/16	92	56	4.7	20.4	0.29	1.08	<0.5	<2.08
5	17/10/20	54	26	5.6	26.6	0.27	1.02	<0.5	<2.08
6	17/10/23	95	52	6.5	24.7	0.63	0.73	<0.5	<2.08
7	17/10/28	86	47	5.8	21.3	0.56	0.56	<0.5	<2.08
8	17/10/31	74	42	5.3	18.7	0.47	0.43	<0.5	<2.08
9	17/11/3	63	45	5.7	15.3	0.52	2.36	<0.5	<2.08
10	17/11/8	98	57	6	22.7	0.57	0.68	<0.5	<2.08
11	17/11/12	83	48	5.4	19.8	0.45	0.56	<0.5	<2.08
12	17/11/16	54	27	4.6	23.3	0.32	1.66	<0.5	<2.08
13	17/11/18	50	24	6.2	16.6	0.16	1.5	<0.5	<2.08
14	17/11/22	64	34	8.5	10.2	0.24	2.33	<0.5	<2.08
15	17/11/27	48	26	7.5	14.5	0.18	2.02	<0.5	<2.08
16	17/11/30	51	27	4.5	15.5	0.32	1.55	<0.5	<2.08
17	17/12/3	46	24	6.2	13.3	0.24	1.04	<0.5	<2.08
18	17/12/8	62.00	34.00	4.80	15.50	0.23	2.09	<0.5	<2.08
19	17/12/12	38.00	21.00	5.60	15.50	0.15	0.98	<0.5	<2.08
20	17/12/16	48.00	25.00	6.20	24.20	0.18	0.87	<0.5	<2.08
21	17/12/18	75.00	40.00	7.50	26.60	0.24	1.24	<0.5	<2.08
22	17/12/22	62	33	5.1	21.0	0.33	1.06	<0.5	<2.08
23	17/12/27	43	23	4.5	17.5	0.29	1.04	<0.5	<2.08
24	17/12/30	88	45	4.6	18.2	0.24	1.23	<0.5	<2.08
AAQ-7, Oakland Tea Estate									
1	17/10/5	72	38	5.5	26.6	0.34	1.88	<0.5	<2.08
2	17/10/9	54	29	4.5	21.2	0.54	1.33	<0.5	<2.08
3	17/10/13	48	26	4.6	23.3	0.62	1.95	<0.5	<2.08
4	17/10/17	38	20	4.2	15.5	0.46	1.77	<0.5	<2.08
5	17/10/21	46	22	4.9	16.2	0.3	1.85	<0.5	<2.08
6	17/10/25	82	47	6.5	24.7	0.74	0.82	<0.5	<2.08
7	17/10/29	75	43	5.8	21.6	0.53	0.64	<0.5	<2.08
8	17/11/2	61	37	6.3	18.5	0.67	2.51	<0.5	<2.08
9	17/11/5	58	32	5.5	20.8	0.56	2.43	<0.5	<2.08

Sl. No.	Date of Monitoring	Concentration of Pollutants							
		PM_{10} ($\mu g/m^3$)	$PM_{2.5}$ ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	CO (mg/m^3)	Hydrocarbon (ppm)	Hydrocarbon (as Non-Methane) ppm	VOC ($\mu g/m^3$)
10	17/11/7	94	54	6.4	22.7	0.67	0.75	<0.5	<2.08
11	17/11/11	87	42	5.7	18.3	0.54	0.58	<0.5	<2.08
12	17/11/17	45	22	4.5	20.2	0.32	1.22	<0.5	<2.08
13	17/11/20	55	28	6.2	16.6	0.45	1.66	<0.5	<2.08
14	17/11/24	78	38	5.8	14.2	0.32	1.88	<0.5	<2.08
15	17/11/28	98	56	7.5	13.3	0.25	2.03	<0.5	<2.08
16	17/12/2	62	32	6.6	10.2	0.15	1.98	<0.5	<2.08
17	17/12/5	42	22	4.5	18.5	0.32	2.01	<0.5	<2.08
18	17/12/7	45	26	5.8	16.6	0.55	1.75	<0.5	<2.08
19	17/12/11	52	28	6.2	17.5	0.45	1.66	<0.5	<2.08
20	17/12/17	66	34	4.6	21.2	0.26	2.01	<0.5	<2.08
21	17/12/20	70	37	5.5	13.3	0.66	1.55	<0.5	<2.08
22	17/12/24	84	46	8.5	26.6	0.35	1.33	<0.5	<2.08
23	17/12/28	53	26	7.5	24.2	0.42	1.21	<0.5	<2.08
24	17/12/31	65	37	6.2	20.4	0.88	1.55	<0.5	<2.08
AAQ-8, Holoidhari									
1	17/10/6	65	36	6.5	13.3	0.26	0.98	<0.5	<2.08
2	17/10/10	78	35	6.2	11.2	0.30	1.22	<0.5	<2.08
3	17/10/14	45	24	4.5	12.2	0.35	1.36	<0.5	<2.08
4	17/10/18	58	29	5.8	19.6	0.29	2.3	<0.5	<2.08
5	17/10/21	62	30	4.3	13.3	0.45	0.97	<0.5	<2.08
6	17/10/24	84	47	6.4	23.7	0.62	0.72	<0.5	<2.08
7	17/10/27	72	43	5.7	22.8	0.54	0.65	<0.5	<2.08
8	17/11/1	68	38	6.6	19.5	0.68	2.58	<0.5	<2.08
9	17/11/4	79	45	5.3	17.4	0.63	1.97	<0.5	<2.08
10	17/11/9	82	37	6.8	21.7	0.58	0.63	<0.5	<2.08
11	17/11/13	97	53	7.2	24.5	0.67	0.75	<0.5	<2.08
12	17/11/15	58	30	5.2	16.6	0.21	1.66	<0.5	<2.08
13	17/11/19	68	37	5.6	20.2	0.31	2.02	<0.5	<2.08
14	17/11/23	62	34	6.3	15.5	0.25	1.5	<0.5	<2.08
15	17/11/26	38	20	4.5	14.2	0.19	0.98	<0.5	<2.08
16	17/12/1	75	36	4.8	13.3	0.23	0.76	<0.5	<2.08
17	17/12/4	48	26	6.6	15.2	0.24	1.66	<0.5	<2.08
18	17/12/9	32.00	20.00	7.20	11.20	0.16	1.28	<0.5	<2.08
19	17/12/13	65.00	34.00	8.20	12.20	0.19	2.33	<0.5	<2.08
20	17/12/15	45.00	26.00	6.60	13.30	0.33	1.88	<0.5	<2.08
21	17/12/19	44.00	25.00	4.50	14.50	0.21	1.99	<0.5	<2.08
22	17/12/23	54	27	5.8	16.6	0.18	2.1	<0.5	<2.08
23	17/12/26	38	19	8.2	20.2	0.34	2.66	<0.5	<2.08
24	17/12/31	35	20	7.5	15.5	0.40	3.22	<0.5	<2.08

Annexure 3.5

Noise Monitoring Results

Location Code		NQ-1	NQ-2	NQ-3	NQ-4	NQ-5	NQ-6	NQ-7	NQ-8	NQ-9	NQ-10	NQ-11	NQ-12	NQ-13	NQ-14
Location Name		Borguri Jurigure Road Site	Rungagora 13No	maijan Borsaikia gaon	Kanaigaon 1no	Garpara gaon 1no	Kanaigaon	Garapara Kunwar	Garapara Gaon	CHABUA	Bagritolia	Mudaigaon	panitola gaon	Mukulgaon	Piporatoli
Time (In Hrs.)	(00.00-01.00) hrs	37.5	37.4	38.3	39.2	39.8	38.3	40.9	40.7	41.5	44.0	38.3	38.4	41.1	41.7
	(01.00-02.00) hrs	40.4	40	41.9	39.3	45.6	41.9	45.8	40.8	37.8	41.0	37.7	35.9	44.8	42.0
	(02.00-03.00) hrs	39.2	39.3	43.3	45.0	41.7	43.3	45.3	43.8	41.4	42.7	36.1	35.8	42.9	45.0
	(03.00-04.00) hrs	38.6	38.8	41.3	44.4	42.6	41.3	44.3	36.6	42.2	38.0	36.1	35.8	42.9	45.0
	(04.00-05.00) hrs	40.3	39.3	42.6	41.3	43.2	42.6	44.3	36.2	43.0	41.8	36.1	35.8	42.9	45.0
	(05.00-06.00) hrs	40.5	40.7	45.3	43.9	39.2	45.3	42.9	41.3	43.7	43.6	44.6	42.8	45.1	44.2
	(10.00-11.00) hrs	54.9	50.2	54.3	53.2	49.2	54.3	49.4	53.8	53.6	53.6	55.7	53.2	55.5	53.0
	(11.00-12.00) hrs	47.6	56.1	53.5	55.8	54.0	53.5	46.3	55.0	55.3	55.1	56.6	55.4	57.9	51.1
	(12.00-13.00) hrs	51.7	50.3	54.1	53.5	58.4	54.1	49.2	55.7	57.9	57.4	59.4	52.1	55.4	52.4
	(13.00-14.00) hrs	51.7	50.5	54.0	59.3	54.8	54.0	57.5	54.5	59.3	57.5	58.3	56.9	58.3	57.4
	(14.00-15.00) hrs	53.4	61.7	56.8	57.7	56.1	56.8	58.8	59.9	54.8	52.7	55.7	56.1	59.4	54.9
	(15.00-16.00) hrs	52.6	47.3	61.1	53.2	56.5	61.1	57.0	56.6	51.8	53.7	57.7	55.0	54.0	54.0
	(16.00-17.00) hrs	44.7	46.6	49.1	53.2	55.7	49.1	57.2	58.3	49.9	49.4	52.0	55.8	53.9	56.9
	(17.00-18.00) hrs	55.5	48.9	49.1	48.2	57.5	49.1	52.7	46.8	47.9	47.3	49.6	52.1	50.2	53.4
	(18.00-19.00) hrs	57.6	56.4	52.7	48.0	55.9	52.7	56.9	46.3	46.7	47.6	50.2	52.5	48.6	57.0

Location Code	NQ-1	NQ-2	NQ-3	NQ-4	NQ-5	NQ-6	NQ-7	NQ-8	NQ-9	NQ-10	NQ-11	NQ-12	NQ-13	NQ-14
Location Name	Borguri Jurigure Road Site	Rungagora 13No	maijan Borsaikia gaon	Kanaigaon 1no	Garpara gaon 1no	Kanaigaon	Garapara Kunwar	Garapara Gaon	CHABUA	Bagritolia	Mudaigaon	panitola gaon	Mukulgaon	Piporatoli
(19.00-20.00) hrs	55.7	53.4	51.4	48.0	53.3	51.4	57.7	50.5	50.6	50.5	51.7	51.8	51.6	54.0
(20.00-21.00) hrs	49	46.8	52.7	53.6	57.2	52.7	56.7	52.3	53.8	54.4	52.9	50.5	52.4	56.9
(21.00-22.00) hrs	46.7	44.8	53.7	54.5	53.5	53.7	55.3	52.2	54.0	51.5	51.1	54.7	54.1	57.8
(22.00-23.00) hrs	45.6	42.4	53.3	54.6	54.0	53.3	49.0	52.0	55.1	55.1	53.2	54.6	53.2	52.5
(23.00-00.00) hrs	38.8	40.1	50.5	48.1	51.5	50.5	48.4	49.1	48.3	52.2	54.3	53.9	53.3	48.5
(6.00-7.00) hrs	46.1	45.2	47.1	44.8	41.1	47.1	43.2	45.9	48.6	46.0	50.8	50.1	43.6	48.3
(7.00-8.00) hrs	45.6	50.2	47.7	43.2	43.0	47.7	40.1	43.0	46.3	44.4	49.6	47.6	44.8	45.5
(8.00-9.00) hrs	54.4	47.1	43.3	38.5	42.9	43.3	42.5	37.7	41.9	42.1	48.3	43.2	38.8	40.2
(9.00-10.00) hrs	54.1	46.9	40.8	37.4	42.6	40.8	47.4	38.4	39.8	38.3	44.3	43.1	37.4	40.5

Annexure 3.6

CPCB Water Quality Criteria

Designated Best Use	Class of Water	Criteria
Drinking Water Source without conventional treatment but after disinfection	**A**	• Total Coliforms Organism MPN/100ml shall be 50 or less • pH between 6.5 and 8.5 • Dissolved Oxygen 6mg/l or more • Biochemical Oxygen Demand 5 days 20°C 2mg/l or less
Outdoor bathing (Organised)	**B**	• Total Coliforms Organism MPN/100ml shall be 500 or less pH between 6.5 and 8.5 Dissolved Oxygen 5mg/l or more • Biochemical Oxygen Demand 5 days 20°C 3mg/l or less
Drinking water source after conventional treatment and disinfection	**C**	• Total Coliforms Organism MPN/100ml shall be 5000 or less pH between 6 to 9 Dissolved Oxygen 4mg/lor more • Biochemical Oxygen Demand 5 days 20°C 3mg/l or less
Propagation of Wild life and Fisheries	**D**	• pH between 6.5 to 8.5 Dissolved Oxygen 4mg/l or more • Free Ammonia (as N) 1.2 mg/l or less
Irrigation, Industrial Cooling, Controlled Waste disposal	**E**	• pH between 6.0 to 8.5 • Electrical Conductivity at 25°C micro mhos/cm Max.2250 • Sodium absorption Ratio Max. 26 • Boron Max. 2mg/l

Annexure 3.7

Primary Traffic Monitoring Data

LOCATION : NH37 UP							
SL. NO.	TIME (Hours)	MOTORIZED VEHICLES			NON-MOTORIZED VEHICLES	TOTAL	PCU
		Heavy Motor Vehicles	Light Motor Vehicles	Two/Three Wheelers			
		(Truck,Bus,Dumper, Tanker,Trailer)	(Car,Jeep,Van,Metador, Tractor,Tempo,Mini Bus)	(Scooter, Motor Cycle, Auto, Moped)	(Bicycle, Tricycle)		
1	9.00-10.00	42	138	48	40	**268**	**497**
2	10.00-11.00	56	205	96	32	**389**	**730.2**
3	11.00-12.00	49	198	97	29	**373**	**690.5**
4	12.00-13.00	61	150	69	30	**310**	**604.7**
5	13.00-14.00	56	142	96	41	**335**	**593.4**
6	14.00-15.00	45	158	112	29	**344**	**600.5**
7	15.00-16.00	47	206	102	31	**386**	**705.5**
8	16.00-17.00	36	236	98	45	**415**	**732.6**
9	17.00-18.00	49	150	89	16	**304**	**575.9**
10	18.00-19.00	37	147	95	12	**291**	**531.3**
11	19.00-20.00	18	102	47	6	**173**	**326.2**
12	20.00-21.00	23	161	45	1	**230**	**470.9**
13	21.00-22.00	29	98	29	0	**156**	**340.3**
14	22.00-23.00	16	56	11	0	**83**	**188**
15	23.00-00.00	13	42	0	0	**55**	**137.9**
16	00.00-01.00	6	19	0	0	**25**	**62.8**
17	01.00-02.00	5	10	0	0	**15**	**39.5**
18	02.00-03.00	3	23	0	0	**26**	**61.1**
19	03.00-04.00	7	24	0	0	**31**	**77.3**
20	04.00-05.00	11	29	2	0	**42**	**103.9**
21	05.00-06.00	12	37	6	0	**55**	**128.2**
22	06.00-07.00	19	58	9	6	**92**	**202.5**
23	07.00-08.00	32	96	41	9	**178**	**357.8**
24	08.00-09.00	40	142	56	29	**267**	**503**
	Total	**712**	2627	**1148**	**356**	**4843**	**9261**

LOCATION : NH37 Down							
SL. NO.	TIME (Hours)	MOTORIZED VEHICLES			NON-MOTORIZED VEHICLES	TOTAL	PCU
		Heavy Motor Vehicles (Truck,Bus,Dumper, Tanker,Trailer)	Light Motor Vehicles (Car,Jeep,Van,Metador, Tractor,Tempo,Mini Bus)	Two/Three Wheelers (Scooter, Motor Cycle, Auto, Moped)	(Bicycle, Tricycle)		
1	9.00-10.00	41	140	92	49	**322**	**534.9**
2	10.00-11.00	37	158	64	32	**291**	**534.7**
3	11.00-12.00	52	198	98	41	**389**	**704.2**
4	12.00-13.00	62	168	102	31	**363**	**674.4**
5	13.00-14.00	72	154	97	37	**360**	**675.8**
6	14.00-15.00	58	237	112	41	**448**	**822.2**
7	15.00-16.00	62	210	160	32	**464**	**813.4**
8	16.00-17.00	65	201	158	58	**482**	**807.7**
9	17.00-18.00	41	126	160	19	**346**	**552.5**
10	18.00-19.00	39	124	132	12	**307**	**517.3**
11	19.00-20.00	42	196	98	6	**342**	**657.8**
12	20.00-21.00	19	206	64	3	**292**	**571.5**
13	21.00-22.00	36	144	38	0	**218**	**473.2**
14	22.00-23.00	58	150	32	0	**240**	**558.6**
15	23.00-00.00	60	98	17	0	**175**	**439.2**
16	00.00-01.00	1	16	0	0	**17**	**38.7**
17	01.00-02.00	2	12	0	0	**14**	**33.4**
18	02.00-03.00	12	46	0	0	**58**	**143.2**
19	03.00-04.00	6	41	0	0	**47**	**111.2**
20	04.00-05.00	16	112	14	0	**142**	**313.6**
21	05.00-06.00	21	132	19	0	**172**	**379.1**
22	06.00-07.00	19	140	29	7	**195**	**399.1**
23	07.00-08.00	19	156	42	36	**253**	**450.5**
24	08.00-09.00	42	162	58	41	**303**	**558**
Total		**882**	**3327**	**1586**	**445**	**6240**	**11764.2**

LOCATION : Panitola Dibrugarh Road (UP)							
SL. NO.	TIME (Hours)	MOTORIZED VEHICLES			NON-MOTORIZED VEHICLES	TOTAL	PCU
		Heavy Motor Vehicles	Light Motor Vehicles	Two/Three Wheelers			
		(Truck,Bus,Dumper, Tanker,Trailer)	(Car,Jeep,Van,Metador, Tractor,Tempo,Mini Bus)	(Scooter, Motor Cycle, Auto, Moped)	(Bicycle, Tricycle)		
1	9.00-10.00	45	145	58	36	**284**	**530.1**
2	10.00-11.00	29	110	93	29	**261**	**423.7**
3	11.00-12.00	49	96	97	58	**300**	**471.9**
4	12.00-13.00	50	91	68	29	**238**	**435.4**
5	13.00-14.00	60	132	91	30	**313**	**579.2**
6	14.00-15.00	65	158	110	40	**373**	**671.1**
7	15.00-16.00	42	210	102	56	**410**	**701.8**
8	16.00-17.00	56	198	110	32	**396**	**726**
9	17.00-18.00	40	124	96	18	**278**	**493.2**
10	18.00-19.00	38	158	95	11	**302**	**558.8**
11	19.00-20.00	19	112	41	6	**178**	**346.9**
12	20.00-21.00	20	98	32	1	**151**	**311.4**
13	21.00-22.00	54	132	16	0	**202**	**492.2**
14	22.00-23.00	19	102	9	0	**130**	**298.1**
15	23.00-00.00	28	96	2	0	**126**	**310.8**
16	00.00-01.00	16	56	0	0	**72**	**179.2**
17	01.00-02.00	2	11	0	0	**13**	**31.2**
18	02.00-03.00	21	9	0	0	**30**	**93.3**
19	03.00-04.00	44	39	0	0	**83**	**239.8**
20	04.00-05.00	40	42	0	0	**82**	**232.4**
21	05.00-06.00	39	96	16	6	**157**	**361.7**
22	06.00-07.00	27	95	38	17	**177**	**337.3**
23	07.00-08.00	28	112	96	36	**272**	**428.4**
24	08.00-09.00	36	141	122	41	**340**	**542**
----	**Total**	**867**	**2563**	**1292**	**446**	**5168**	**9795.9**

LOCATION : : Panitola Dibrugarh Road (Down)							
SL. NO.	TIME (Hours)	MOTORIZED VEHICLES			NON-MOTORIZED VEHICLES	TOTAL	PCU
		Heavy Motor Vehicles	Light Motor Vehicles	Two/Three Wheelers			
		(Truck,Bus,Dumper, Tanker,Trailer)	(Car,Jeep,Van,Metador, Tractor,Tempo,Mini Bus)	(Scooter, Motor Cycle, Auto, Moped)	(Bicycle, Tricycle)		
1	9.00-10.00	36	151	91	38	**316**	**538.6**
2	10.00-11.00	30	162	63	42	**297**	**520.2**
3	11.00-12.00	50	196	97	29	**372**	**689.6**
4	12.00-13.00	61	154	101	34	**350**	**639.9**
5	13.00-14.00	70	160	96	40	**366**	**681.8**
6	14.00-15.00	56	210	103	37	**406**	**747.8**
7	15.00-16.00	61	236	158	52	**507**	**869.5**
8	16.00-17.00	39	210	162	18	**429**	**731.7**
9	17.00-18.00	62	198	155	13	**428**	**779.2**
10	18.00-19.00	32	196	129	5	**362**	**647.4**
11	19.00-20.00	40	158	78	9	**285**	**551.8**
12	20.00-21.00	18	145	64	2	**229**	**433.6**
13	21.00-22.00	29	140	58	1	**228**	**456.1**
14	22.00-23.00	33	98	37	0	**168**	**360.7**
15	23.00-00.00	3	95	16	0	**114**	**232.3**
16	00.00-01.00	2	29	0	0	**31**	**70.8**
17	01.00-02.00	12	16	0	0	**28**	**77.2**
18	02.00-03.00	5	30	0	0	**35**	**83.5**
19	03.00-04.00	11	6	0	0	**17**	**51.7**
20	04.00-05.00	19	12	0	0	**31**	**92.9**
21	05.00-06.00	36	41	2	2	**81**	**218.2**
22	06.00-07.00	26	56	13	4	**99**	**225.4**
23	07.00-08.00	19	132	27	9	**187**	**380.3**
24	08.00-09.00	39	110	62	13	**224**	**430.7**
Total		**789**	**2941**	**1512**	**348**	**5590**	**10510.9**

Annexure 3.8

Formula for Calculation of IVI

Phytosociology provides frequency, abundance, density and Important Value Index (IVI) of plant species.

Importance value Index- IVI

The following formula was used to estimate the IVI

Frequency: Frequency of a species is determined as the number of individuals per sample plot.

$$\text{Frequency} = \frac{\textbf{\textit{Total number of individual of each species}}}{\textbf{\textit{Number of plots in which the species occured}}}$$

Density: Density is defined as the number of individuals of a species in a unit area and is an expression of the numerical strength of a species in a community. The density was calculated from the data sampled using the formula.

$$\text{Density} = \frac{\textbf{\textit{Total number of individuals}}}{\textbf{\textit{Total number of quadrates studied}}}$$

Dominance: It was calculated using Girth at Breast Height (GBH) in the following standard equation:

$$\text{Dominance/ Basal Area} = \mathbf{0.00007854} \times \boldsymbol{DBH^2}$$

Relative Density: Relative density (RD) is the study of numerical strength of a species in relation to total number of all species and is calculated as:

$$\text{Relative Density} = \frac{\textbf{\textit{Number of individuals of each species}}}{\textbf{\textit{Total number of individuals of all species}}} \boldsymbol{X\ 100}$$

Relative Dominance: The relative basal area was calculated using the following formula:

$$\text{Relative Dominance} = \frac{\textbf{\textit{Basal area of each species}}}{\textbf{\textit{Total basal area of all species}}} \boldsymbol{X\ 100}$$

Annexure 3.9

List of Plant Species Present in Study Area

Sl No.	Common Name	Scientific Name
	Trees	
1.	Ahat	*Ficus religlosa*
2.	Ajar	*Lagerstromia flosreginae*
3.	Am	*Mangifera indica*
4.	Amara	*Spondinis mangifera*
5.	Amora	*Spondias pinnata*
6.	Amsia	*Drimycarpus recemosus*
7.	Badam	*Mansonia dipikae*
8.	Bahat	*Artocarpus lakocha*
9.	Bajiou	*Dilenia Pentagyna*
10.	Ban aam	*Mangifera syhatica*
11.	Bandardima	*Dynoxlum binectariferum*
12.	Barpat	*Ailathus grandis*
13.	Barun	*Cretava magna*
14.	Bat	*Ficus benghalensis*
15.	Bhatghilla	*Croxylon indica*
16.	Bhelkar	*Trewia nudiflora*
17.	Bher	*Salix tetrasperma*
18.	Bhelu	*Tetrameles nudiflora*
19.	Bhomora	*Terminalia belerica*
20.	Bhomlati	*Symplocos spicata*
21.	Bogijam	*Eugenia jambos*
22.	Bogipoma	*Chikrassia tabularis*
23.	Bogori	*Ziziphus hodsonii*
24.	Bola	*Moras laevigate*
25.	Bon-am	*Mangifera sylvatica*
26.	Bon-bagari	*Zizyphus rugosas*
27.	Bob-jolokia	*Cryptocarya amygdalina*
28.	Bor-pat	*Gracinia pedunculata*
29.	Bual	*Cordial dichotoma*
30.	Chalmurga	*Hydnocarpus kurzii*
31.	Dalchini	*Cinnamomum zeylanicum*
32.	Desacham	*Artocarpus lakoocha*
33.	Dhuna	*Canarium bergalenses*
34.	Dimarce	*Ficus glometura*
35.	Dimoru	*Ficus hispida*

Sl No.	Common Name	Scientific Name
36.	Galranga	*Elaeocarpus rugosus*
37.	Gahari sopa	*Nassa scssiliflora*
38.	Gaharisopa	*Magnolia griffithii*
39.	Gendhlipoma	*Dysoxylum lamiltoonil*
40.	Gohora	*Premna bengalensis*
41.	Gomari	*Gmelina arborea*
42.	Gonsorai	*Cinnamomum glaucescens*
43.	Garumora	*Crypteronia paniculata*
44.	Haludsopa	*Adina oligocephala*
45.	Haludsaki	*Endosperum chinense*
46.	Hatipoila	*Pterospermum acerifolium*
47.	Hengunia	*Meliosma pinnata*
48.	Hingori	*Castanopsis indica*
49.	Hilikha	*Terminalia chebula*
50.	Hollock	*Terminalia myriocarpa*
51.	Hollong	*Dipterocarpus macrocarpus*
52.	Jaglo, Morolia	*Macaranga denticulate*
53.	Jalpai	*Elaeocarpus floribundus*
54.	Jamuk	*Eugenia jambolana*
55.	Jari	*Ficus benjamina*
56.	Jawa, Jhawa	*Holigarna longifolia*
57.	Jia	*Lannea grandis*
58.	Jinari, Kathbhaluka	*Podocarpus neriifolia*
59.	Joba-hingari	*Slonca assamica*
60.	Jutuli	*Altingia excelsa*
61.	Kadam	*Neolamarckia cadamba*
62.	Kanchan	*Bauhinia purpurnea*
63.	Karipan, kharipati Dimoru	*Ficus nervosa*
64.	Kathal	*Artocarpus heterophyllus*
65.	Kathalsopa	*Michelia manii*
66.	Khokon	*Duabanga grandiflora*
67.	Khorikadewa	*Artocarpus gomezianus*
68.	Koliori	*Mitrephora tomentosa*
69.	Koroi	*Albizia procera*
70.	Kuhir	*Bridelia retusa*
71.	Kurial, Kanchan	*Bauhinia prupurnea*

Sl No.	Common Name	Scientific Name
72.	Lati	*Amoora walllichii*
73.	Lemtern	*Gynocordia odorata*
74.	Leluk	*Beilschmiedia brandisii*
75.	Lamtem	*Gynocardia odorata*
76.	Lewa	*Engelhardtia spicata*
77.	Madar	*Erythrina variegata*
78.	Makai	*Shorea assamica*
79.	Maskoita	*Collicarpa arborea*
80.	Medelua, Mouhita	*Dalbergia assamica*
81.	Mekahi	*Phoebe cooperiana*
82.	Moj	*Albizia lucida*
83.	Morsal, Morahal	*Vatica lanceaefolia*
84.	Morolia	*Mallotus albus*
85.	Motanahar	*Pterosperumum lanceaefolium*
86.	Naga Dalchini, Paihunda	*Cinnamomum obtusifolium*
87.	Naga udal, Hirikh	*Sterculia guttata*
88.	Nahar	*Mesua ferrea*
89.	Odal	*Sterculia vilosa*
90.	Outenga	*Dillenia indica*
91.	Oxi	*Dillenia pentagyna*
92.	Pahari	*Sterculia alata*
93.	Panikadam	*Hymemodicton excelsum*
94.	Pan sopa	*Michelia Montana*
95.	Paroli	*Stereospermum chelonides*
96.	Phakdima, phulgamari	*Trema orientalis*
97.	Phulkata	*Styrax serrulatum*
98.	Phulsopa	*Manglietia insignis*
99.	Pichola	*Kydia calycina*
100.	Poma	*Cedrela toona*
101.	Ramanbih	*Asculus assamila*
102.	Rudrasksha	*Elaeocarpus shpaericus*
103.	Salang	*Sapium baccatum*
104.	Sam kathal	*Artocarpus chaplasha*
105.	Sationa	*Alstonia scholaris*
106.	Seleng	*Sapium beccatum*
107.	Silikha	*Terminalia chebula*

Sl No.	Common Name	Scientific Name
108.	Simolu	*Bombax ceiba*
109.	Simul	*Salmalia malabarica*
110.	Singori	*Castonopsis indica*
111.	Sisso	*Dalbergia sisso*
112.	Sirish	*Albizia lebbek*
113.	Sopa	*Michelia doltsopa*
114.	Tepor	*Garcinia xanthochymus*
115.	Tezpat	*Cinnamomum tamala*
116.	Thekera	*Garcinia* sp.
117.	Thutmala	*Garuga pinnata*
118.	Titasopa	*Michelia champaca*
119.	Thowthowa	*Dolouma hodsonii*
120.	Urium	*Bischofia javanica*
121.	Kasood	*Cassia siamea*
122.	Gamari	*Gmelina arborea*
123.	–	*Shonka arvenis*
124.	Kadamb	*Anthocephalus sinensis*
125.	Arjun	*Terminalia arjuna*
126.	Beal	*Aegle mermelos*
127.	Krishnachura	*Delonix regia*
128.	Indian Rosewood	*Dalbergia sisso*
129.	Peepal	*Ficus religiosa*
130.	Neem	*Azadirchta indica*
131.	Auri	*Acacia auriculoformis*
132.	Tokopat	*Livistonia jenkinsiana*
133.		*Albizia chinensis*
134.		*Areca catechu*
135.		*Cascabela thevetia*
136.		*Lagerstroemia speciosa*
137.		*Melia azedarach*
138.		*Mimusops elengi*
139.		*Pongamia pinnata*
	Herbs and Shrubs	
140.	Akan	*Calotropis gigantea*
141.	Bhang	*Cannabis sativa L.*
142.	Bahak	*Adhatoda vasica*

Sl No.	Common Name	Scientific Name
143.	Betibah	*Bambusa mastersii*
144.	Bhekuri	*Solanum indicum*
145.	Bogitara	*Alpinia allughas*
146.	Bajal bah	*Pseudostachyum polymorphum*
147.	Bon-madhuriam	*Pyrenaria barringtoniaefolia*
148.	Bon-pasala	*Sarauja roxburhil*
149.	Bhui amlokhi	*Phyllanthus nirumi*
150.	Bormanimuni	*Centella asiatica*
151.	Chorat	*Laportea cranulata*
152.	Daridiga	*Senna tora*
153.	Dhoptita	*Clerodendron infortunatum*
154.	Dighloti	*Litsaea salicifolia*
155.	Doronphul	*Leucas asperra*
156.	Dudh Bon	*Euphorbia hirta*
157.	Ekra, Bata	*Sclerostachya fusca*
158.	Eragoch	*Ricinus communis*
159.	Gerguatomol, ramtomot	*Pinanga gracilis*
160.	Haru manimuni	*Hydrocotyle rotundifolia*
161.	Hatikhoj	*Elephantopus scaber*
162.	Hauka bet	*Zalacca secunda*
163.	Heloch	*Antidesma ghaesembilla*
164.	Houke	*Calamus latifolius*
165.	Jati bet	*Calamus tenuis*
166.	Jarmoni bon	*Eupatorium odoratum*
167.	Jati bah	*Bambusa tulda*
168.	Jengum japipat	*Licuala peltata*
169.	Kanasimake	*Commelina benghalensis*
170.	Kehraj	*Eclipta alba*
171.	Kotahi bengena	*Sotanum myriacanthus*
172.	Lajukibon	*Mimosa pudica*
173.	Lejai bet	*Balamus floribundus*
174.	Lejai bet	*Calamus floribundus*
175.	Medelua	*Senna occidentalis*
176.	Phutkola	*Melastoma malabathricum*
177.	Raidang	*Calamus flagellum*
178.	Teeta bet	*Calamus leptospadix*

Sl No.	Common Name	Scientific Name
179.	Kasidoria	*Myrsine capitellata*
180.	–	*Osbekia* spp.
181.	Kaupat	*Phrynium placentarium*
182.	Borgitora	*Alpinea allughas*
183.	–	*Myrsine capitellata*
184.	Nal	*Phragmites karka*
185.	Sorat	*Laprotea crenulata*
186.	Kush	*Saccharum sponataneum*
187.	Patidoi	*Schumannianthus dichotomus*
188.	Makhioti	*Moghania strobilifera (Syn: Flemingia strobilifera)*
189.	Titaphul	*Phlogacanthus thyrsiflorius*
190.	Wkthoi, makal bak	*Bambusa pallidia*
191.		*Bergera koenigii*
192.		*Camelia sinensis*
193.		*Cleodendron viscosum*
194.		*Euphorbia sp.*
195.		*Hibiscus rosa-sinensis*
196.		*Lantena camera*
197.		*Tamarix gallica var. indica*
198.		*Ageratum conyzoids*
199.		*Colocasia esculenta*
200.		*Diplazium esculentum*
201.		*Dryopteris filix-mas*
202.		*Ipomoea fistulosa*
203.		*Leonurus sibiricus*
204.		*ludwigia parviflora*
205.		*Oxalis corniculata*
206.		*Polygonum hydropiper*
207.		*Polygonum* sp.
208.		*Pteris* sp.
209.		*Ranunculus sceleratus*
210.		*Solanum nigrum*
211.		*Solanum xanthocarpum*
212.		*Spilanthes acmella*
213.		*Zea mays*
	Grasses	

Sl No.	Common Name	Scientific Name
214.	Akashi Lata	*Cusceeta reflexa*
215.	Bhet	*Nymphaea nouchali*
216.	Bonguuti	*Chyrsopobon aciculatus*
217.	Borpuni	*Pistia stratiotes*
218.	Dubariban	*Cynodon dactylon*
219.	Harcupuni	*Hydrilla berticillata*
220.	Hignori	*Trapa natans*
221.	Kalmau Sak	*Ipomea aquatica*
222.	Khagori	*Phragmites karka*
223.	Kohua	*Saccharum Spontaneum*
224.	Kuhila	*Aeschynomene aspera*
225.	Mati Kaduri	*Altemanthera sessilis*
226.	Nal	*Arundo donax*
227.	Nikori	*Euryale ferox*
228.	Pani Lajuki	*Neptunia oberacea*
229.	Pmeteka	*Monochoria hastata*
230.	Raghumola	*Lauranthus longiflomas*
231.	Tarcc	*Alpinia allughas*
232.	Ulukher	*Imperata cylindrica*
	Climbers	
233.	Chonga lata	*Thunbergia coccinea*
234.	Datbijla, datbijli	*Dalbergia stipulacea*
235.	Dhindau-bagori lota	*Tapiria hirsute*
236.	Ghill, Barghilla/Ghila-lawa	*Entata phaseoloides*
237.	Gowalia lata	*Vitis latifolia*
238.	Hatamul	*Asparagus racemoses*
239.	Kanda Alu	*Dioscorea bulbifora*
240.	Kukua loti	*Thundergia grandiflora*
241.	Kapalphutalota	*Cardiospermus halicacabun*
242.	Mikania, manikilata	*Mikania micrantha*
243.	Nak-lati-lewa	*Bauhinia vahlii*
244.	Tikoni borua	*Byttneria aspera*
	Epiphytes	
245.		*Acampe papillosa (*
246.		*Acampe Regida*
247.		*Aerides multiflorum*

Sl No.	Common Name	Scientific Name
248.		*Aerides odoratum*
249.		*Aerides rosea*
250.		*Bulbopyllum delitescence*
251.		*Bulbophyllum odorantissum*
252.		*Celeisostoma appendiculatum*
253.		*Cleisosoma subulatum*
254.		*Cymbidium aloifolium*
255.		*Cymbidium bicolor*
256.		*Cymbidium dauanum*
257.		*Dendrobium aduncum*
258.		*Dendrobium aphyllum*
259.		*Dendrobium fimbriatum*
260.		*Dendrobium lituiflorum*
261.		*Dendrobium nobile*
262.		*Dendrobium moschatum*
263.		*Dendrobium transporens*
264.		*Eriea pubescens*
265.		*Eulophis hormushii*
266.		*Flickingeria fugax*
267.		*Gastrochilus calceotaris*
268.		*Gastrochilus dasypogon*
269.		*Gastrochilus inconspicum*
270.		*Habenria stenopetala*
271.		*Kingidium deliciosa*
272.		*Liparis longipes*
273.		*Luisa trichorhiza*
274.		*Micropero rostratum*
275.		*Oberonia iridifolia*
276.		*Papilionanthe terea*
277.		*Pholidota pallida*
278.		*Pronatocalpa undulatum*
279.		*Rhynocostylis albiflora*
280.		*Rhynostylis Retusa*
281.		*Robiquetia spathulata*
282.		*Zeuxine lindeyana*

Annexure 3.10

Reptilian Species Reported by the Forest Department

Sl No.	Common Name	Scientific Name	Wildlife Schedule
1	Indian or Ganges Softshell Turtle	*Nilssonia gangeticus*	I
2	Black softshell Turtle	*Nilssonia nigricans*	-
3	Indian Peacook Softshell Turtle	*Nilssonia hurum*	I
4	Narrow-headed softshell	*Chitra indica*	IV
5	Malayan Box Turtle	*Cuora amboinensis*	-
6	Oldham's Leaf Turtle	*Cyckemys oldhamii*	-
7	Spotted Pond Turtle	*Geoclemys hamiltonii*	I
8	Brown Roofed Turtle	*Pangshura smithii*	-
9	Assam Roofed Turtle	*Pangshura sulhetensis*	I
10	Indian Tent Turtle	*Pangshura trntoria*	I
11	Tricarinate Turtle	*Melanochelys tricarinata*	-
1	Diard's Blind Snake	*Typhlops diardii*	IV
2	Brahminy Blind Snake	*Ramphotyphlops brahminus*	IV
3	Burmese Rock Python	*Python molurus bivittatus*	I
4	Short-nosed Vine Snake	*Ahaetulla prasina*	IV
5	Buff-Striped Keelback	*Amphiesma stolata*	IV
6	Eastern Cat Snake	*Boiga siamensis*	IV
7	Copper-headed Trinket Snake	*Coelognathus radiatus*	IV
8	Ornate Flying Snake	*Chrysopelea ornata*	IV
9	Painted Bronzeback Tree Snake	*Dendrelaphis pictus*	IV
10	Common Wolf Snake	*Lycodon aulicus*	IV
11	White-Barred Kukri Snake	*Oligodon albocinctus*	IV
12	Smooth Water Snake	*Enhydris enhydris*	IV
13	Indo-Chinese Rat Snake	*Ptyas korros*	IV
14	Indian Rat Snake	*Ptyas mucosa*	II
15	Assam Snail Eater	*Pareas monticola*	IV
16	Mock Viper	*Psammodynastes pulverulentus*	IV
17	Red-mecked Keelback	*Rahabdophis subminiatus*	IV
18	Checkered Keelback	*Xenochrophis piscator*	II
19	Banded Krait	*Bungarus fasciatus*	IV
20	Black Krait	*Bongarus niger*	IV
21	Monocled Cobra	*Naja kaouthia*	II
22	King Cobra	*Ophiophagus hannah*	II
23	White-lipped Pit Viper	*Cryptelytrops albolabris*	

Sl No.	Common Name	Scientific Name	Wildlife Schedule
1	Indian Garden Lizard	*Calotes versicolor*	
2	Many-lined Grass Skink	*Eutropis multifasciata*	
3	Bronze Grass or Little Sun Skink	*Eutropis macularia*	
4	White spotted Supple Skink	*Lygosoma albopunctaum*	
5	Asian House Gecko	*Henidactylus franatus*	
6	Tikay Gecko	*Gekko gecko*	
7	Brook's House Gecko	*Hemidactylus*	
8	Bengal Monitor	*Varanus bengalensis*	I
9	Water Monitor	*Varanus salvator*	I

[Source: Management plan for Dibru-Saikhowa National Park and Bherjan-Borajan-Padumoni Wildlife Sanctuary

Annexure 3.11

Checklist of Avian Species Reported by the Forest Departmen

Sl No.	Common Name	Scientific Name
1	Black Francolin	*Francolinus Francolinus*
2	Swamp Francolin	*Francolinus gularis*
3	Common Quail	*Coturnix coturinx*
4	Rain Quail	*Coturnix coromandelica*
5	Blue-breasted Quail	*Coturnix chinensis*
6	Red Junglefowl	*Gallus gallus*
7	Kalij Pheasant	*Lophura leucomelanos*
8	Yellow-legged Buttonquail	*Turnix tanki*
9	Barred Buttonquail	*Turnix suscitatior*
10	Small buttonquail	*Turnix suylvatica*
11	Fulvous Whistling-duck	*Dendrocygna bicolor*
12	Lesser Whistling-duck	*Dendrocygna javanica*
13	Red -breasted Goose	*Branta ruficollis*
14	Bean Goose	*Anser fabalis*
15	Lesser White-fronted Goose	*Anser erythropus*
16	Greylag Goose	*Anser anser*
17	Bar-headed Goose	*Anser indicus*
18	Ruddy Shelduck	*Tadorna ferruginea*
19	Common Shelduck	*Tadorna tadorna*
20	White-winged Duck	*Cairina scutulata*
21	Comb Duck	*Sarkidiornis melanotos*
22	Cotton Pygmy-goose	*Nattapus coromandelianus*
23	Mandarin Duck	*Aix galericulata*
24	Gadwall	*Anas strepera*
25	Falcated Duck	*Anas falcate*
26	Eurasian Wigeon	*Anas penelope*
27	Mallard	*Anas platyrhnchos*
28	Spot-billed Duck	*Anas poecilorhyncha*
29	Nothern Shoveler	*Anas clypeata*
30	Northern Pintail	*Anas acuta*
31	Common Teal	*Anas crecca*
32	Baikal Teal	*Anas formosa*
33	Garganey	*Anas querquedula*
34	Long-tailed duck	*Clengula hyemalis*
35	Common Goldeneye	*Bucephala clangula*

Sl No.	Common Name	Scientific Name
36	Smew	*Mergellus albellus*
37	Red-rested Pochard	*Rhodonessa rufina*
38	Common Pochard	*Aythya ferina*
39	Ferruginous Pochard	*Aythya nyroca*
40	Baer's Pochard	*Aythya baeri*
41	Tufted Duck	*Aythya fuligula*
42	Greater Scaup	*Aythya marila*
43	Common Merganser	*Mergus merganser*
44	Eurasian Wryneck	*Jynx troquilla*
45	Speckled Piculet	*Picumnus innominatus*
46	White-browed Piculet	*Sasia ochracea*
47	Grey-capped Pygmy woodpecker	*Dendrocopos canicapillus*
48	Rufous Woodpecker	*Celeus brachyurus*
49	Fulvous-breasted Woodpecker	*Dendrocopos macei*
50	Lesser Yellownape	*Picus Chlorolophus*
51	Greater Yellownape	*Picus flavinucha*
52	Streak-throated Woodpecker	*Picus xanthopygaeus*
53	Grey-headed Woodpecker	*Picus canus*
54	Greater Flameback	*Chrysocolaptes lucidus*
55	Himalayan Flameback	*Dinopium shorii*
56	Pale-headed Woodpecker	*Gecinulus grantia*
57	Bay Woodpecker	*Blythipicus pyrrhotis*
58	Great Barbet	*Megalaima virens*
59	Lineated Barbet	*Megalaima lineate*
60	Blue-throated Barbet	*Megalaima asiatica*
61	Coppersmith Barbet	*Megalaima haemacephala*
62	Blue-eared Barbet	*Megalaima australis*
63	Oriental Pied Hornbill	*Anthracoceros albirostris*
64	Great Hornbill	*Buceros bicornis*
65	Common Hoopoe	*Upupa epops*
66	Red-headed Trogon	*Harpactes erythrocephalus*
67	Indian Roller	*Coracias benghalensis*
68	Dollarbird	*Eurystomus orientails*
69	Blyth's Kingfisher	*Alcedo hercules*
70	Common Kingfisher	*Alcedo atthis*

Sl No.	Common Name	Scientific Name
71	Blue-eared Kingfisher	*Alcedo meninting*
72	Stork-billed Kingfisher	*Halcyon capensis*
73	Ruddy Kingfisher	*Halcyon coromanda*
74	White-throated Kingfisher	*Halcyon smyrnensis*
75	Crested Kingfisher	*Megaceryle lugubris*
76	Pied Kingfisher	*Ceryle rudis*
77	Blue-bearded Bee-eater	*Nyctyornis ahtertoni*
78	Green Bee-eater	*Merops orientalis*
79	Blue-tailed Bee-eater	*Merops philippinus*
80	Chestnut-headed Bee-eater	*Merops leschenaulti*
81	Chestnut-winged Cuckoo	*Clamator coromandus*
82	Pied Cuckoo	*Clamator jacobinus*
83	Common Hawk Cuckoo	*Hierococcyx varius*
84	Large Hawk Cuckoo	*Hierococcyx sparverioides*
85	Eurasian Cuckoo	*Cuculus canorus*
86	Indian Cuckoo	*Cuculus micropterus*
87	Lesser Cuckoo	*Cuculus poliocephalus*
88	Banded Bay Cuckoo	*Cacomantis sonneratil*
89	Plaintive Cuckoo	*Cacomantis merulinus*
90	Grey-bellied Cuckoo	*Cacomantis passerinus*
91	Drongo Cuckoo	*Surniculus lugubris*
92	Asian koel	*Eudynamys scolopacea*
93	Green-billed Malkoha	*Phaenicophaeus tristis*
94	Asian Emerald Cuckoo	*Chrysococcyx maculatus*
95	Greater Coucal	*Centropus sinensis*
96	Lesser Coucal	*Centropus bengalensis*
97	Alexandrine Parakeet	*Psittacula eupatria*
98	Rose-ringed Parakeet	*Psittacula krameri*
99	Blossom-headed Parakeet	*Psittacula roseata*
100	Red-breasted Parakeet	*Psittacula alexandri*
101	Himalayan Swiftlet	*Collocalia brevirostris*
102	Asian Palm Swift	*Cypsiurus balasiensis*
103	Fork-tailed Swift	*Apus pacificus*
104	House Swift	*Apus affinis*
105	Alpine Swift	*Tachymarptis melba*
106	White-throated Needletail	*Hirondapus caudacutus*

Sl No.	Common Name	Scientific Name
107	Grass Owl	*Tyto capensis*
108	Barn Owl	*Tyto Alba*
109	Oriental bay Owl	*Phodilus bedius*
110	Oriental Scops Owl	*Otus sunia*
111	Collared Scops Owl	*Otus bakkamoena*
112	Eurasian Eagle Owl	*Bubo bubo*
113	Brown fish Owl	*Ketupa zeylonensis*
114	Tawny Fish Owl	*Ketupa flavipes*
115	Asian Barred Owlet	*Glaucidium cuculoides*
116	Jungle Owlet	*Glaucidium radiatum*
117	Collared Owlet	*Glaucidium brodiei*
118	Spotted Owlet	*Athene brama*
119	Brown Hawk Owl	*Ninox scutulata*
120	Short-eared Owl	*Asio flammeus*
121	Large-tailed	*Caprimulgus macrurus*
122	Indian Nightjar	*Caprimulgus asiaticus*
123	Grey Nightjar	*Caprimulgus indicus*
124	Rock Pigeon	*Columba livia*
125	Pale-capped Pigeon	*Columba punicea*
126	Oriental Turtle Dove	*Streptopelia orientalis*
127	Spotted Dove	*Streptopelia chinensis*
128	Red Collared Dove	*Streptoelia tranquebarica*
129	Eurasian Collared Dove	*Streptoelia decaocto*
130	Barred Cuckoo Dove	*Macropygia unchall*
131	Emerald Dove	*Chalcophaps indica*
132	Pompadour Green Pigeon	*Treron pompadora*
133	Thick-billed Green Pigeon	*Treron curvirostra*
134	Yellow-footed Green Pigeon	*Treron phoenicoptera*
135	Pin-tailed Green Pigeon	*Treron apicauda*
136	Wedge-tailed Green Pigeon	*Treron sphenura*
137	Green Imperial Pigeon	*Ducula aenea*
138	Mountain Imperial Pigeon	*Ducula badia*
139	Bengal Florican	*Houbaropsis bengalenisis*
140	Sarus Crane	*Grus antigone*
141	Common Carne	*Grus grus*

Sl No.	Common Name	Scientific Name
142	Masked Finfoot	*Heliopais peusonata*
143	Slaty-legged Crake	*Rallina eurixonoides*
144	Slaty-breasted Rail	*Gallirallus striatus*
145	Water Rail	*Rallus aquaticus*
146	White-breasted Waterhen	*Amaurornis phoenicurus*
147	Black-tailed Crake	*Porzana bicolor*
148	Ruddy-breasted Crake	*Porzana Fusca*
149	Brown Crake	*Porzana akool*
150	Watercock	*Gallicrex cinerea*
151	Purple Swamphen	*Porphyrio porophyrio*
152	Common Moorthen	*Gallinula chloropus*
153	Common Coot	*Fulica atra*
154	Pintail Snipe	*Gallinago atenura*
155	Common Snipe	*Gallinago gallinago*
156	Spotted Redshank	*Tringa eruthropus*
157	Common Tedshank	*Tringa totanua*
158	Common Greenshank	*Tringa nebularia*
159	Nordmann's Greenshank	*Tringa Guttifer*
160	Green Sandpiper	*Tringa ochropus*
161	Wood Sandpiper	*Tringa glareola*
162	Common Sandpiper	*Actitis hypoleucos*
163	Marsh Sandpiper	*Tringa stagnatilis*
164	Asian Dowitcher	*Limnodromus semipalmatus*
165	Temminck's Stint	*Calidris temminckil*
166	Ling-toed Stint	*Calidris minuta*
167	Little Stint	*Calidris minuta*
168	Whimbrel	*Numenius phaeopus*
169	Eurasian Curlew	*Numenius arquata*
170	Bar-tailed Godwit	*Limosa lapponica*
171	Greater painted-snipe	*Rostratula benghalensis*
172	Pheasant-winged Jacana	*Hydrophasianus chirurgus*
173	Bronze-winged Jacana	*Metopidius indicus*
174	Great Thick-knee	*Esacus recurvirostris*
175	Eurasian Thick-knee	*Burhinus oedicnemus*
176	Pied Avocet	*Recurvirostra avosetta*
177	Pacific Golden Plover	*Pluvialis fulva*
178	Little Ringed Plover	*Charadrius dubius*

Sl No.	Common Name	Scientific Name
179	Kentish Plover	*Charadrius alexandrius*
180	Eurasian Golden Plover	*Pluvialis apricaria*
181	Long-billed Plover	*Charadrius placidus*
182	Black-winged Stilt	*Himantopus himantopus*
183	Northern Lapwing	*Vanellus canellus*
184	River Lapwing	*Vanellus duvaucelii*
185	Grey-headed Lapwing	*Vanellus cinereus*
186	Red-wattled Lapwing	*Vanellus indicus*
187	Small Pratincole	*Glareola lactea*
188	Pallas's Gull	*Larus ichthyaetus*
189	Brown-headed Gull	*Larus brunnicephalus*
190	Black-headed Gull	*Larus ridibundus*
191	River Tern	*Sterna aurantia*
192	Whiskered Tern	*Chlidonias hybridus*
193	Black-bellied Tern	*Sterna acuticauda*
194	Osprey	*Pandion haliaetus*
195	Jerdon's Baza	*Aviceda jerdoni*
196	Black Baza	*Aviceda leuphotes*
197	Oriental Honey-buzzard	*Pernis ptilorhyncus*
198	White-eyed Buzzard	*Butastur teesa*
199	Black-shouldered Kite	*Elanus caeruleus*
200	Black Kite	*Milvus migrans*
201	Brahminy Kite	*Haliastur indus*
202	White-tailed Eagle	*Haliaeetus albicilla*
203	Pallas's Fish Eagle	*Haliaeetus leucoryphus*
204	Lesser Fish Eagle	*Ichthyophaga humilis*
205	Grey -headed Fish Eagle	*Ichthyophaga ichthyaetus*
206	Benelli's Eagle	*Hieraaetus fasciatus*
207	Booted Eagle	*Hieraaeatus pennatus*
208	Rufous-billed Eagle	*Hieraaeatus kienerii*
209	Black Eagle	*Ictinaetus malayensis*
210	White-tailed Eagle	*Haliaeetus alvicilla*
211	White-rumped Vulture	*Gyps bengalensis*
212	Slender-billed Vulture	*Gyps tenvirostris*
213	Himalayan Griffon	*Gyps himalayansis*
214	Red-headed Vulture	*Sarcogyps calvus*
215	Cinereous Vulture	*Aegypius monachus*

Sl No.	Common Name	Scientific Name
216	Short-toed Snake Eagle	*Circaetus gallicus*
217	Crested Serpent Eagle	*Spilornis cheela*
218	Eurasian Marsh Harrier	*Circus aeruginosus*
219	Hen Harrier	*Circus cyaneus*
220	Pallid harrier	*Circus macrourus*
221	Pied Harrier	*Circus melanoleucos*
222	Crested Goshawk	*Accipiter trivirgatus*
223	Shikra	*Accipiter badius*
224	Besra	*Accipiter virgatus*
225	Eurasian Sparrowhawk	*Accipiter nisus*
226	Japanese Sparrowhawk	*Accipiter gularis*
227	Common Buzzard	*Buteo buteo*
228	Greater Spotted Eagle	*Aqyuila clanga*
229	Changeable Hawk Eagle	*Spizaetus cirrhatus*
230	Mountain Hawk Eagle	*Spizaetus nipalensis*
231	Pied Falconet	*Microhierax melanoleucus*
232	Lesser Kestrel	*Falco naumanni*
233	Common Kestrel	*Falco tinnunculus*
234	Red-necked Falcon	*Falco chicquera*
235	Amur Falcon	*Falco amurensis*
236	Oriental Hobby	*Falco severus*
237	Eurasian Hobby	*Falco subbuteo*
238	Peregrine Falcon	*Falco peregrinus*
239	Little Grebe	*Tachybaptus ruficollis*
240	Great Crested Grebe	*Podiceps cristaus*
241	Black-necked Grebe	*Podiceps nigricollis*
242	Darter	*Anhinga melanogaster*
243	Little Cormorant	*Phalacrocorax niger*
244	Indian Cormorant	*Phalacrocorax fuscicollis*
245	Great Cormorant	*Phalacrocorax carbo*
246	Little Egret	*Egretta garzetta*
247	Grey Heron	*Ardea cinerea*
248	Purple Heron	*Ardea Purpurea*
249	White-bellied Heron	*Ardea insignis*
250	Great Egret	*Casmerodius albus*
251	Intermediate Egret	*Mesophoyx intermedia*
252	Cattle Egret	*Bubulcus ibis*

Sl No.	Common Name	Scientific Name
253	Indian Pond Heron	*Ardeola Grayii*
254	Little Heron	*Butorides striatus*
255	Black-crowned Night Heron	*Nycticorax nycticorax*
256	Malayan Night Heron	*Gorsachius melanolophus*
257	Little Bittern	*Ixobrychus minutus*
258	Yellow Bittern	*Ixobrychus sinensis*
259	Cinnamon Bittern	*Ixobrychus cinnamomeus*
260	Black Bittern	*Dupetor flavicollis*
261	Glossy lbis	*Plegadis falcinellus*
262	Eurasian Spoonbill	*Platalea leucorodia*
263	Great White Pelican	*Pelecanus onocrotalus*
264	Spot-billed Pelican	*Pelecanus philippensis*
265	Asian Openbill	*Anastomus Oscitans*
266	Black Stork	*Ciconia nigra*
267	Woolly-necked Stork	*Ciconia episcopus*
268	Black-necked Stork	*Ephippiorhynchus asiaticus*
269	Painted Stork	*Mycteria leucocephala*
270	White Stork	*Ciconia ciconia*
271	Lesser Adjutant	*Leptoptilos javanicus*
272	Greater Adjutant	*Leptotilos dubius*
273	Hooded Pitta	*Pitta sordida*
274	Long-tailed Broadbill	*Psarisomus dalhousiae*
275	Silver-breasted Broadbill	*Serilophus lunatus*
276	Asian Fairy Bluebird	*Irena puella*
277	Blue-winged Leafbird	*Chloropsis cocohinchinensis*
278	Golden-fronted Leafbird	*Chloropsis aurifrons*
279	Orange-bellied Leafbird	*Chloropsis hardwickii*
280	Brown Shrike	*Lanius cristatus*
281	Long-tailed Shrike	*Lanius schach*
282	Grey-backed Shrike	*Lanius tephronotus*
283	Common Green Magpie	*Cissa chubebsis*
284	Rufous Treepie	*Dendrocitta vagabunda*
285	Grey Treepie	*Dendrocitta formosae*
286	House Crow	*Carvus splendens*
287	Large-billed Crow	*Carvus macrohynchos*
288	Ashy Woodswallow	*Artamus fascus*

Sl No.	Common Name	Scientific Name
289	Black-hooded Oriole	*Oriolus xanthornus*
290	Maroon Oriole	*Oriolus traillii*
291	Large Cuckooshrike	*Coracina macel*
292	Black-winged Cukooshrike	*Coracina melaschistos*
293	Rosy Minivet	*Pericrocotus roseus*
294	Small Minivet	*Pericrocotus cinnamomeus*
295	Long-tailed Minivet	*Pericrocotus ethologus*
296	Short-billed Minivet	*Pericrocotus brevirostris*
297	Scarlet Minivet	*Pericrocotus flammeus*
298	Bar-winged Flycatcher-shrike	*Hemipus picatus*
299	White-throated Fantail	*Rhipifura albicollis*
300	Black Drongo	*Dicrurus macrocercus*
301	Ashy Drongo	*Dicrurus leucophaeus*
302	Crow-billed Drongo	*Dicrurus annectans*
303	Bronzed Drongo	*Dicrurus aeneus*
304	Lesser Racket-tailed Drongo	*Dicrurus remifer*
305	Spangled Drongo	*Dicrurus hottentottus*
306	Greater Racket-tailed Drongo	*Dicrurus paradiseus*
307	Black-naped Monarch	*Hypothymis azurea*
308	Asian Paradise-flycatcher	*Terpsiphone paradisi*
309	Common lora	*Aegithina tiphia*
310	Large Woodshrike	*Tephrodornis gularis*
311	Common Woodshrike	*Tephrodornis pondicerianus*
312	Blue Rock Thrush	*Monticola solitarius*
313	Chestnut-billed Rock Thrush	*Monticola rufiventris*
314	Blue Whistling Thrush	*Myophonus caeruleus*
315	Orange-headed Thrush	*Zoothera citrina*
316	Dark-sided Thrush	*Zoothera marginata*
317	Scaly Thrush	*Zoothera dauma*
318	Tickell's Thrush	*Turdus unicolor*
319	Black-breasted Thrush	*Turdus dissimilis*
320	Chestnut Thrush	*Turdus rubrocanus gouldi*
321	Dark-throated Thrush	*Turdus ruficollis*
322	Dusky Thrush	*Turdus naumanni*

Sl No.	Common Name	Scientific Name
323	Grey-winged Blackbird	*Turdus boulboul*
324	Lesser Shortwing	*Brachypteryx leucophrys*
325	Ferruginous Flycatcher	*Muscicapa ferruginea*
326	Red-throated Flycatcher	*Ficedula parva*
327	Snowy-browed Flycatcher	*Ficedula hyperythra*
328	Little Pied Flycatcher	*Ficedula westermanni*
329	Slaty-blue Flycatcher	*Ficedula tricolor*
330	Sapphire Flycatcher	*Ficedula sapphira*
331	Verditer Flycatcher	*Eumyias thalassina*
332	Large Niltava	*Niltava grandis*
333	Small Niltava	*Niltava macgrigoriae*
334	Rufous-bellied Niltava	*Niltava sundara*
335	Pale-blue Flycatcher	*Cyornis unicolor*
336	Pale-chinned Flycatcher	*Cyornis poliogenys*
337	White-throated Fantail Flycatcher	*Phipidura albicollis*
338	Grey-headed Canary Flycatcher	*Culicicapa ceylonensis*
339	Siberian Rubythroat	*Luscinia callliope*
340	White-tailed Rubythroat	*Luscinia pactoralis*
341	Bluethroat	*Luscinia svecica*
342	Firethroat	*Luscinia pectardents*
343	Oriental Magpie Robin	*Copsychus saularis*
344	White-rumped Shama	*Copsychus ochruros*
345	Black Redstart	*Phoenicurus hodgsoni*
346	Hodgson's Redstart	*Phoenicurus Hodgsoni*
347	Daurian Redstart	*Phoenicurus auroreus*
348	Blue-fronted Redstart	*Phoenicurus frontalis*
349	Plumbeous Redstart	*Rhyacornis fuliginosus*
350	White-capped Water Redstart	*Chaimarrornis leucocephalus*
351	White-tailed Robin	*Myiomela leucura*
352	Black-backed Forktail	*Enicurus immaculatus*
353	Hodgson's Bushchat	*Saxicola insignis*
354	Siberian Stonechat	*Saxicola maura*
355	White-tailed Stonechat	*Saxicola leucura*
356	Jerdon's Bushchat	*Saxicola jerdoni*
357	Common Stonechat	*Saxicola torquata*

Sl No.	Common Name	Scientific Name
358	Grey bushchat	*Sxicola ferrea*
359	Spot-winged Starling	*Saroglossa spiloptera*
360	Chestnut-tailed Starling	*Sturnus malabaricus*
361	Brahminy Starling	*Sturnus pagodarum*
362	Asian Pied Starling	*Sturnus contra*
363	Common Starling	*Sturnus vulgaris*
364	Common Myna	*Acridotheres tristis*
365	Bank Myna	*Acridotheres ginginianus*
366	Jungle Myna	*Acridotheres fuscus*
367	White-Vented Myna	*Acridotheres cinereus*
368	Common Hill Myna	*Gracula religiosa*
369	Chestnut-bellied Nuthatch	*Sitta castanea*
370	Velvet-fronted Nuthatch	*Sitta frontalis*
371	Great Tit	*Parus major*
372	Sultan Tit	*Melanochlora sultanea*
373	Pale Martin	*Riparia diluta*
374	Sand Martin	*Riparia riparia*
375	Plain Martin	*Riparia paludicola*
376	Barn Swallow	*Hirundo rustica*
377	Red-rumped Swallow	*Hirundo daurica*
378	Striated Swallow	*Hirundo striolata*
379	Black-crested Bulbul	*Pycnonotus melanicterus*
380	Red-whiskered Bulbul	*Pycnonotus jocosus*
381	Red-vented Bulbul	*Pycnonotus cafer*
382	Ashy Bulbul	*Hemixos flavala*
383	Black Bulbul	*Hypsipetes leucociphalus*
384	Whited-throated Bulbul	*Alophixus flaveolus*
385	Zitting Cisticola	*Cisticola joncidis*
386	Bright-headed Cisticola	*Cisticola exilis*
387	Rufous-vented (Swamp) Prinia	*Prinia burnesii cinerascens*
388	Grey-breasted Prinia	*Prinia hodgsonii*
389	Yellow-bellied Prinia	*Prinia flaviventris*
390	Plain Prinia	*Prinia inornata*
391	Graceful Prinia	*Prinia gracilis*
392	Ashy Prinia	*Prinia socialis*

Sl No.	Common Name	Scientific Name
393	Jungle Prinia	*Prinia sylvatica*
394	Oriental White-eye	*Zosterops palpebrosus*
395	Slaty-bellied Tesia	*Tesia olivea*
396	Grey-bellied tesia	*Tesia cyaniventer*
397	Pale-footed Bush Warbler	*Cettia pallidipes*
398	Brownish-flanked Bush Warbler	*Cettia fortipes*
399	Chestnut-crowned Bush Warbler	*Cettia major*
400	Aberrant Bush Warbler	*Cettia flavolivacea*
401	Grey-sided Bush Warbler	*Cettia brunnifrons*
402	Spotted Bush Warbler	*Bradypterus thoracicus*
403	Chinese Bush Warbler	*Bradypterus tacsanowskius*
404	Russet Bush Warbler	*Bradypterus seebohmi*
405	Paddyfield Warbler	*Acrocephalus agricola*
406	Blunt-winged Warbler	*Acrocephalus concinens*
407	Blyth's Reed Warbler	*Acrocephalus dumetorum*
408	Clamorous Reed Warbler	*Acrocephalus stentoreus*
409	Thick-billed Warbler	*Acrocephalus aedon*
410	Oriental Reed Warbler	*Acrocephalus orientalis*
411	Black-browed Reed Warbler	*Acrocephalus bistrigiceps*
412	Lesser Whitehroat	*Sylvia curruca*
413	Mountain Tailorbird	*Orthotomus cuculatus*
414	Common Tailorbird	*Orhotomus sutorius*
415	Dark-necked Tailorbird	*Orthotomus atrogularis*
416	Dusky Warbler	*Phylloscopus fuscatus*
417	Smoky Warbler	*Phylloscopus fuligiventer*
418	Tickell's Leaf Warbler	*Phylloscopus affinis*
419	Greenish Warbler	*Phylloscopus trochiloides*
420	Large-billed Leaf Warbler	*Phylloscopus magnirostris*
421	Blyth's Leaf Warbler	*Phylloscopus reguloides*
422	Yellow -vented Warbler	*Phylloscopus cantator*
423	Yellow-browed Warbler	*Phylloscopus inornatus*
424	Hume's Warbler	*Phylloscopus humei*
425	Ashy-throated Warbler	*Phylloscopus maculipennis*
426	Eastern Crowned Warbler	*Phylloscopus coronatus*
427	Common Chiffchaff	*Phylloscopus collybita*

Sl No.	Common Name	Scientific Name
428	Golden-hooded Warbler	*Seicercus burkil*
429	Grey-hooded Warbler	*Seicercus xanthoschistos*
430	White-spectacled Warbler	*Seicercus affinis*
431	Grey-cheeked Warbler	*Seicercus poliogenys*
432	Chestnut-crowned Warbler	*Seicercus*
433	Rufous-faced Warbler	*Abroscopus albogularis*
434	Yellow-bellied Warbler	*Abroscopus superciliaris*
435	Striated Grassbird	*Megalurus palustris*
436	Bristed Grassbird	*Chaetomis striatus*
437	Rufous-rumped Grassbird	*Graminicola bengalensis*
438	Lesser Neckaced Laughingthrush	*Garrulax monileger*
439	Greater Necklaced Laughingthrush	*Garrulax pectoralis*
440	Rufous-necked Laughingthrush	*Garrulas ruficolis*
441	Abbott's Babbler	*Malacocincla abbotti*
442	Buff-breasted Babbler	*Pellorneum tickelli*
443	Marsh Babbler	*Pellorneum palustre*
444	Puff-throated Babbler	*Pellorneum rificeps*
445	Spot-throated Babbler	*Pellorneum albiventre*
446	White-browed Scimitar Babbler	*Pomstorhinus schisticeps*
447	Pygmy Wren-Babbler	*Pnoepyga pusilla*
448	Rufous-fronted Babbler	*Stachyris rufifrons*
449	Grey-throated Babbler	*Stachyis nigriceps*
450	Striped Tit Babbler	*Macronous gularis*
451	Chestnut-capped Babbler	*Timalia pileata*
452	Jerdon's Babbler	*Chrysomma altirostre*
453	Yellow-eyed Babbler	*Chrysomma sinense*
454	Striated Babbler	*Turdoides earlei*
455	Slender-billed Babbler	*Turdoides longirostris*
456	Jungle Babbler	*Turdoides striatus*
457	White -hooded Babbler	*Gampsorhynchus rufulus*
458	Nepal Fulvetta	*Alcippe nipalensis*
459	White-bellied yuhina	*Yohina zantholeuca*
460	Black-breasted Parrotbill	*Paradoxomis*
461	Red-tailed Munia	*Minla ignotincta*

Sl No.	Common Name	Scientific Name
462	Bengal Bushlark	*Mirafra assamica*
463	Send Lark	*Calandrella raytal*
464	Oriental Skylark	*Alauda gulgula*
465	Yellow-cented Flowerpecker	*Dicaeum chrysorrheum*
466	Pale-billed Flowerpecker	*Dicaeum erythrorhynchos*
467	Fire-breasted Flowerpecker	*Dicaeum ignipectus*
468	Scarlet-becked Flowerpecker	*Dicaeum cruentatum*
469	Plain Flowerpecker	*Dicaeum concolor*
470	Ruby-cheeked Sunbird	*Anthreptes singltensis*
471	Purple Sunbird	*Nectarinia asiatica*
472	Crimson Sunbird	*Aethopyga siparaja*
473	Black-throated sunbird	*Aethopyga saturata*
474	Streaked Spiderhunter	*Arachnothera magna*
475	House Sparrow	*Passer domesticus*
476	Eurasian Tree Sparrow	*Passer montanus*
477	Forest Wagtail	*Dendronanthus indicus*
478	White-Wagtail	*Motacilla alba*
479	White-browed Wagtail	*Motacilla maderaspatensis*
480	Citrine Wagtail	*Motacilla citreola*
481	Yellow Wagtail	*Motacilla flava*
482	Grey Wagtail	*Motacilla cinerea*
483	Richard's Pipit	*Anthus richardi*
484	Paddyfield Pipit	*Anthus rufulus*
485	Blyth's Pipit	*Anthus godlewskii*
486	Tree Pipit	*Anthus trivialis*
487	Olive-backed Pipit	*Anthus hodgsoni*
488	Rosy Pipit	*Anthus roseatus*
489	Buff-bellied Pipit	*Anthus rubescens*
490	Black-breasted Weaver	*Ploceus benghalensis*
491	Streaked Weaver	*Ploceus manyar*
492	Baya Weaver	*Ploceus philippinus*
493	Finn's Weaver	*Ploceus megarhynchus*
494	Red Avadavat	*Amandava amandava*
495	Scaly-breasted Munia	*Lonchura punctulata*
496	Black-headed Munia	*Lonchura malacca*

Sl No.	Common Name	Scientific Name
497	White-rumped Munia	*Lonchura striata*
498	Common Rosefinch	*Carpodacus erythrinus*
499	Chestnut-eared Bunting	*Emberiza fucata*
500	Little-Bunting	*Emberiza pusilla*
501	Yellow-breasted Bunting	*Emberiza aureola*
502	Black-faced Bunting	*Emberiza apodocephala*

Source: Management plan for Dibru-Saikhowa National Park and Bherjan-Borajan-Padumoni Wildlife Sanctuary

Annexure 3.12

Mammalian Species Reported by the Forest Department

Sl No.	Common Name	Scientific Name	Wildlife Schedule
1.	Chinese pangolin	*Manis pentadactyla*	I
2.	Himalayan Mole, Indian Short-tailed Mole, Eastern mole	*Talpa micrura*	-
3.	House shrew, Grey Musk Shrew	*Suncus murinus*	-
4.	Indian Flying Fox	*Pteropus giganteus*	IV
5.	Slow loris	*Nycticebus bengalensis*	I
6.	Northern pig-tailed macaque	*Macaca leonina*	II
7.	Assamese macaque	*Macaca assamensis*	II
8.	Rhesus macaque	*Macaca mulatta*	II
9.	Capped langur	*Trachypithecus pileatus*	I
10.	Western Hoolock Gibbon	*Hoolock hoolock*	I
11.	Wild dog	*Cuon alpinus*	II
12.	Golden jackal	*Canis aureus*	II
13.	Sloth Bear	*Melursus ursinus*	I
14.	Eurasian Otter	*Lutra lutra*	II
15.	Small Indian Civet	*Viverricula indica*	II
16.	Small Asian Mongoose	*Herpestes javanicus*	I
17.	Indian Grey Mongoose	*Herpestes edwardsii*	II
18.	Jungle cat	*Felis chaus*	II
19.	Leopard cat	*Prionailurus bengalensis*	I
20.	Clouded leopard	*Neofelis nebulosa*	I
21.	Leopard	*Panthera pardus*	I
22.	Tiger	*Panthera tigris*	I
23.	Gangetic dolphin	*Platanista gangetica*	I
24.	Asian Elephant	*Elephas maximus*	I
25.	Eurasian Wild pig of Wild boar	*Sus scrofa*	III
26.	Sambar	*Rusa unicolor*	III
27.	Hog deer	*Axis porcinus*	III
28.	Barking deer	*Muntiacus muntjak*	III
29.	Indian Water Buffalo	*Bubalus arnee*	I
30.	Malayan or Black Giant Squirrel	*Ratufa bicolor*	II
31.	Pallas's Squirrel	*Callosciurus erythraeus*	-
32.	Himalayan Hoary-bellied squirrel	*Callosciurus pygerythrus*	-
33.	Red Giant Flying Squirrel	*Petaurista petaurista*	-
34.	Particoloured Flying Squirrel	*Hylopetes alboniger*	II
35.	Malayan or Himalayan Crestless Porcupine	*Hystrix brachyura*	-
36.	Indian Hare	*Lepus nigricollis*	II

Source: Management plan for Dibru-Saikhowa National Park and Bherjan-Borajan-Padumoni Wildlife Sanctuary

Annexure 3.13:

Checklist of Fishes in the Study Area

S No	Scientific Name	Common Name
1.	*Amplypharyngodon mola*	Mowa
2.	*Anabas testudineus*	Koi
3.	*Catla catla*	Bhokua
4.	*Chanda nama*	Chanda
5.	*Chanda nama*	
6.	*Chanda ranga*	Chanda
7.	*Channa gachua*	Cheng
8.	*Channa marulius*	Sal
9.	*Channa striatus*	Shal
10.	*Cirrhinus reba*	
11.	*Clarius batrachus*	Magur
12.	*Colisa fasciatus*	Kholiana
13.	*Heteropneustes fossilis*	Singhi
14.	*Labeo rohita*	Bahu
15.	*Labeo bata*	Bhangon
16.	*Labeo calbasu*	Mali
17.	*Labeo rohita*	Rohu
18.	*Mastacembelus armatus*	Bami
19.	*Monopterus cuchia*	Kuchia
20.	*Mystus tengara*	
21.	*Mystus vittatus*	Lalthenga
22.	*Nandus nandus*	
23.	*Notopterus notopterus*	
24.	*Ompok pabda*	
25.	*Ompok bimaculatus*	
26.	*Osteobrama cotio cotio*	
27.	*Puntius sarana*	
28.	*Puntius ticto*	
29.	*Puntius chola*	Puthi
30.	*Puntius conchonius*	Puthi
31.	*Rita rita*	
32.	*Wallago attu*	Borali
33.	*Xenentodon cancila*	Kokila

Source: Secondary Data from Local People

Annexure 3.14

Demographic Profile of the Study Area Villages

Sl No.	Villages	No. of Household	Total Population	Household Size	% of Male Population	% of Female Population	Sex Ratio	% SC Population	% of ST Population
1	Mothola 5/142 Orr	137	554	4.04	53.43	46.57	872	0.00	2.89
2	Kandulibari Grant 4 No.F.S.16 NLR	901	4405	4.89	51.60	48.40	938	0.30	0.16
3	Kanai Gaon	228	1034	4.54	49.52	50.48	1020	26.60	1.16
4	Genichuk	323	1523	4.72	50.95	49.05	963	16.22	0.46
5	Mukalbari T.E.	663	3198	4.82	49.94	50.06	1003	0.59	0.03
6	Chengdhora T.E.	131	666	5.08	50.90	49.10	965	0.00	0.00
7	Maijan	336	1619	4.82	49.78	50.22	1009	0.00	0.00
8	Dhopabor Gaon	148	743	5.02	51.28	48.72	950	2.02	0.00
9	Raidang	95	480	5.05	54.38	45.63	839	25.63	11.25
10	Piporatoli	13	57	4.38	59.65	40.35	676	22.81	0.00
11	Udalguri T.E.	273	1504	5.51	50.00	50.00	1000	0.00	0.00
12	Kharjan Grant	287	1431	4.99	48.43	51.57	1065	0.00	0.49
13	Balijan Gaon	117	505	4.32	54.06	45.94	850	0.99	0.00
14	Balijan Pani Era	298	1412	4.74	50.42	49.58	983	42.42	0.50
15	Maricha Gaon	467	2232	4.78	50.90	49.10	965	78.23	1.70
16	Mohabir Bari	18	96	5.33	57.29	42.71	745	0.00	0.00
17	Hatigadhoi	132	590	4.47	50.51	49.49	980	0.00	0.00
18	Dangar Chuk	164	785	4.79	49.43	50.57	1023	0.00	0.00
19	Kanjikhowa	267	1233	4.62	49.64	50.36	1015	0.00	0.00
20	Kharjan Gaon	247	1259	5.10	50.75	49.25	970	0.00	2.07
21	Dinjan T.E. 106 F.C(B)	290	1438	4.96	50.76	49.24	970	0.35	0.00
22	No-2 Balupara Gaon	27	136	5.04	52.94	47.06	889	0.00	0.00
23	Lezaihula Gaon	183	748	4.09	50.67	49.33	974	2.67	0.00
24	Panitola Te.No-111 Nlr	329	1495	4.54	50.10	49.90	996	0.00	0.00
25	Panitola T.E. No - 105/102,75 /72 Nlr	542	2608	4.81	55.02	44.98	817	0.81	0.12

Sl No.	Villages	No. of Household	Total Population	Household Size	% of Male Population	% of Female Population	Sex Ratio	% SC Population	% of ST Population
26	Baghbari Gaon	183	912	4.98	49.67	50.33	1013	0.00	0.00
27	Panitola Town	372	1809	4.86	51.35	48.65	947	7.46	2.16
28	Panitola Te.No-66 Fs.Gt.	377	1752	4.65	50.80	49.20	969	0.17	0.00
29	Raidang Gaon	164	963	5.87	50.36	49.64	986	0.00	0.00

Annexure 3.15

Literacy Profile of the Study Area Villages

Sl No.	Villages	Total Population	% Literate	% Male Literate	% Female Literate
1	Mothola 5/142 Orr	554	41.83	56.52	23.79
2	Kandulibari Grant 4 No.F.S.16 NLR	4405	45.94	55.54	35.98
3	Kanai Gaon	1034	62.29	72.53	51.99
4	Genichuk	1523	89.38	93.11	85.54
5	Mukalbari T.E.	3198	51.91	60.41	43.36
6	Chengdhora T.E.	666	47.08	59.00	34.40
7	Maijan	1619	70.77	78.80	62.89
8	Dhopabor Gaon	743	86.74	93.05	80.31
9	Raidang	480	57.86	64.32	50.26
10	Piporatoli	57	48.98	55.17	40.00
11	Udalguri T.E.	1504	50.52	64.55	36.46
12	Kharjan Grant	1431	33.50	42.60	24.76
13	Balijan Gaon	505	69.27	82.43	53.30
14	Balijan Pani Era	1412	79.54	88.55	70.35
15	Maricha Gaon	2232	86.81	92.97	80.51
16	Mohabir Bari	96	87.95	91.30	83.78
17	Hatigadhoi	590	75.97	86.04	65.34
18	Dangar Chuk	785	73.34	82.30	64.41
19	Kanjikhowa	1233	72.48	83.52	61.28
20	Kharjan Gaon	1259	76.58	82.44	70.47
21	Dinjan T.E. 106 F.C(B)	1438	49.75	64.72	34.49
22	No-2 Balupara Gaon	136	78.33	86.15	69.09
23	Lezaihula Gaon	748	95.11	97.37	92.79
24	Panitola Te.No-111 Nlr	1495	56.83	73.22	40.34
25	Panitola T.E. No - 105/102,75/72 Nlr	2608	71.51	79.09	62.12
26	Baghbari Gaon	912	76.87	86.71	66.75
27	Panitola Town	1809	91.74	95.08	88.26
28	Panitola Te.No-66 Fs.Gt.	1752	54.58	63.73	44.95
29	Raidang Gaon	963	79.76	89.42	70.51

Annexure 3.16

Workforce Participation in the Study Area Villages

Sl No.	Villages	Total Population	Total worker Population	% Cultivator	% Agricultural Labor	% Household industry worker	% other worker
1	Mothola 5/142 Orr	554	554	7.14	63.27	6.63	22.96
2	Kandulibari Grant 4 No.F.S.16 NLR	4405	4405	0.32	6.32	0.27	93.08
3	Kanai Gaon	1034	1034	7.87	0.90	4.49	86.74
4	Genichuk	1523	1523	18.74	53.56	2.85	24.85
5	Mukalbari T.E.	3198	3198	0.29	18.89	0.50	80.32
6	Chengdhora T.E.	666	666	1.04	35.51	0.00	63.45
7	Maijan	1619	1619	27.72	9.59	9.38	53.30
8	Dhopabor Gaon	743	743	37.11	19.85	27.32	15.72
9	Raidang	480	480	1.50	98.50	0.00	0.00
10	Piporatoli	57	57	37.50	0.00	6.25	56.25
11	Udalguri T.E.	1504	1504	0.42	0.42	0.00	99.16
12	Kharjan Grant	1431	1431	0.52	28.80	2.79	67.89
13	Balijan Gaon	505	505	1.33	0.00	0.00	98.67
14	Balijan Pani Era	1412	1412	4.42	0.59	1.18	93.81
15	Maricha Gaon	2232	2232	4.32	6.34	1.73	87.61
16	Mohabir Bari	96	96	7.69	0.00	0.00	92.31
17	Hatigadhoi	590	590	16.07	0.45	0.89	82.59
18	Dangar Chuk	785	785	49.46	8.24	5.38	36.92
19	Kanjikhowa	1233	1233	10.92	12.66	0.00	76.43
20	Kharjan Gaon	1259	1259	47.47	39.56	1.01	11.95
21	Dinjan T.E. 106 F.C(B)	1438	1438	0.27	0.00	0.13	99.60
22	No-2 Balupara Gaon	136	136	9.26	18.52	3.70	68.52
23	Lezaihula Gaon	748	748	12.00	3.00	5.50	79.50
24	Panitola Te.No-111 Nlr	1495	1495	0.15	0.61	0.15	99.08
25	Panitola T.E. No - 105/102,75/72 Nlr	2608	2608	4.44	3.35	1.09	91.12
26	Baghbari Gaon	912	912	0.65	1.30	0.00	98.05
27	Panitola Town	1809	1809	1.22	0.70	0.87	97.21
28	Panitola Te.No-66 Fs.Gt.	1752	1752	4.31	16.45	1.44	77.80
29	Raidang Gaon	963	963	44.19	20.71	2.78	32.32

Annexure 3.17

Community Consultation in the Study Area Villages

A	*Project Title:*	EIA/EMP Study of the Khagorijan Field	
B	*Stakeholder Title:*	Discussion with the resident villagers	
Note: This document provides a working summary of the main facts captured during the consultation/ key informant interview held and should not be treated as formal minutes. It is therefore deliberately not exhaustive or chronological. Its purpose is to record significant information/ feedback and not intended for official review or approval.			
C	*Basic details:*		
	Location:	Village- Balijan Panchayat- Balijan Tehsil: Dibrugarh	
	Date	22/11/2017	
D	*Attended By (Attendance Sheet Attached)*		
	Sr.	Name	Designation
	1.	Souvik Basu	ERM
	2.	Abhishek Roy Goswami	ERM
	3.	Local Villagers	Balijan
E	*Purpose of Consultation*		
	• Collection of information regarding baseline socio-economic condition.		
F	***Key Points Inferred:*** • Most people of this belongs to Assamese community. Apart from that few tea tribal people also residing here. • Most of the people area dependent on agriculture. Few people are also working in tea garden. • Agriculture in this area is entirely dependent on monsoon rain. No irrigation facility is available. Paddy is the main crop. • LP and ME school is present within the village. High school and collage are present in Tingkhon village • Primary sub-centre is available within the village. Nearest hospital is located in Tingkhon • Primary drinking water source of the villagers is from Tube well and dug well. • Power supply facilities are available in the village. Durga Puja and Christmas is being celebrated by the villagers as part of cultural activities. • Consultation also reveal that Oil India has some CSR intervention in this village like road construction, boundary wall of school. • One doctor and mobile medical unit also come from Oil in weekly basis. They also provide free medication to the villagers. • There is a well activity is also going on in this area. As per local community they only face some problem related noise. Other than that they do not have any problem related oil drilling. They also confirm that OIL also provide some cash compensation to nearby houses for noise problem. • They also confirm that Oil India directly purchase their land for oil drilling activity.		

A	*Project Title:*	EIA/EMP Study of the Khagorijan Field	
B	*Stakeholder Title:*	Discussion with the resident villagers	
Note: This document provides a working summary of the main facts captured during the consultation/ key informant interview held and should not be treated as formal minutes. It is therefore deliberately not exhaustive or chronological. Its purpose is to record significant information/ feedback and not intended for official review or approval.			
C	*Basic details:*		
	Location:	Village- Guijan Panchayat- Guijan Tehsil: Dibrugarh	
	Date	22/11/2017	
D	*Attended By (Attendance Sheet Attached)*		
	Sr.	Name	Designation
	1.	Souvik Basu	ERM
	2.	Abhishek Roy Goswami	ERM
	3.	Local Villagers	Guijan
E	*Purpose of Consultation*		
	• Collection of information regarding baseline socio-economic condition.		
F	***Key Points Inferred:*** • Most people of this belongs to Bengali community. Apart from that few Assamese people are also residing here. • Most of the people area dependent on agriculture. Few people are also working in tea garden. • Agriculture in this area is entirely dependent on monsoon rain. No irrigation facility is available. Paddy is the main crop. • LP school is present within the village. ME school, High school and collage are present in Chabua village • Primary sub-centre is available within the village. Nearest hospital is located in Rajgarh • Primary drinking water source of the villagers is from Tube well and dug well. • Power supply facilities are available in the village. • Consultation also reveal that Oil India has some CSR intervention in this village like road construction, boundary wall of school. • One doctor and mobile medical unit also come from Oil in weekly basis. They also provide free medication to the villagers. • There is a well activity is also going on in this area. As per local community they only face some problem related noise. Other than that they do not have any problem related oil drilling. They also confirm that OIL also provide some cash compensation to nearby houses for noise problem. • They also face flies problem during well drilling activity. • They also confirm that Oil India directly purchase their land for oil drilling activity.		

A	*Project Title:*	EIA/EMP Study of the Khagorijan Field	
B	*Stakeholder Title:*	Discussion with the resident villagers	
Note: This document provides a working summary of the main facts captured during the consultation/ key informant interview held and should not be treated as formal minutes. It is therefore deliberately not exhaustive or chronological. Its purpose is to record significant information/ feedback and not intended for official review or approval.			
C	*Basic details:*		
	Location:	Village- Pokhrijan Gaon Panchayat- Raidang Tehsil: Dibrugarh	
	Date	22/11/2017	
D	*Attended By (Attendance Sheet Attached)*		
	Sr.	Name	Designation
	1.	Souvik Basu	ERM
	2.	Abhishek Roy Goswami	ERM
	3.	Local Villagers	Pokhrijan Gaon
E	*Purpose of Consultation*		
	• Collection of information regarding baseline socio-economic condition.		
F	***Key Points Inferred:*** • Most people of this belongs to Tea tribe. Apart from that few Assamese and Bengali people are also residing here. • Majority of the people are working in personal Tea garden. Other than that people also earn livelihood from agriculture. • Agriculture in this area is entirely dependent on monsoon rain. No irrigation facility is available. Paddy is the main crop. • LP, ME, High school is present with in the village and nearest collage present Chabua • Nearest hospital is located in Tingkhon • Primary drinking water source of the villagers is from Tube well and dug well. • Power supply facilities are available in the village. • Consultation also reveal that Oil India has some CSR intervention in this village like road construction. • There is a well activity is also going on in the tea garden area. Community consultation reveals that some time water flows out from the well site and reduce the productivity of the tea garden. Apart from that they also face some problem related to noise.		

A	*Project Title:*	EIA/EMP Study of the Khagorijan Field	
B	*Stakeholder Title:*	Discussion with the resident villagers	
Note: This document provides a working summary of the main facts captured during the consultation/ key informant interview held and should not be treated as formal minutes. It is therefore deliberately not exhaustive or chronological. Its purpose is to record significant information/ feedback and not intended for official review or approval.			
C	*Basic details:*		
	Location:	Village- Bakul Chariali Panchayat- Bakul Tehsil: Dibrugarh	
	Date	22/11/2017	
D	*Attended By (Attendance Sheet Attached)*		
	Sr.	Name	Designation
	1.	Souvik Basu	ERM
	2.	Abhishek Roy Goswami	ERM
	3.	Local Villagers	Bakul Chariali
E	*Purpose of Consultation*		
	• Collection of information regarding baseline socio-economic condition.		
F	***Key Points Inferred:*** • Most people of this belongs to Assamese community. Other than that few Bengali people and tea tribe are also residing here. • People are mainly dependent on agricultural activity. Apart from that people are also work in local tea garden. • Agriculture in this area is entirely dependent on monsoon rain. No irrigation facility is available. Paddy is the main crop. • ME and LP school is present with in village Collage is present in Lawhal • Health sub center is present in the village. Nearest hospital is located in Lengri • Primary drinking water source of the villagers is from Tube well and dug well. • Power supply facilities are available in the village. • As per community consultation, Oil do not have any CSR intervention in this village • Oil drilling and exploration activity is going on near this village for last 5 years but they do not face any problem related that. Local villagers also get job in this activity		

A	*Project Title:*	EIA/EMP Study of the Khagorijan Field	
B	*Stakeholder Title:*	Discussion with the resident villagers	
Note: This document provides a working summary of the main facts captured during the consultation/ key informant interview held and should not be treated as formal minutes. It is therefore deliberately not exhaustive or chronological. Its purpose is to record significant information/ feedback and not intended for official review or approval.			
C	*Basic details:*		
	Location:	Village- Noloni Samuha Panchayat- Nakhat Tehsil: Dibrugarh	
	Date	22/11/2017	
D	*Attended By (Attendance Sheet Attached)*		
	Sr.	Name	Designation
	1.	Souvik Basu	ERM
	2.	Abhishek Roy Goswami	ERM
	3.	Local Villagers	Noloni Samhua
E	*Purpose of Consultation*		
	• Collection of information regarding baseline socio-economic condition.		
F	***Key Points Inferred:*** • Most people of this belongs to Assamese community. Other than that few Bengali people and tea tribe are also residing here. • People are mainly dependent on agricultural activity. People are also involved in Tea garden • Agriculture in this area is entirely dependent on monsoon rain. No irrigation facility is available. Paddy is the main crop. • LP school is present within village. ME and High school is present in Laowhal village • Primary health center is located in village. Apart from that people also go to Lawhal for availing hospital facility . • Primary drinking water source of the villagers is from Tube well and dug well. • Power supply facilities are available in the village. • OCS of OIL is present in thes are for last 10 years but local not face any problem for that • As per community consultation, Oil do not have any CSR intervention in this village.		

A	*Project Title:*	EIA/EMP Study of the Khagorijan Field	
B	*Stakeholder Title:*	Discussion with the resident villagers	
Note: This document provides a working summary of the main facts captured during the consultation/ key informant interview held and should not be treated as formal minutes. It is therefore deliberately not exhaustive or chronological. Its purpose is to record significant information/ feedback and not intended for official review or approval.			
C	*Basic details:*		
	Location:	Village- 1 No Tipomiya Panchayat- Sologari Tehsil: Dibrugarh	
	Date	22/11/2017	
D	*Attended By (Attendance Sheet Attached)*		
	Sr.	Name	Designation
	1.	Souvik Basu	ERM
	2.	Abhishek Roy Goswami	ERM
	3.	Local Villagers	1 No Tipomiya
E	*Purpose of Consultation*		
	• Collection of information regarding baseline socio-economic condition.		
F	***Key Points Inferred:*** • Most people of this belongs to Assamese community. Other than that few Bengali people and tea tribe are also residing here. • People are mainly dependent on agricultural activity. People are also involved in Tea garden • Agriculture in this area is entirely dependent on monsoon rain. No irrigation facility is available. Paddy is the main crop. • LP and ME school is present within village. High school and Collage is present in Dibrugarh • Primary health center is located in village. Apart from that people also go to Dibrugarhfor availing hospital facility . • Primary drinking water source of the villagers is from Tube well and dug well. • Power supply facilities are available in the village. • As per community consultation, Oil do not have any CSR intervention in this village.		

Annexure 4.1

Impact Assessment Methodology

IMPACT IDENTIFICATION AND ASSESSMENT

Impact identification and assessment starts with scoping and continues through the remainder of the impact assessment process (IAP). The principal impact assessment (IA) steps are summarized below:

- **Impact prediction**: to determine what could potentially happen to resources/receptors as a consequence of the Project and its associated activities.
- **Impact evaluation:** to evaluate the significance of the predicted impacts by considering their magnitude and likelihood of occurrence, and the sensitivity, value and/or importance of the affected resource/receptor.
- **Mitigation and enhancement:** to identify appropriate and justified measures to mitigate negative impacts and enhance positive impacts.
- **Residual impact evaluation:** to evaluate the significance of impacts assuming effective implementation of mitigation and enhancement

Prediction of Impacts

Prediction of impacts is essentially an objective exercise to determine what could potentially happen to the environment as a consequence of the project and its associated activities. This is essentially a repeat of the process undertaken in scoping, whereby the potential interactions between the project and the baseline environment are identified. From these potential interactions, the potential impacts to the various resources/receptors are identified, and are elaborated to the extent possible. The diverse range of potential impacts considered in the IA process typically results in a wide range of prediction methods being used including quantitative, semi-quantitative and qualitative techniques. The nature and types of impacts that has been addressed in this EIA is defined in the ***Box 1*** below.

Box 1 ***Nature and types impacts considered for impact assessment***

- **Negative**, when impact is considered to represent adverse change from the baseline or to have introduced a new undesirable factor; and
- **Positive or beneficial**, when impact is considered to represent improvement to baseline or to have introduced a new desirable factor.
- **Direct,** impacts that result from a direct interaction between the project and a resource/ receptor
- **Indirect**, impacts that follow on from the direct interactions between the project and its environment as a result of subsequent interactions within the environment; and
- **Induced**, impacts that result from other activities (which are not part of the project) that happen as a consequence of the project

Evaluation of Impacts

In assessing the significance of impact, the following impact characteristics are taken into consideration:

Determining Magnitude of an impact

Magnitude, i.e. severity of an impact or degree of change caused by a project activity is a function of one or more of the following characteristics:

- *Scale*: Degree of damage that may be caused to the environmental components concerned.
- *Extent*: The extent refers to spatial or geographical extent of impact due to proposed project and related activities.
- *Duration*: The temporal scale of the impact in terms of how long it is expected to last.

Criteria have been defined for each of these key elements and classified based on the level of impacts (low, medium and high) on the environmental component, presented in ***Table 1*** below:

Table 1 ***Magnitude Prediction Criteria***

Impact Elements	Criteria	Ranking
Scale	• Irreversible damage to natural environment and/or difficult or may not to revert back to earlier stage with mitigation; • Major changes in comparison to baseline conditions and / or likely to regularly or continually exceed the standard;	High
	• Reversible damage to natural environment but likely to easily revert back to earlier stage with mitigation; • Perceptible change from baseline conditions but well within acceptable norms.	Medium
	• Effect is within the normal range of natural variation; • Effect will be insignificant with proper embedded control • No perceptible or readily measurable change from baseline conditions;	Low
Extent	• Project site and beyond 5.0 km from project site	National
	• Project site and 5.0 km study area	Regional
	• Project site and its immediate vicinity (0.5 km from site)	Local
Duration	• Spread along entire lifecycle of the project and beyond at all times	Long term
	• Spread across the entire drilling phase of the project • Spread across the entire pre-drilling and decommissioning phases of the project • Spread across at entire life cycle of the project intermittently	Medium term
	• Spread across intermittently at a single phase of the project	Short term

Magnitude essentially describes the intensity of the change that is predicted to occur in the resource/receptor as a result of the impact. The magnitude combines the impact characteristics of Extent, Duration and Scale and is a multiplicative factor of these three criteria set. Based on the above understanding magnitude of impact is assessed as per the ***Table 2***.

Table 2 Assessing Magnitude of Impact

Extent	Duration	Scale	Magnitude
Local	Short Term	Low	Negligible
Regional	Short Term	Low	Small
Local	Medium term	Low	Small
Local	Short Term	Medium	Small
National	Short Term	Low	Small
Local	Long term	Low	Small
Local	Short Term	High	Small
Regional	Medium term	Low	Small
Regional	Short Term	Medium	Small
Local	Medium term	Medium	Small
National	Medium term	Low	Medium
National	Short Term	Medium	Medium
Regional	Long term	Low	Medium
Regional	Short Term	High	Medium
Local	Long term	Medium	Medium
Local	Medium term	High	Medium
Regional	Medium term	Medium	Medium
National	Long term	Low	Medium
National	Short Term	High	Medium
Local	Long term	High	Medium
National	Medium term	Medium	Large
Regional	Long term	Medium	Large
Regional	Medium term	High	Large
National	Long term	Medium	Large
National	Medium term	High	Large
Regional	Long term	High	Large
National	Long term	High	Large

Determining Sensitivity/ Importance/ Vulnerability of Receptor

In addition to characterising the magnitude of impact, the other principal step necessary to assign significance for an impact is to define the sensitivity/ vulnerability/ importance of the impacted resources/ receptor. Sensitivity of the receptor is based on the relationship between the respective project and present baseline environment (the receptor). It is assessed based on vulnerability of the receptor. These receptors include the surrounding population and environment. As the effect of an impact is more readily absorbed and easily mitigated it becomes less sensitive; on the other hand, as an impact is more challenging to mitigate and cannot be absorbed by the population or the environment it becomes more sensitive and requires an extensive management plan. The sensitivity of the receptor is assessed as (***Table 3***).

Table 3 ***Sensitivity/Importance/ Vulnerability Criteria***

Sensitivity Criteria	Contributing Criteria
High	• Existing physical environment quality is already under stress; • Ecologically sensitive/ protected area, provides habitat for globally protected species; • Profound or multiple levels of vulnerability that undermine the ability to adapt to changes brought by the project. • Human receptors/ vulnerable community are located within the project footprint and directly affected by the project
Medium	• Existing physical environment quality shows some sign of stress; which is sensitive to change in quality or physical disturbance; • Natural habitat provides habitat for wildlife, which are protected under National regulations; • Some, but few areas of vulnerability; still retaining an ability to at least in part adapt to change brought by the project. • Human receptors/ vulnerable community are located adjacent the project site and likely to be affected by the project
Low	• Existing physical environment quality is good; • Modified habitat provides habitat for common species; • Human receptors are located away and are not likely to be affected due to the project related activities

Evaluating Significance of Impacts

Once magnitude of impact and sensitivity/ vulnerability/ importance of resource/ receptor have been characterized, the significance was assigned for each impact. Impact significance is designated using the matrix shown in ***Figure 1***.

Figure 1 ***Assessing Significance of Impact due to Proposed Project***

		Sensitivity /Vulnerability / Important Resource / Receptor		
		Low	**Medium**	**High**
Magnitude of Impact	Negligible	Negligible	Negligible	Negligible
	Small	Negligible	Minor	Moderate
	Medium	Minor	Moderate	Major
	Large	Moderate	Major	Major

The matrix applies universally to all resources/receptors, and all impacts to these resources/receptors, as the resource/receptor-specific considerations are factored into the assignment of magnitude and sensitivity/vulnerability/ importance designations that enter into the matrix. ***Box 2*** provides a context for what the various impact significance ratings signify.

Box 2 Context of Impact Significance

An impact of **negligible** significance is one where a resource/receptor (including people) will essentially not be affected in any way by a particular activity or the predicted effect is deemed to be 'imperceptible' or is indistinguishable from natural background variations.

An impact of **minor** significance is one where a resource/receptor will experience a noticeable effect, but the impact magnitude is sufficiently small (with or without mitigation) and/or the resource/receptor is of low sensitivity/ vulnerability/ importance. In either case, the magnitude should be well within applicable standards.

An impact of **moderate** significance has an impact magnitude that is within applicable standards, but falls somewhere in the range from a threshold below which the impact is minor, up to a level that might be just short of breaching a legal limit. Clearly, to design an activity so that its effects only just avoid breaking a law and/or cause a major impact is not best practice. The emphasis for moderate impacts is therefore on demonstrating that the impact has been reduced to a level that is as low as reasonably practicable (ALARP). This does not necessarily mean that impacts of moderate significance have to be reduced to minor, but that moderate impacts are being managed effectively and efficiently.

An impact of **major** significance is one where an accepted limit or standard may be exceeded, or large magnitude impacts occur to highly valued/sensitive resource/receptors. An aim of IA is to get to a position where the Project does not have any major residual impacts, certainly not ones that would endure into the long-term or extend over a large area. However, for some aspects there may be major residual impacts after all practicable mitigation options have been exhausted (i.e. ALARP has been applied). An example might be the visual impact of a facility. It is then the function of regulators and stakeholders to weigh such negative factors against the positive ones, such as employment, in coming to a decision on the Project.
Identification

Identification of Mitigation and Enhancement Measures

Once the significance of an impact has been characterized, the next step is to evaluate what mitigation and enhancement measures are warranted. For the purposes of this IA, ERM has adopted the following Mitigation Hierarchy:

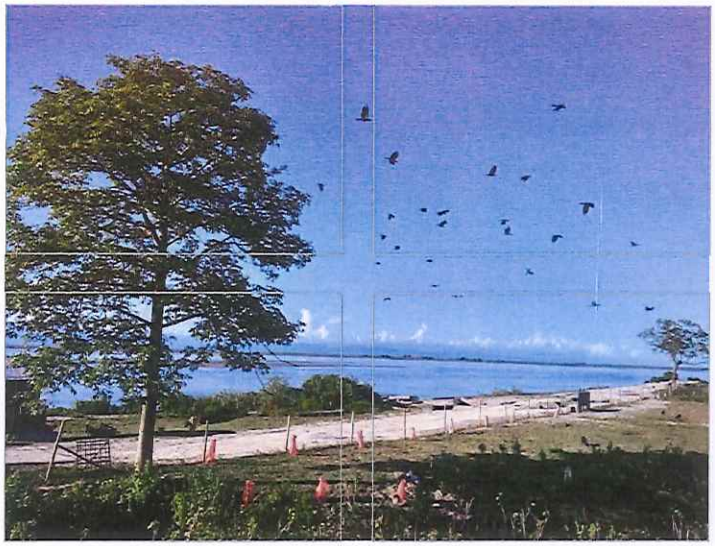
- **Avoid at Source;** Reduce at Source: avoiding or reducing at source through the design of the project.
- **Abate on Site**: add something to the design to abate the impact.
- **Abate at Receptor:** if an impact cannot be abated on-site then control measures can be implemented off-site.
- **Repair or Remedy:** some impacts involve unavoidable damage to a resource and these impacts can be addressed through repair, restoration or reinstatement measures.
- **Compensate in Kind, compensate through other means**: where other mitigation approaches are not possible or fully effective, then compensation for loss, damage and disturbance might be appropriate.

The priority in mitigation is to first apply mitigation measures to the source of the impact (i.e., to avoid or reduce the magnitude of the impact from the associated Project activity), and then to address the resultant effect to the resource/receptor via abatement or compensatory measures or offsets (i.e., to

reduce the significance of the effect once all reasonably practicable mitigations have been applied to reduce the impact magnitude).

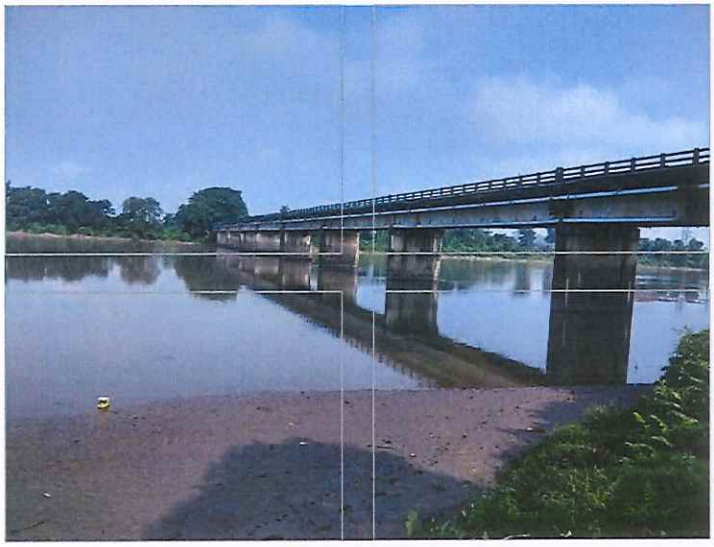
Residual Impact Evaluation

Once mitigation and enhancement measures are declared, the next step in the IA Process is to assign residual impact significance. This is essentially a repeat of the impact assessment steps discussed above, considering the assumed implementation of the additional declared mitigation and enhancement measures.










ऑयल इंडिया लिमिटेड
(भारत सरकार का उद्यम)
Oil India Limited
(A Government of India Enterprise)

EIA for Onshore Oil & Gas development drilling and production in Khagorijan Oil & Gas Field in Dibrugarh & Tinsukia District under Tinsukia PML, Tinsukia Extension PML and Chabua PML

Executive Summary- Assamese & English

কার্য্যনির্বাহকৰ সাৰাংশ

1. ভূমিকা

অইল ইণ্ডিয়া লিমিটেড চমুকৈ অইলে সম্প্রতি ৫৪ টা অন্বেষণমূলক আৰু বিকাশমূলক কূপ খনন, ২ টা প্রডাক্সন ইনষ্টলেচন আৰু অসমৰ তিনিচুকীয়া তথা ডিব্রুগড় জিলাস্থিত খাগৰিজান ক্ষেত্রত প্রায় ২০১ কিলোমিটাৰ জোৰা পাইপলাইন বহুওৱাৰ পৰিকল্পনা কৰিছে। এই পৰিকল্পনা মতে অসমৰ ডিব্রুগড় আৰু তিনিচুকীয়া জিলাত পূৱ খাগৰিজান জিজিএছৰ পৰা ডিকম ওচিএছলৈ ২০০ মি.মি.ৰ ২১ কিলোমিটাৰ দৈর্ঘ্যৰ প্রাকৃতিক গেছৰ পাইপলাইন, পূৱ খাগৰিজান জিজিএছৰ পৰা চাবুৱা এফজিজিএছলৈ ৩০০ মি.মি.ৰ ২০ কিলোমিটাৰ দৈর্ঘ্যৰ প্রাকৃতিক গেছৰ পাইপলাইন, ২০০ মি.মি.ৰ ১০ কিলোমিটাৰ দৈর্ঘ্যৰ পাইপলাইন নাদুৱা ওচিএছৰ পৰা ডিকম ওচিএছলৈ আৰু খাগৰিজান অইল এণ্ড গেছ ফিল্ডত ৫০ ৰপৰা ৩০০ মি.মি.ৰ প্রায় ১৫০ কিলোমিটাৰ দৈর্ঘ্যৰ তেল আৰু গেছৰ ফ্লাইন/ডেলিভাৰি লাইন বহুওৱা হ'ব।

তেল আৰু গেচ অন্বেষণনৰ এই কার্য্যসূচীক ২০০৬ চনৰ EIA ৰ বিজ্ঞপ্তি অনুসৰি 'A' কেটগৰীত ৰখা হৈছে, যাৰ বাবে বন, পৰিবেশ আৰু জলবায়ু মন্ত্রণালয়ৰ (MOEF&CC)পৰা পৰিবেশ সম্পর্কীয় অনুমোদনৰ প্রয়োজন। MOEF&CC এ এই সন্দর্ভত ১১ মার্চ ২০১৪ তাৰিখৰ J-11011/35/2018-IA II(I) নম্বৰৰ অধিসূচনাৰ জৰিয়তে অইলক এই কাম সম্পাদন কৰাৰ বাবে অনুমোদন দিয়ে।

<u>অৱস্থান আৰু অভিগম্যতা</u>

খাগৰিজান অইল এণ্ড গেছ ফিল্ড অসমৰ ডিব্রুগড় আৰু তিনিচুকীয়া জিলাত অৱস্থিত। খাগৰিজান অইল এণ্ড গেছ ফিল্ডৰ মূঠ মাটিকালি হৈছে ৪০৫ বর্গকিলোমিটাৰ। অঞ্চলটোৰ প্রমুখ ৰাজপথ ৩৭ নং ৰাষ্ট্রীয় ঘাইপথটো খাগৰিজান ফিল্ডৰ দক্ষিণাঞ্চলেদি পূৱৰ পৰা পশ্চিম দিশ হৈ পাৰ হৈছে। এই পথটোৱে ক্ষেত্রখনৰ দক্ষিণ-পূৱ কোণত থকা তিনিচুকীয়া চহৰক ক্ষেত্রখনৰ বাহিৰত দক্ষিণ-পশ্চিম দিশত থকা ডিব্রুগড় চহৰ সংযোগ কৰে। ক্ষেত্রখনত থকা দুটা প্রমুখ জংছন হৈছে তিনিচুকীয়া জংছন আৰু নিউ তিনিচুকীয়া জংছন।

<u>কূপৰ ক্ষেত্র আৰু উত্পাদন কেন্দ্রৰ পৰিৱেশসংক্রান্ত স্থিতি</u>

খাগৰিজান ক্ষেত্রখন ব্রহ্মপুত্রৰ নিষ্কাশন অববাহিকাত অৱস্থিত। ব্রহ্মপুত্রৰ (উত্তৰাঞ্চলেদি প্রৱাহিত) উপৰিও ব্রহ্মপুত্রৰ উপনদী ডাঙৰি নৈ উত্তৰ-পূৱ দিশৰ পৰা উত্তৰ-পশ্চিম দিশলৈ ক্ষেত্রখনৰ মাজেৰে প্রৱাহিত হৈছে। দিনজান নদীখন কম-বেছি পৰিমাণে ক্ষেত্রখনৰ দক্ষিণাঞ্চলেদি প্রৱাহিত হৈছে। খাগৰিজান ক্ষেত্রখনৰ উত্তৰ-পূৱ অংশটো ডিব্রু-ছৈখোৱা ৰাষ্ট্রীয় উদ্যানৰ বাফাৰ এলেকাত পৰে। তাৰোপৰি ভেৰজান-বৰাজান-পদুমণি বন্যাপ্রাণী অভয়াৰণ্যৰ পদুমণি খণ্ড (১.৭ বর্গকিলোমিটাৰ) ক্ষেত্রখনৰ পূর্বাঞ্চলত পৰে। অঞ্চলটোত বৃহত চাহবাগান,

কৃষিভূমি থকা গ্রামাঞ্চল, বসতিস্থল আৰু পামধৰা অঞ্চল আছে। ক্ষেত্রখনত থকা প্রমুখ চাহবাগানকেইখন হৈছে অকলেণ্ড চাহবাগান, হাজেলবেংক চাহবাগান, নাদুৱা চাহবাগান, নৰ্থ বালিজান চাহবাগান, দিনজয় চাহবাগান, খাৰজান চাহবাগান, পানীতোলা চাহবাগান, দিনজান চাহবাগান, ৰাংগাগোৰা চাহবাগান, নালানি চাহবাগান, নখ্রই চাহবাগান, লিমবুগুডি চাহবাগান আদি।

৫৩ টা কূপৰ ৯ টা কৃষিভূমিত, ৮ টা পামধৰা এলেকাত আৰু ২৬ টা চাহবাগানৰ ভিতৰত আৰু ১ টা ইটাৰ ভাট্টা ক্ষেত্রত পৰাৰ বিপৰীতে ২৬ টা কূপ অইলৰ ইতিপূৰ্বে থকা তৈলক্ষেত্রৰ ভিতৰতে অৱস্থিত। এটা উত্পাদন কেন্দ্র কৃষিভূমিত অৱস্থিত আৰু আনটো চাহবাগানত অৱস্থিত।

2. প্রকল্পৰ কার্য্য প্রণালী

<u>ভূমি ক্রয়</u>

প্রকল্পৰ বাবে প্রয়োজনীয় ভূমি স্থানীয় কৃষকৰ, চাহবাগানৰ পৰা ক্রয় কৰা হ'ব। সাধাৰণতে অইলে ভূমি ক্রয়ৰ কামটো সম্পন্ন কৰে স্থানীয় লোকসকলৰ লগত হোৱা বুজাবুজিৰ জৰিয়তে আৰু যদি এনেদৰে কাম নহয় তেন্তে ১৮৯/১৯০ of AL&RR, ১৮৮৬ আইনৰ অধীনত এই কাম সম্পন্ন কৰা হয়। ভূমি ক্রয় কৰোতে ভূমিৰ লগতে শস্যৰবাবেও ক্ষতিপূৰণ দিয়া হ'ব। প্রস্তাৱিত প্রকল্প এলেকাত বাসস্থান নাই বাবে কাকো পুনঃসংস্থাপন প্রযোজ্য নহয়।

<u>প্রকল্প স্থানৰ প্রস্তুতি আৰু খনন স্থানৰ নির্মাণ</u>

প্রকল্পস্থানপ্রস্তুতিৰ ক্ষেত্রত প্রধানকৈ গুৰুত্ব দিয়া হ'ব যাতে ঠাইডোখৰ সমান কৰাৰ বাবে দ ঠাইবোৰ পোতা আৰু পৃষ্ঠ ভাগ টান কৰা যাতে সা সৰঞ্জাম আৰু যন্ত্র পাতিসমূহ থব পাৰি। প্রতিডোখৰ ঠাই পৃথকে পৃথকে ২ মিটাৰ ওখ jingle wire fencing বা XPM fencing ৰে বেৰিব লাগিব।

খনন স্থানৰ প্রস্তুতি আৰু নির্মাণৰ সময়ত কৃষি উপযোগী ভূপৃষ্ঠৰ মাটিভাগ ভৱিষ্যতে ব্যৱহাৰ কৰাৰ বাবে খান্দি পৃথকে ৰখা হ'ব। বুনিয়াদী গাঠনি (Foundation System) প্রস্তুত কৰাৰ বাবে RCC (Reinforcement Cement Concrete) ব্যৱহাৰ কৰা হ'ব। বিশেষ দৈর্ঘ্যতাৰ Cast in-situ ও ব্যৱহাৰ কৰা হব।

<u>খনন আৰু পৰীক্ষণ</u>

তেল গেছ অন্বেষণৰ বাবে ভূপৃষ্ঠ আৰু সম্ভাব্য ভূপৃষ্ঠৰ তৈলাশয়ৰ মাজত এটা নাদ নির্মাণ কৰা হ'ব। এই কার্য্যৰ বাবে এটা "Standard Land Rig"বা "Mobile Land Rig"ব্যৱহাৰ কৰা হব যাৰ লগত এটা standard Water based drilling fluid treatment system সংযুক্ত থাকিব। এই Rig নির্ধাৰিত ৩৯০০ মিটাৰৰ তললৈকে খনন কৰাৰ ক্ষমতা যুক্ত হব।

খননৰ সময়ত এক বিশেষ তৰল পদাৰ্থ (Drill Fluid বা Mud) ব্যৱহাৰ কৰা হয়। এক বিশেষ যান্ত্রিক ব্যৱস্থাৰ দ্বাৰা এই Drill Fluid খননৰ সময়চোৱাত খাদৰ মাজেৰে ওপৰলৈ নিৰন্তৰ ভাৱে সঞ্চাৰিত কৰি ৰখা হয়। এই পদ্ধতিৰ দ্বাৰা খননৰ বাবে খাদত উৎপন্ন হোৱা শিল বালি সমূহ ভূপৃষ্ঠৰ ওপৰলৈ উঠাই অনা হয়। তাৰোপৰি নিৰন্তৰ খননৰ ফলত Drill Bit ত উৎপন্ন হোৱা তাপ নিয়ন্ত্রণ আৰু ইয়াক পৰিস্কাৰ কৰি ৰখাৰ বাবেও Drill Fluid বা Mud ব্যৱহাৰ কৰা হয়। কোনো কোনো সময়ত ভূগর্ভত সৃষ্টি হোৱা অস্বাভাৱিক চাপ নিৰীক্ষণ আৰু নিয়ন্ত্রণৰ বাবেও এই Drill Fluid বা Mud ব্যৱহাৰ কৰা হয়। এই প্রক্রিয়াৰ সহায়ত ওপৰলৈ কঢ়িয়াই অনা শিল বালি সমূহ এক বিশেষ পদ্ধতিৰ দ্বাৰা (Solid Control System) নিষ্কাষণ কৰি তৰল ভাগ পুনৰ খাদত ব্যৱহাৰ কৰা হয়। এই প্রক্রিয়া গোটেই খননৰ সময়চোৱাত অবিৰাম ভাবে চলি থাকিব।

এইদৰে খননৰ পৰা উৎপন্ন হোৱা শিল বালি ইত্যাদি Solid Control System দ্বাৰা নিষ্কাষণৰ পিছত HDPE ৰে আৱৰা গাঁতত প্রকল্প থলীতে অস্থায়ী ভাবে ৰখা হ'ব।

অপ্রয়োজনীয় পানীভাগো একেদৰেই ৰখা হ'ব যদিও পানীভাগ ওপৰঞ্চিকৈ Mobile ETP মেচিনেৰে শোধন কৰা হ'ব S No. ৭২ এ (ii) Schedule I অনুসৰি, যিটো CPCB ৰ তেল খনন আৰু গেছ নিস্কাষণ উদ্যোগৰ পাৰিপার্শ্বিক প্রদূষণ নিস্কাষণৰ বাবে উপযুক্ত। যদি কোনো অতিৰিক্ত পৰিশোধিত বর্জনীয় পানী থাকে তেন্তে নির্গমণ নিয়ম অনুযায়ী তথা অসম প্রদূষণ পৰিষদৰ অনুমতি সাপেক্ষে ওচৰৰ কোনো প্রাকৃতিক নলাত নির্গমিত কৰা হ'ব।

প্রস্তাবিত প্রকল্পত আন কিছুমান আনুসংগিক (Ancillary) ব্যৱস্থা, যেনে Drilling Mud System, Effluent Treatment System(ETP), Cutting Disposal, Drill cementing equipment বিজুলীৰ বাবে DG set, পানী, ডিজেল আদি থাকিব। খনন প্রক্রিয়া চলাই নিবৰ বাবে আৰুই প্রকল্পৰ এটা অংশ হ'ব।

খাদস্থলী Decommissioning

খনন কার্য্য শেষ হোৱাৰ পাছত খাদসমূহত প্লাগ লগাই ৰখা হ'ব নাইবা Flow Line ৰ লগত সংযোগ কৰা হ'ব নাইবা সম্পূর্ণ ৰূপত বন্ধ কৰি দিয়া হ'ব। সম্পূর্ণ ৰূপে বন্ধ কৰাৰ সিদ্ধান্ত লোৱা খাদ সমূহত এক লৱণযুক্ত পদার্থ দিয়া হ'ব খাদ বোৰৰ সুৰক্ষাৰ বাবে। এই কাম শেষ হোৱাৰ পাছত Cement Plug ৰ সহায়ত ছীল কৰা হ'ব। তাৰ পাছত সকলো সৰঞ্জাম সামৰি, ঠাইডোখৰ পৰিস্কাৰ কৰি ঠাইডোখৰ আগৰ অৱস্থালৈ ঘূৰাই অনা হ'ব।

সম্ভাৱনাপূর্ণ হাইদ্রকার্বনৰ উপস্থিতিৰ উমান পালে খাদটো সাময়িক ভাৱে plugged কৰি ৰখা হ'ব আৰু হাইদ্রকার্বনৰ উপস্থিতিৰ বাণ্যিজিক কার্যকারিতা নিরুপন কৰাৰ বাবে আৰু অধিক খাদ খনন কৰা হ'ব।

প্রডাক্সন ইনষ্টলেচনচ্

দুটা প্রডাক্সন ইনষ্টলেচন খাগৰিজান ক্ষেত্রতে স্থাপন কৰাৰ পৰিকল্পনা কৰা হৈছে। প্রডাক্সন ইনষ্টলেচনত থাকিব পাৰে অইল কালেক্সন চিষ্টেম (ওচিএচ), গেছ কম্প্রেছৰ ষ্টেচন (জিচিএছ), ফিল্ড গ্রুপ গেদাৰিং ষ্টেচন (এফজিজিএছ) অথবা কুইক প্রডাক্সন চিষ্টেম (কিউপিএছ) আদি।

প্রয়োজনীয় ব্যৱহার্য্য সেৱা আৰু সম্পদ

শক্তি : প্রতিটো খনন স্থলীত প্রয়োজন হোৱা বিজুলী শক্তিৰ প্রয়োজন পূৰাব এটা ৬৩ KVA জেনেৰেটৰে। খননৰ সময়ত ১০০০ কিলোৱাট ক্ষমতা সম্পন্ন জেনেৰটৰ ব্যৱহাৰ কৰা হ'ব খনন তথা প্রয়োজনীয় পোহৰ আৰু আন আন আনুসংগিক প্রয়োজনীয়তা পূৰণ কৰাৰ বাবে জেনেৰেটৰ ব্যৱহাৰ কৰা হব। আনুমানিক ভাৱে প্রতিটো খননৰ বাবে ৩.৫ KLD ডিজেল প্রয়োজন হব।

২১৬ কিলোৱাট ক্ষমতাৰ গেছ জেনেৰেটৰ (জিজি) যোগে প্রডাক্সন ইনষ্টলেচনৰ বাবে আৱশ্যকীয় শক্তি ব্যৱস্থা কৰা হ'ব।

পানী : খননৰ সময়ত প্রতিদিনেআনুমানিক ৬০ ঘনমিটাৰ পানীৰ প্রয়োজন হ'ব বুলি ধৰা হৈছে। খনন স্থলী নির্মাণ আৰু খননৰ বাবে প্রয়োজন হোৱা পানীৰ বাবে ভূগর্ভৰ পানী প্রয়োজনীয় অনুমতি সহ ব্যৱহাৰ কৰা হ'ব।খোৱাপানীৰ ব্যৱস্থা package water ৰ দ্বাৰা কৰা হ'ব। উপৰঞ্চি ভাৱে পানী ধৰি ৰাখিবৰ বাবে এটা ১০০০ ঘনমিটাৰ গাত খন্দা হ'ব যাতে জৰুৰীকালীন সময়ত, যেনে জুই আদি নুমুৱাবৰ বাবে উপৰিভাগৰ পানী ব্যৱহাৰ কৰিব পাৰি।

উত্পাদন কেন্দ্রৰ বাবে প্রায় প্রতিদিনে ৩ ঘনমিটাৰ পানী শ্রমিকৰ বাবে নির্মাণৰ পর্যায়ত প্রয়োজন হ'ব। প্রায় ২০ ঘনমিটাৰ পানী প্রডাক্সন ইনষ্টলেচনৰ পৰিচালনৰ বাবে প্রতিদিনে প্রয়োজন হ'ব। পানীৰ আৱশ্যকীয় অনুমতি পোৱাৰ পিছত ভূজলৰ যোগেদি পানীৰ প্রয়োজনীয়তা পুৰণ কৰা হ'ব।

জনশক্তি : Drilling ৰিগ পৰিচালনা কৰিবৰ বাবে কিছুমান বিশেষ সময়ত প্রায় ৫০ জন লোকৰ প্রয়োজন হ'ব। তেওঁলোকে দুটা shift ত অবিৰত ভাৱে কাম কৰিব। এওঁলোকৰ লগত থাকিব কাৰিকৰী বিশেষজ্ঞ, বিশেষজ্ঞ আদি। এওঁলোক খননৰ লগত জৰিত সকলো বোৰ কামৰ বাবে দায়বদ্ধ হ'ব। প্রকল্পটোৰ ব্যৱস্থাপনাৰ বাবে সাময়িক ভাৱে প্রয়োজনীয় অপৈণত বনুৱা স্থানীয় এলেকাৰ পৰা পূৰণ কৰা হব।

উত্পাদন কেন্দ্রত তিনিটা চিফটত কাম চলিব য'ত প্রতিটো চিফটৰ বাবে ১০ জনকৈ ব্যক্তিয়ে কাম কৰিব।

প্রদূষণৰ উৎস

বায়ু নিৰ্গমণ : প্ৰধান উৎস সমূহ হ'ল জেনেৰটৰ, খননৰ কামত আৰু প্ৰডাক্সন ইনষ্টলেচন ব্যৱহৃত যান বাহন সমূহ আৰু ষ্টোৰেজ এলেকাৰ পৰা ওলোৱা ধূলি বালি যি বতাহৰ সহায়ত পৰিবাহিত হ'ব।

শব্দ আৰু কম্পন : প্ৰধান উৎস সমূহ হ'ব ড্ৰিলিং ৰিগ, DG/GG জেনেৰেটৰ আৰু বাহন সমূহ।

তৰল আৰ্বজনা : খননৰ সময়ত Rig চাফা কৰা, বোকা চাফা কৰা, drill cutting আদি চাফা কৰোতে ব্যৱহাৰ কৰা পানী। এই বৰ্জনীয় পানী সমূহ ETP (Effuent Treatment System) সহায়ত পৰিশোধন কৰি পুনৰ ব্যৱহাৰ কৰিব পৰা যাব।

উত্পাদন কেন্দ্ৰত প্ৰডিউচড্ ফৰ্মেচন ৱাটাৰৰ যাৱতীয় ব্যৱস্থাপনৰ পিছত খালি কূপত নিষ্পত্তি কৰা হ'ব; অইল ৱাটাৰ চেপাৰেটৰ (ওডব্লিউএছ) যোগে ব্যৱস্থাপনা কৰাৰ পিছত চাৰ্ফেচ ৱানঅফ কৰা হ'ব আৰু চেডিমেণ্টেচন টেংক প্ৰাকৃতিক খাৱৈত পেলাই দিয়া হ'ব।

আনুমানিক ৫০০ ঘনমিটাৰ drill cutting আৰু ৯০০ – ১২০০ ঘনমিটাৰ spent mud উৎপাদন হ'ব।

ড্ৰিল কাটিংছ আৰু স্পেণ্ট মাডঃ ড্ৰিল কাটিংছ আৰু স্পেণ্ট মাড ক্ষেত্ৰত থকা অভেদ্য লাইনাৰত সুআৰ্হিৰে নিৰ্মিত খালত নিষ্পত্তি কৰা হ'ব।

3. বুনিয়াদী পাৰিপাৰ্শ্বিক স্থিতি

ব্যৱহৃত আৰু অধিগৃহীত মাটি

খাগৰিজান ক্ষেত্ৰৰ ৪০৫ বৰ্গকিলোমিটাৰ এলেকাৰ ভিতৰত ৮০.৬৭ বৰ্গকিলোমিটাৰৰ কৃষিৰ বাবে, ১০৫.৮১ বৰ্গকিলোমিটাৰ চাহবাগান, নদী আৰু নদীগৰ্ভ অঞ্চলৰ লগতে ১০৬.৬৫ বৰ্গকিলোমিটাৰ মিটো পৰীক্ষণ কৰা অঞ্চলৰ ২৬.৩২ % পৰিবেষ্টিত। মানুহৰ বসতি প্ৰধান অঞ্চলৰ লগতে গছ গছনিয়ে ৭৯.৫১ বৰ্গকিলোমিটাৰআৱৰা। খাগৰিজান ক্ষেত্ৰৰ মাত্ৰ মাত্ৰ ২.২৮% বনাঞ্চলত আছে। ইয়াৰে ভিতৰত পৰে ঘাইকৈ ডিব্রু ছৈখোৱা ৰাষ্ট্ৰীয় উদ্যান আৰু পদুমণি সংৰক্ষিত বনাঞ্চল।

মাটিৰ গুণাগুণ

পাঁচটা বেলেগ বেলেগ ঠাইৰ পৰা বেলেগ বেলেগ ধৰণৰ মাটিৰ নমুনা সংগ্ৰহৰ পাছত কৰা পৰীক্ষাৰ পৰা গম পোৱা গ'ল যে মাটি খিনি লিকটীয়া আঠাযুক্ত, কিছু পৰিমাণে এঁচিদ গুণসম্পন্ন। মাটিৰ নমুনা আল্লিকতা থকা আলতীয়া, বালিয়া বোকামাটি আৰু বোকা পলসুৱা

মাটি। সুক্ষ্ম পুষ্টিকণাযুক্ত। মাটিৰ নমুনাৰ এনপিকে মূল্য বেছিৰ পৰা কম পোৱা গৈছিল। ধাতৱীয় প্ৰদূষণ পৰ্যবেক্ষণত পোৱা গৈছিল। পোষক পদাৰ্থ যেনে নাইট্ৰজেনৰ পৰিমাণ তুলনামূলক ভাৱে ভাল। ফচফৰাচ আৰু পটাচিয়ামৰ পৰিমাণ কম। প্ৰদূষিত ধাতু দেখা পোৱা নগল।

<u>জলবায়ু আৰু বতৰবিজ্ঞান</u>

সমীক্ষাত গম পোৱা গ'ল যে অঞ্চলটো আদ্ৰতা সম্পন্ন উষ্ণ অঞ্চল, ডিচেম্বৰৰ পৰা ফ্ৰেব্ৰুৱাৰীলৈকে থকা পৰিমিত ঠাণ্ডাৰ বাহিৰে। শীতকালত (ডিচেম্বৰ ২০১৭ ৰ পৰা ফ্ৰেব্ৰুৱাৰী ২০১৮) লোৱা প্ৰতি ঘণ্টাৰ ডাটা অনুসৰি অনুমান কৰা হৈছে যে ঘণ্টাত ০. ১৬ মিটাৰ per second বেগত উত্তৰ পূবৰ দিশৰ পৰা বতাহৰ গতিঅনুভূত হয়।

<u>বায়ুৰ গুণাগুণ</u>

ব্লক এলেকাৰ ভিতৰত আঠটা স্থানত চৌপাশৰ (Ambient) বায়ুৰ গুণাগুণ পৰ্য্যবেক্ষণ কৰা হয়। প্ৰাথমিক পৰ্য্যায়ৰ বায়ুৰ গুণাগুণৰ পৰীক্ষণৰ মাত্ৰা এনে ধৰণৰ

PM_{10} – ৭১.৫০ ৰ পৰা ৭৫.৯৬ $\mu g/m^3$

$PM_{2.5}$ – ৩৬.৩৮ৰ পৰা ৪২.৭২ $\mu g/m^3$

অন্যান্য গেচীয় উপাদান যেনে SO_2, NOx আৰু CO ইত্যাদিৰ পৰিমাণ NAAQS ৰ অনুমোদিত মাত্ৰাৰ ভিতৰতে আছে। সামগ্ৰিকভাৱে পৰ্য্যবেক্ষণ স্থলীত হাইদ্ৰকাৰ্বনৰ মাত্ৰা ১.৬৫ ৰ পৰা ২.০৭ ppm পোৱা যায়। আন সকলো non methane হাইদ্ৰকাৰ্বনৰ মাত্ৰা নুন্যতম পৰীক্ষণ (detection) স্তৰৰ (<0.৫ ppm) তলত। তেনেদৰে সকলো volatile organic compound (VOC) মাত্ৰাও চপাথোৱা স্থানৰ বাদে নুন্যতম পৰীক্ষণ স্তৰৰ তলত পোৱা যায়। চপাথোৱাত VOC ৰ মাত্ৰা অধিকতম ৪.২২ $\mu g/m^3$ জোখা হয়।

<u>শব্দৰ গুনাগুণ</u>

ব্লকৰ আশে পাশে থকা আঠটা অঞ্চলৰ শব্দৰ গুণাগুণ নিৰীক্ষণ কৰা হয়। প্ৰাথমিক শব্দৰ গুণাগুণ পৰীক্ষা কৰি দেখা গ'ল যে আবাসিক অঞ্চলৰ সমতুল্য শব্দৰ পৰিমাণ দিনৰ ভাগত ৫২.৯-৫৪.৯ dB(A) আৰু ৰাতিৰ ভাগত ৪০.০-৪৪.৬ dB(A) ৰ ভিতৰত। ৰাতিৰ শব্দ প্ৰদূষণ আঠোটা অঞ্চলতে ৪৫ dB(A) Standard অনুযায়ী মান্য।

<u>ভূগর্ভৰ পানীৰ গুণাগুণ</u>

ব্লকৰ দাতি কাষৰীয়া চাৰিটা অঞ্চলৰ ভূগর্ভস্থ পানীৰ পৰ্য্যবেশন কৰি কিছু পৰিমাণে এচিডযুক্ত পোৱা গ'ল(pH-৬.৫৪-৬.৮৪) লগতে বেছিভাগ নমুনাই ঘোলা আৰু লৌহ মৌলযুক্ত তথা যি স্বীকৃত IS: ১০৫০০:২০১২ ৰ মান্যতা তকৈ বেছি। বাকী পাৰামিটাৰ বোৰ খোৱাপানীৰ মান্যতাৰ লগত সঙ্গতিপূর্ণ (IS: ১০৫০০:২০১২)।

কিছুমান নমুনাত গ্রহণযোগ্য সীমালৈ নাইট্রেট আদিৰ দৰে মৌলৰ মাপদণ্ডৰ হিচাপত উপস্থিতিৰ কথা প্রকাশ পাইছে। অন্যথা গৰিষ্ঠসংখ্যকৰ মাপদণ্ডৰ ঘনত্ব গ্রহণযোগ্য সীমা IS: ১০৫০০:২০১২ মানকৰ ভিতৰতে পোৱা গৈছে।

ভূপৃষ্ঠৰ পানীৰ গুণাগুণ

ব্রহ্মপুত্র, ডাঙৰী, দিনজান নদীৰ পানী পৰীক্ষা কৰি পোৱা গ'ল যে পানীৰ গুণগত মান CPCB Class D ৰ লগত সঙ্গতিপূর্ণ। অর্থাৎ বন্যজীৱন আৰু মৎস্যৰ বিস্তাৰ উপযোগি।

জৈৱিক পৰিবেশ

ভেৰজান-বৰজান-পদুমণি বন্যপ্রাণী অভয়াৰণ্যৰ পদুমণি আৰু ভেৰজান খণ্ড খাগৰিজান ক্ষেত্রত পৰে। ডিব্রু ছৈখোৱা ৰাষ্ট্রীয় উদ্যানখন ক্ষেত্রৰ উত্তৰাঞ্চলত অৱস্থিত। বনাঞ্চলৰ ভিতৰত এটাও কূপ নাইবা উত্পাদন কেন্দ্র নপৰে। অধ্যয়ন কেন্দ্রত অনুসূচী ১ৰ প্রজাতি হিচাপে বর্গীকৰণ কৰা চাৰিটা স্তন্যপায়ী প্রজাতি থকা বুলি প্রতিবেদন পোৱা গৈছে। অনুসূচী ১ৰ ভিতৰত পৰা কোনো পক্ষী, উভচৰ অথবা সৰিসৃপ প্রজাতি অধ্যয়ন ক্ষেত্রত পোৱা নগ'ল।

আর্থ সামাজিক পৰিবেশ

প্রস্তাৱিত খাদৰ ১ কিলোমিটাৰৰ ভিতৰত ২৯ খন গাওঁ আছে। জনসংখ্যাৰ বেছিভাগেই কৃষিৰ লগত জড়িত। ধানেই প্রধান উৎপাদিত সামগ্রী। কিছুমান মানুহে চাহ বাগানত এ কাম কৰে দৈনন্দিন ব্যৱহৃত পানীৰ প্রয়োজনীয়তা দমকলৰ পানীৰেই পূৰণ কৰা হয়। আটাই কেইখন গাৱঁতে প্রাথমিক বিদ্যালয় আছে।কিন্তু উচ্চ শিক্ষাৰ হাৰ নিম্ন। প্রাথমিক স্বাস্থ্যকেন্দ্র আছে উন্নত চিকিৎসাৰ বাবে স্থানীয় বাসিন্দা সকল তিনিচুকীয়া আৰু ডিব্রুগড়লৈ যাবলগীয়া হয়।

4. প্রভাৱৰ মূল্যায়ন

নির্মাণআৰু খননৰ ফলত পৰা প্রধান প্রভাৱ সমূহ তলত দিয়া ধৰণৰ :

বায়ুৰ গুণাগুণ : নির্মাণ আৰু খননৰ সময়ত চলোৱা জেনেৰেটৰ, যান বাহনৰ চলাচল আৰু মেচিনৰ ব্যৱহাৰে বায়ু প্রদূষণৰ কাৰক সৃষ্টি কৰিব পাৰে। কিছুমান বিশেষ সময়ত, হাইড্রকার্বন আৰু NOx ও খননৰ সময়ত উৎপাদন হ'ব পাৰে।

শব্দৰ গুণাগুণ : উচ্চ ক্ষমতা সম্পন্ন মেচিন, সৰঞ্জাম, যান বাহনৰ ব্যৱহাৰে শব্দৰ মাত্রা বৃদ্ধি কৰিব পাৰে। খননৰ সময়চোৱাত ড্রিলিং ৰিগ আৰু আন আনুসঙ্গিক সা সৰঞ্জাম যেনে Shale Shaker, mud pump আৰু ডিজেল / গেছ জেনেৰেটৰ আদিৰ ব্যৱহাৰে অপাৰেচনৰ সময়চোৱাতসাময়িক ভাৱে হলেও শব্দৰ মাত্রাত প্রভাৱ পৰাৰ সম্ভাৱনা আছে।

মাটিৰ গুণাগুণ : প্ৰকল্প এলেকাত ভূপৃষ্ঠৰ মাটিখিনি খন্দাৰ ফলত মাটিৰ সৰুৱা গুণ সাময়িক ভাৱে নাইকিয়া হ'ব পাৰে। ত্ৰুটিপূৰ্ণভাৱে ৰখা সামগ্ৰীবোৰআৰু প্ৰকল্পত ব্যৱহৃত হোৱা তেল, মবিল, খননৰ পৰা ওলোৱা বোকা মাটি আদিৰ ফলত মাটিৰ ওপৰত প্ৰতিকূল প্ৰভাৱ পৰিব পাৰে।

পানীৰ গুণাগুণ আৰু ভূবিজ্ঞান : খননৰ সময়ত নিষ্কাষিত হোৱা বৰ্জনীয় পানী ভাগ ETP ৰ সহায়ত শোধন কৰা হ'ব। দিচে নলা প্ৰকল্পৰ ওচৰতে হোৱাৰ বাবে পৰিশোধিত তথা নিষ্কাষিত পানীভাগ দিচে নলাত পৰাৰ সম্ভাৱনা আছে। যিহেতু বৰ্জনীয় পানী ভাগ চেডিমেণ্টেচন টেংক আৰু অইল ৰাটাৰ চেপাৰেটৰ (ওডব্লিউএছ) ৰ সহায়ত পৰিশোধিত কৰা হ'ব সেইবাবে ভূপৃষ্ঠৰ পানীভাগ দূষিত হোৱাৰ সম্ভাৱনা কম হ'ব।

জৈৱিক পাৰিপাৰ্শ্বিকতা : প্ৰকল্প স্থাপনৰ বাবে চাফা কৰাৰ সময়ত প্ৰতিটো খনন স্থলীৰ সৰু (প্ৰায় ৩ হেক্টৰ) তৃণ আৰু গুল্ম জাতীয় গছবোৰ চাফা কৰা হ'ব যদিও ডাঙৰ গছ গছনি কটা নহয়।

খনন কাৰ্য্য আৰু বাহনৰ চলাচলে খনন স্থলী আৰু ওচৰৰ ৰাষ্টা ঘাটত থকা চৰাই, সৰীসৃপ আৰু স্তন্যপায়ী প্ৰাণীৰ ওপৰত প্ৰভাৱ পেলাব পাৰে আৰু সেইবোৰ সাময়িক ভাৱে প্ৰকল্প স্থলী এৰি যাব পাৰে। পৃথকীকৃত গোটা পদাৰ্থ বোৰে পানীৰ ক্লেদাক্ত ভাৱ বৃদ্ধি কৰিলে পানীৰ অক্সিজেন লেভেলৰ ওপৰত বিৰূপ প্ৰভাৱ পেলাব পাৰে। ক্লেদাক্ত পানী আৰু কমি যোৱা অক্সিজেন লেভেলে নদীকাষৰীয়া ঠাইবোৰ উৎপাদন ক্ষমতাৰ ওপৰত প্ৰভাৱ পেলাব পাৰে। এই প্ৰক্ৰিয়া উপযুক্ত ভাৱে ETP ৰ সহায়ত পৰিশোধিত কৰি ঔদ্যোগিক প্ৰবাহিত নিৰ্গমণৰ মান্যতা বজাই ৰখা হ'ব। এই পৰিশোধিত নিৰ্গমণ ব্যৱস্থাই পানীৰ গুণগত মানৰ পৰিবৰ্তন নকৰিব।

আৰ্থ সামাজিক পাৰিপাৰ্শ্বিকতা : প্ৰকল্পটোৰ বাবে প্ৰয়োজনীয় মাটি কিনা হ'ব স্থানীয় লোকৰ পৰা। মাটিৰ বাবে কোনো ধৰণৰ স্থানচ্যুতি নহ'ব। প্ৰতিটো প্ৰকল্পস্থলীৰ বাবে প্ৰয়োজন হোৱা মানুহৰ মাটিৰ পৰিমাণ হ'ব প্ৰায় ৩ হেক্টৰ। পুৰণা NH-৩৭ ৰাষ্ট্ৰীয় পথৰ পৰা প্ৰকল্প স্থলীলৈ নিৰ্মাণ কৰিব লগীয়া ১০০-১৫০ মিটাৰ উপপথ নিৰ্মাণৰ বাবেও মাটি ক্ৰয় কৰা হ'ব।

অইল/অইলৰ ঠিকাদাৰ সকলে প্ৰয়োজনীয়তা অনুপাতে স্থানীয় অপৈণত বনুৱা মকৰলৰ বাবে উদ্যম লব লাগিব। যি কি নহওঁক এই বনুৱাৰ প্ৰয়োজন সম্পূৰ্ণৰূপে সাময়িক হব আৰু প্ৰকল্প শেষ হোৱালৈকেহে থাকিব দক্ষ আৰু সুদক্ষ অভিবাসী বনুৱা ঠিকাদাৰ সকলে যোগান ধৰিব।

প্ৰকল্প নিৰ্মাণৰ সময়ত প্ৰত্যক্ষ আৰু পৰোক্ষ ক্ষণস্থায়ী ভাৱে সাময়িক ভাৱে কৰ্মসংস্থাপনৰ সুবিধা ওলাব। আনুমানিক হিচাপ মতে নিৰ্মাণৰ কাম পূৰ্ণোদমে চলি থকাৰ সময়ত প্ৰত্যক্ষ

ভাৱে নিয়োজিত কর্মী প্রায় ৫০ জন অপৈণত বনুৱাৰ প্রয়োজন হব। অস্থায়ীভাৱে প্রয়োজন হোৱা অপৈণত বনুৱাসমূহ ওচৰৰ গাওঁবোৰৰ পৰা পূৰণ কৰিব পৰা যাব।

<u>জনস্বাস্থ্য আৰু সুৰক্ষাৰ ওপৰত প্রভাৱ</u> : গাওঁৰ মাজেৰে গধুৰ যান বাহনৰ চলাচল, ৰিগৰ পৰা হোৱা শব্দ প্রদূষণে জনস্বাস্থ্য আৰু সুৰক্ষাৰ ওপৰত প্রভাৱ পেলাব। সকলোৱে নিৰাপত্তাৰ প্রতি লক্ষ্য ৰাখি যাতায়তৰ নিয়ম সমূহ কঠোৰ ভাৱে প্রকল্পৰ লগত জড়িত লোক সকলে মানি চলিব লাগিব।

5. পৰিবেশ নিয়ন্ত্রণ আঁচনি

পৰিবেশ নিয়ন্ত্রণ আঁচনিৰ অন্তর্গত বিষয়বোৰ তলত দিয়া ধৰণৰ

- চৌপাশৰ বায়ুৰ গুণাগুণ: তিনিটা অৱস্থান, এবাৰ নির্মাণৰ সময়ত, দুবাৰ খননৰ সময়ত আৰু এবাৰ নির্মাণ স্থলী সামৰাৰ সময়ত গুণাগুণ পৰীক্ষা কৰিব;খননৰ সময়ত জেনেৰেটৰ পৰা হোৱা নির্গমণ পৰীক্ষা কৰিব।
- চৌপাশৰ শব্দৰ গুণাগুণ: তিনিটা নিয়ন্ত্রণৰ অৱস্থান, এবাৰ নির্মাণৰ সময়ত, দুবাৰ খননৰ সময়ত আৰু এবাৰ নির্মাণ স্থলী সামৰাৰ সময়ত পৰীক্ষা কৰিব।
- কর্মস্থলীৰ শব্দ প্রদূষণ নিয়ন্ত্রণ : ৫ টা বিশেষ স্থানত খননৰ সময়চোৱাত দুবাৰকৈ পৰীক্ষা কৰিব।
- ভুপৃষ্ঠৰ পানীৰ গুণাগুণ: এবাৰ নির্মাণৰ সময়ত, এবাৰ খননৰ সময়ত আৰু এবাৰ নির্মাণ স্থলী সামৰাৰ সময়ত গুণাগুণ পৰীক্ষা কৰিব।
- পৰিশোধিত পানীৰ গুণাগুণ: দুটা ETP ৰ পৰা, এটা অইল ৰাটাৰ চেপাৰেটৰ ৰ পৰা খননৰ সময়চোৱাত এবাৰকৈ পৰীক্ষা কৰিব।
- ভূগর্ভৰ পানীৰ গুণাগুণ: খননৰ সময়চোৱাত এবাৰকৈ পৰীক্ষা কৰিব।
- মাটিৰ গুণাগুণ: এবাৰকৈ নির্মাণৰ পূর্বে, খননৰ সময়ত আৰু খননৰ পাছত পৰীক্ষা কৰিব।

উত্পাদন কেন্দ্রত স্বাভাৱিক বাতাবৰণ, জিজি চেটযোগে ষ্টেক এমিছন, পাৰিপার্শ্বিক আৰু কর্মস্থলীৰ শব্দৰ নিৰীক্ষণ, ব্যৱস্থিত বর্জ্য পানীৰ নিৰীক্ষণ আৰু মাটিৰ গুণাগুণৰ নিৰীক্ষণ বছৰত দুবাৰকৈ কৰা হ'ব।

6. প্রকল্পৰ লাভ

- অসম চৰকাৰলৈ অধিক ৰাজহ আৰু ভাৰত চৰকাৰলৈ অধিক শুল্ক;
- স্থানীয় লোকৰ বাবে নিয়োগৰ অধিক সুবিধা;
- অঞ্চলটোৰ আন্তঃগাঁথনিৰ বিকাশ (ৰাস্তা, কালভার্ট, দলং, স্কুল ইত্যাদি);

- স্থানীয় লোকৰ বাবে ব্যবসায়ীক সুযোগ বৃদ্ধি;
- দেশখনৰ বাবে শক্তি প্ৰতিৰক্ষা;
- অইলৰ কৰ্পৰেট ছচিয়েল ৰেচপনচিবিলিটি (চিএছআৰ) কাৰ্যসূচীৰ অধীনত জীৱিকা সৃষ্টি, স্বাস্থ্যৰ উন্নতি।

7. Risk মূল্যায়ন আৰু প্ৰশমন

সংখ্যাত্মক সংকাত মূল্যায়নৰ (QRA) লক্ষ্য হ'ল প্ৰস্তাৱিত পাঁচোটা অনুসন্ধানমূলক খাদৰ খননৰ সময়ত হ'ব পৰা ডাঙৰ সংকাত সমূহৰ প্ৰণালীবদ্ধ বিশ্লেষণ কৰা। QRA এ পদ্ধতিগত আঁচনিৰ জৰিয়তে যুক্তিসংগত মূল্যায়নেৰে হব পৰা সংকট সমূহ চিনাক্ত কৰিব আৰু প্ৰতিৰোধ আৰু নিয়ন্ত্ৰণ কৰাৰ বাবে আঁচনি প্ৰস্তুত কৰিব।

প্ৰস্তাৱিত প্ৰকল্পৰ সতে জড়িত থকা তিনিবিধ ডাঙৰ হানিকাৰক সংকাত সমূহ হ'ল-

- অনিয়ন্ত্ৰিত ভাৱে খাদৰ পৰা ওলোৱা গেচীয় পদাৰ্থ, Jet fires, Pool Fires আদি;
- খননৰ সময়ত ধাৰণ ক্ষমতা কম হোৱাৰ ফলত হাইড্ৰকাৰ্বনৰ লিক হোৱা;
- আঁচনি বিহীন ভাৱে লগোৱা জুই, বিস্ফোৰণ, হঠাতে উফৰি অহা কোনো বিপদজনক পদাৰ্থ আৰু কাম কাজৰ পৰা হ'ব পৰা ঘটনা যাৰ ফলত কৰ্মস্থলীতে মানুহৰ মৃত্যু বা সাংঘাটিক ধৰণে আঘাট পাব পাৰে; আৰু
- আন যিকোনো ঘটনা যিটোৱে ৰিগৰ ক্ষতিসাধন কৰিব পাৰে।

বিপদশংকা হ্ৰাসকৰণ ব্যৱস্থা

- Kick Simulation প্ৰশিক্ষণ
- উপযুক্ত ভাৱে প্ৰশিক্ষণপ্ৰাপ্ত ইঞ্জিনীয়াৰৰ উপস্থিতি
- খাদৰ উপযুক্ত নক্সা
- উপযুক্ত খাদ নিয়ন্ত্ৰণ প্ৰক্ৰিয়া
- উপযুক্ত বোকা (Mud) প্ৰক্ৰিয়া
- প্ৰাথমিক আৰু আনুসংগিক নিৰ্গমণ নিৰ্বাৰক স্থাপন
- দক্ষ আৰু প্ৰশিক্ষণপ্ৰাপ্ত পৰীক্ষণ কৰ্মী।

যন্ত্ৰপাতিৰ ছিদ্ৰৰ পৰা হোৱা দুৰ্ঘটনা হ্ৰাসকৰণ

- যন্ত্ৰপাতি সমূহৰ পৰিকল্পনা, স্থাপন আৰু ভালদৰে ৰখাৰ বাবে আন্তঃৰাষ্ট্ৰীয় মানৰ আঁচনি হ'ব লাগে
- প্ৰতিটো safety critical যন্ত্ৰৰ বাবে এক উপযুক্ত নিবাৰক তত্বাবধান প্ৰক্ৰিয়া প্ৰণয়ন
- দক্ষ test separator।

সংৰক্ষিত এলেকাৰ বিপদৰোধৰ উপায়

- উপযুক্ত তত্বাবধান প্রক্রিয়া, সবল নিৰাপত্তা ব্যৱস্থা আৰু সুৰক্ষা প্রক্রিয়া
- Storage tank ৰ বাবে আনুসংগিক সংৰক্ষণ ব্যৱস্থা।

আন বিপদ শংকা ব্যৱস্থাপনা লাভ কৰাৰ উপায়

- Hydrocarbon Gas Detection System যাৰ লগত দুটা alarm ৰ ব্যৱস্থা থাকিব ২০% আৰু ৬০% LEI পর্য্যায়ৰ।
- Oil Spills/Leaks and Soil Contamination প্রক্রিয়া।

৪. পৰিবেশ ব্যৱস্থাপনা প্রক্রিয়া

<u>বায়ু প্রদূষণ ব্যৱস্থাপনা প্রক্রিয়া</u>

- বাহনে কঢ়িওৱা কেচাঁ সামগ্রী সমূহ ঢাকি ৰখা হব যাতে fugitive emission ৰোধ কৰিব পাৰি।
- বান্ধ, সামগ্রী কঢ়িওৱা ৰাষ্টাবোৰত আৰু সামগ্রীৰ ওপৰত নির্মাণৰ সময়ত পানী চটিওৱা।
- পর্যাপ্ত উচ্চতাৰ Flare Stack বনোৱা।
- নিয়ম অনুসৰি পর্যাপ্ত উচ্চতাৰ জেনেৰেটৰ stack বনোৱা।
- Environmental Monitoring System ৰ লগত সংগতি ৰাখি সময় মতে জেনেৰেটৰ Stack পর্য্যবেশন কৰা যাতে CPCB DG Set Exhaust মানৰ লগত পৰিমাপৰ মিল থাকে।

<u>শব্দ প্রদূষণ ব্যৱস্থাপনা প্রক্রিয়া</u>

- কম শব্দ ওলোৱা যন্ত্রপাতিৰ নির্বাচন আৰু ব্যৱহাৰৰ ওপৰত গুৰুত্ব দিয়া।
- বেছি শব্দ হোৱা ঠাইত কাম কৰোতে শ্রমিকসকলে প্রয়োজনীয় PPEs বিশেষকৈ Ear Plug পিন্ধাটো বাধ্যতামূলক কৰা।
- কেঁচা সামগ্রী আৰু মানুহ কঢ়িৱাওতে ব্যৱহাৰ হোৱা গাড়ী বোৰৰ ন্যায়সংগত Pollution Under Control Certificates (PUC) থকাটো বাঞ্চনীয়।
- বেচিকৈ শব্দ উৎপাদন হোৱা যন্ত্র পাতিবোৰ বিচাৰি উলিওৱা আৰু সময়মতে সেইবোৰৰ মেৰামতি কৰা।
- নিশাৰ ভাগত যানবাহনৰ চলাচল আৰু নির্মাণৰ কাম বন্ধ ৰখা।

মাটিৰ গুণাগুণ ব্যৱস্থাপনা প্ৰক্ৰিয়া

- যানবাহন আৰু যন্ত্ৰপাতিৰ মেৰামতি আৰু ইন্ধন ভৰোৱাৰ সময়ত Drip Tray ব্যৱহাৰ কৰা।
- তেল মবিল জাতীয় বস্তুবোৰ ৰখা ঠাইত হাততে পোৱাকৈ Spill Kit ৰখাটো প্ৰয়োজনীয়। এইবোৰ উপচি পৰিলে বা ফুটাৰে বৈ আহিলে লগে লগে ফুটা বন্ধ কৰি ঠাইডোখৰ চাফা কৰা আৰু কৰ্তৃপক্ষক অৱগত কৰা।
- Dedicated Paved Storage অঞ্চল চিনাক্ত কৰা হব ৰাসায়নিক, তেল, মবিল আদিৰ বাবে।
- ১.৫ mm HDPE লাইনেৰে আবৃত গাঁত(pit) ব্যৱহাৰ কৰা হব।

ভূপৃষ্ঠৰ পানীৰ গুণাগুণ ব্যৱস্থাপনা প্ৰক্ৰিয়া

- প্ৰকল্পৰ মাটিভাগ সমানকৈ প্ৰস্তুত কৰাৰ সময়ত সামান্য ভাৱে মাটিবোৰ খন্দা যাতে মাটিৰ আকৃতি,অৱয়বৰ ওপৰত কম প্ৰভাৱ পৰে।
- প্ৰকল্প স্থানৰ প্ৰস্তুতি আৰু নিৰ্মাণৰ সময়ত ভূপৃষ্ঠৰ ভাগ উপযুক্ত ভাৱে নিৰ্মাণ কৰা নলাৰে বোৱাই পঠিওৱা হ'ব।
- Sediment Filters and অইল ৰাটাৰ চেপাৰেটৰ প্ৰকল্প স্থানত উৎপাদন হোৱা গাৰ্হস্থ্য বৰ্জ্য জল চেপটিক টেংক আৰু soak pit ৰ মাধ্যমেৰে এৰি দিয়া হ'ব।
- বৰ্জনীয় পানীভাগ Effluent Treatment Plant (ETP) সহায়ত পৰিশোধন কৰা হ'ব।

পথাৰৰ পানীৰ গুণাগুণ ব্যৱস্থাপনা প্ৰক্ৰিয়া

- Water Based Mud (পানীমিহলি মাটি)প্ৰস্তাৱিত প্ৰকল্পৰ খননৰ সময়ত ব্যৱহাৰ কৰা হ'ব।
- Eco Friendly Synthetic mud প্ৰয়োজন অনুপাতে ব্যৱহাৰ কৰা হ'ব Pollution Control Board ৰ অনুমতি সাপেক্ষে।
- Spent Mud ৰ লগতে Drill Cutting বোৰ HDPE Lined Pit ত ৰখা হ'ব।

আৰ্বজনা ব্যৱস্থাপনা প্ৰক্ৰিয়া

- খনন তৰল (Fluid) প্ৰস্তুত কৰাৰ বাবে কম বিষাক্ত ৰাসায়নৰ ব্যৱহাৰ।
- তেল খনন বা গেচ নিষ্কাষন উদ্যোগ সমূহৰ পৰা বৰ্জনীয় পদাৰ্থৰ মান 2005 চনৰ সংশোধিত CPCB ৰ অনুসৰি হ'ব লাগিব।
- বিপদজনক আৰ্বজনাৰ (আৰ্বজনা আৰু ব্যৱহৃত তেল) ব্যৱস্থাপনা চনৰ Hazardour Waste (Management, Handling & Transboundary) ২০১৬ আইন মতে হ'ব লাগিব।
- পাকঘৰৰ আৰ্বজনাবোৰ ওচৰৰ পৌৰসভা বা গাঁৱৰ আৰ্বজনা পেলোৱা ঠাইত হ'ব।
- নলা নৰ্দমাৰ আৰ্বজনা চেপটিক টেংক আৰু soak pit ৰ মাধ্যমেৰে এৰি দিয়া হ'ব।

- ব্যৱহৃত বেটাৰীবোৰ ২০০১ চনৰ Batteries (Management and Handling) Rules অনুসৰি Acid Battery যোগানকাৰী জৰিয়তে পুনঃব্যৱহাৰ কৰা হ'ব।
- বাৰিষাৰ সময়ত Drilling Cuttings Pit বোৰ টাৰপলিনেৰে বান্ধি ঢাকি ৰখা হ'ব।

<u>বন্যপ্রাণী ব্যৱস্থাপনা প্রক্রিয়া</u>

- নিশাৰ ভাগত গধু�ৰ যানবাহনৰ চলাচল বন্ধ ৰখা হব যদিহে পথচোৱা জঙ্গলৰ ওচৰত হয় কাৰণ নিশাৰ ভাগত জীব জন্তু Mammal বোৰ বাহিৰলৈ ওলাই আহে।
- কম শব্দ ওলোৱা যন্ত্রপাতিৰ নির্বাচন আৰু ব্যৱহাৰৰ ওপৰত গুৰুত্ব দিয়া।
- সাময়িক ভাৱে কোনো বিদ্যুৎ সংযোগ Grid ৰ পৰা লোৱা নহয়। বিদ্যুৎৰ প্রয়োজনীয়তা জেনেৰেটৰৰ সহায়ত পূৰণ কৰা হ'ব।

<u>পথ সুৰক্ষা আৰু যাতায়ত ব্যৱস্থাপনা প্রক্রিয়া</u>

- যিবোৰ পথ আৰু দলঙেৰে যানবাহন আৰু ড্রিলিং ৰিগ বোৰৰ যাতায়ত হব সেইবোৰ চিনাক্ত কৰি মেৰামতি কৰা হব।
- বাট পথৰ যাতে ক্ষতি নহয় তাৰবাবে সাৱধানতা অৱলম্বন কৰিব লাগিব।
- বেছি মানুহৰ সমাগম হোৱাৰ সময়ত যাতায়ত ব্যৱস্থা নিয়ন্ত্রণ কৰা হ'ব।

<u>পেশাদাৰী স্বাস্থ্য আৰু সুৰক্ষা ব্যৱস্থাপনা প্রক্রিয়া</u>

- ব্যৱহৃত যন্ত্র পাতি সমূহ Indian Standards (IS) কডৰ সমপর্য্যায়ৰ হব লাগিব। ভাল অৱস্থাত থাকিব লাগিব, সময়ে সময়ে পৰীক্ষা আৰু মেৰামতি কৰিব লাগিব IS বিধান অনুসৰি।
- বিপজ্জনক ঠাই, সংস্থাপনা, সা সৰঞ্জাম, সুৰক্ষা সামগ্রী, জরুরীকালীন প্রস্থান আদি যথোপযুক্ত ভাৱে চিন দি থোৱা হ'ব।

<u>সামাজিক বিষয় ব্যৱস্থাপনা</u>

- অস্থায়ীভাবে প্রয়োজন হোৱা অপৈণত বনুৱাৰ নিযুক্তিত কাষৰীয়া গাঁৱৰ লোকসকলক আগস্থান দিয়া হব।
- প্রকল্প স্থাপনৰ পূর্বে কাষৰীয়া লোকৰ লগত মত বিনিময় কার্য্যসূচী গ্রহণ কৰা, স্থানীয় লোকৰ লগত প্রকল্পৰ লক্ষ্যৰ বিষয় আলোচনা কৰা, প্রকল্পৰ ফল আৰু উপশমৰ আলোচনা কৰা আদি।
- Corporate Social Responsibility (CSR) আঁচনি অনুসৰি ঠাইডোখৰৰ উন্নতি, স্বাস্থ্য সম্বন্ধীয় সুবিধাবোৰৰ উন্নতি, খোৱাপানীৰ ব্যৱস্থা আদিৰ ক্ষেত্রত গুৰুত্ব প্রদান কৰা।
- প্রকল্পস্থানত বেৰ আৰু গেট দিয়া হব যাতে সৰু লৰা ছোৱালীবো লগতে ঘৰচিয়া জীব জন্তু ভিতৰলৈ সোমাব নোৱাৰে।

জৰুৰীকালীন প্ৰতিক্ৰিয়া ব্যৱস্থা

- ড্ৰিলিং ৰিগ আৰু তাৰ লগত জড়িত যন্ত্ৰপাতি সমূহৰ মান আন্তৰাষ্ট্ৰীয় পৰ্য্যায়ৰ হব লাগিব।
- Blow Out Preventers আৰু তাৰ লগত জড়িত যন্ত্ৰপাতি সমূহৰ মান, আন্তৰাষ্ট্ৰীয় পৰ্য্যায়ৰ হব লাগিব।
- প্ৰয়োজনীয় গেছ ছিদ্ৰ সনাক্তকৰণ পদ্ধতি খনন স্থান আৰু উৎপাদন সমূহত সহজলভ্য হব লাগে।
- অগ্নি নিৰ্বাপন সামগ্ৰী যোগান ধৰিব লাগিব।

9. প্ৰকল্পৰ খৰছ

প্ৰকল্পৰ সৰ্বমূঠ ব্যয় প্ৰায় ১৯৮৮.৬২ কোটি টকা হ'ব। ইএমপি ৰুপায়নৰ ব্যয় প্ৰতি কূপ হিচাপত প্ৰায় ১০.২২ লাখ টকা ব্যয় হ'ব। প্ৰত্যেকটো উত্পাদন কেন্দ্ৰৰ ইএমপি ৰুপায়নৰ ব্যয় হ'ব ৬.২৭ লাখ টকা প্ৰতি বছৰ।

EXECUTIVE SUMMARY

INTRODUCTION

Oil India Ltd. (OIL) is currently planning for drilling of 54 onshore exploratory and developmental wells, 2 nos. of production installations and laying of approximately 201 km of pipelines in Khagorijan Field located in Tinsukia and Dibrugarh District of Assam. The pipelines include 200 mm 21 km long crude oil pipeline from East Khagorijan GGS to Dikom OCS, 300 mm 20 km long natural gas pipeline from East Khagorijan GGS to Chabua FGGS, 200 mm 10 km long natural gas pipeline from Nadua OCS to Dikom OCS and 50 mm to 300 mm approx. 150 km long assorted oil & gas flowlines/ delivery lines in Khagorijan Oil & Gas Field under Dibrugarh and Tinsukia district of Assam.

The exploration of oil and gas is included under activities has been categorized as "A" level project in EIA Notification, 2006 that requires an Environmental Clearance (EC) from the Ministry of Environment, Forests and Climate Change (MoEFCC). MoEFCC has issued an approved Terms of Reference ToR vide J-11011/35/2018-IA II (I) dated 11th March 2018 to OIL for conducting the EIA study.

The scope of the EIA study will be to establish the likely effect of drilling and production activities in Khagorijan Field on the physical, social and biological environment of the surrounding areas. The scope of the EIA is delineated in line with the approved Terms of Reference (ToR) received from MoEFCC.

PROJECT DESCRIPTION

Location and Accessibility

The Khagorijan Oil and Gas Field is located in Dibrugarh and Tinsukia districts of Assam. Total area of Khagorijan Oil and gas Field is 405 sq. km. NH 37, being the most prominent road in the region, runs through the southern side of Khagorijan Field, in an east to west orientation. This road connect Tinsukia town located in the south eastern corner of the Field, with Dibrugarh town located on the south western side, outside the Field. Tinsukia Junction and New Tinsukia Junction are the major railway stations within the Field.

Environmental Settings of Khagorijan Field

Khagorijan Field is located in the drainage basin of Brahmaputra River. Apart from Brahmaputra (flowing through North). The branch of the Brahmaputra River, Dangori River flows within Field from north-eastern to the northwestern part. Dinjan river that flows more or less through the southern part of the Field. North eastern part of the Khagorijan Field falls within the buffer of Dibru-Saikhowa National Park. Apart from Padumoni section (1.7

sq. Km) of the Bherjan-Borajan-Padumoni Wild Life Sanctuary falls in the eastern part of the Field. The field mostly comprises with large tea estate, rural area with agricultural lands, settlements and homestead plantation. Major tea estate within the field area are Oakland T.G, Hazelbank T.G, Nadua T.G, North Balijan T.G, Dinjoy T.G, Kharjan T.G, Panitola T.G, Dinjan T.G, Rangagora T.G, Nalani T.G, Nokhroy T.G, Limbugudi T.G. etc.

Environment setting of the Well sites and Production Facilities

Among the 54 wells, 9 wells are located in agricultural land, 8 wells located in homestead plantation area, 26 wells located in tea garden, 1 wells located in brick field and 26 wells located in existing well sites of OIL. One production facility is located in agricultural land and the other is located in tea garden.

Project Activities

Land Procurement

The land required for the well sites and production facilities will be procured from the local villagers through direct purchase. Generally, OIL will procure the required land through private negotiation. In few cases, OIL may apply the provision of Rule-189/190 of AL&RR, 1886, if private negotiation is not successful. Land procurement will be done including crop compensation. No physical displacement will not occur; hence, resettlement and rehabilitation will not be applicable for this project.

Site Preparation & Construction Drill site

Site preparation will involve levelling, filling and consolidation of the site for staging equipment and machinery. Individual sites will be duly fenced to a height of about 2 m using jingle wired fencing or Xpm fencing.
Preparation and construction of drill sites and production facilities will involve top soil scraping and storage for future use, elevating the site by excavated material from the site and material brought from authorized quarry area. Reinforced Cement Concrete (RCC) will be used for the construction of foundation system at drill sites. For making foundations of the main rig structure, cast in-situ bored under- reamed piles of specified lengths will also be used.

Drilling & Testing

The exploitation of hydrocarbons requires the construction of a conduit between the surface and the reservoir. This is achieved by the drilling process. The exploration wells will be drilled using a standard land rig or a "Mobile Land Rig" with standard water based drilling fluid treatment system. This rig will be suitable for deep drilling up to the desired depth of 3900 metres as planned for the project.

During drilling operations, a fluid known as drilling fluid (or 'mud') is pumped through the drill string down to the drilling bit and returns between the drill pipe –casing annulus up to surface back into the circulation system after separation of drill cuttings /solids through solids control equipment. Drilling fluid is essential to the operation and helps in controlling down hole

pressure, lift soil/rock cuttings to the mud pit, prevent cuttings from settling in the drill pipe, lubricate, cool and clean the drill bit.

Drill cuttings generated will be collected and separated using a solid control system and temporarily stored on-site in HDPE lined pits. Drilling and wash wastewater generated will also be stored at an onsite HDPE lined pit. The water will be adequately treated in a mobile ETP to ensure conformance to the S No. 72 A (ii) Schedule I - Standards for Emission or Discharge of Environmental Pollutants from Oil Drilling and Gas Extraction Industry of CPCB and discharged into a nearby natural drainage channel.

There will be other ancillary facilities like Drilling mud system, Effluent Treatment System (ETP), Cuttings disposal, Drill Cementing, equipment etc. and utilities to supply Power (DG sets), water, fuel (HSD) to the drilling process and will be set up as a part of the project.

Between drilling operations for different zones, logging operations will be undertaken to provide information on the potential type and quantities of hydrocarbons present in the target formations.

Well Site decommissioning

On completion of activities, the wells will be either plugged and connected with flow lines or suspended. In the event of a decision to suspend the well, it will be filled with a brine solution containing very small quantities of inhibitors to protect the well. After the activities, the well will be sealed with a series of cement plugs, all the wellhead equipment will be removed leaving the surface clear of any debris and site will be restored.

Production Installations

Two Production installations planned within the Khagorijan Field. The production installation may include Oil Collection System (OCS), Gas Compressor Station (GCS), Field Group Gathering Station (FGGS) or Quick Production System (QPS).

Utilities and Resource Requirements

Power: The power requirement for each drill site construction will be met through the 100 KW DG Sets. During drilling, DG sets of 1000 KW capacities, will be used to meet the power requirement for drilling. Lighting and other power requirements at drill sites will met through 200KW DG sets. It is estimated that 3.5 KLD of diesel will be required during drilling phase. Power requirement for the production installations will be met through Gas Generator (GG) sets of 216 KW capacity.

Water: During the drilling operations, water requirement at a drill site is expected to be 60 m^3 per day. The water requirement at the drilling sites during construction and drilling phase will be met groundwater after obtaining necessary permission. Potable water requirement at site will be met through packaged drinking water. In addition, a water storage pit of around 1000 m^3 is proposed to store water for fire water supply the likely source being surface water. For production facility approximately, 5 m^3 per day water will be required for construction and 3 m^3 per day for workers during construction

phase. Approximately 20 m3 per day water is required during the operation of the production installations. The water requirement will be met groundwater after obtaining necessary permission.
Manpower: The drilling rig will be operated by approximately 50 persons on the rig at any particular time. The manpower will operate in two shifts with continuous operations on the rig. This will include technical experts, who will be responsible for various drilling related activities and some local workers who will be hired from nearby villages for the entire duration of the Project. Production facilities are operated in three shifts with approximately 10 persons operating per shift.

Pollution Sources

- *Air emissions*: Point source air emissions will be generated from DG/GG sets. Fugitive emissions will occur from vehicles involved in the drilling operations and from windblown dust from storage and staging areas within the drill sites and production facilities.
- *Noise & Vibrations*: Noise and vibration will be generated due to operation of drilling rig, DG/GG sets and vehicles.
- *Liquid wastes:* During the drilling phase, wastewater will be generated as a result of rig wash and dewatering of spent mud and washing of drill cuttings. The wastewater will be treated in an Effluent Treatment System (ETP) at site. The treated water would be reused. Domestic wastewater will be generated from the drill sites would be treated in septic tanks and soak pits. In production facilities, produced formation water will be disposed to the shallow wells after necessary treatment; surface Runoff after treatment through Oil Water Separator (OWS) and sedimentation tank will be discharge to natural drains.
- *Drill cuttings & spent mud:* Approximately 350-400 m3 of drill cuttings and 900-1200 m3 of spent mud will be generated per site. Drill cuttings and spent mud will be disposed off in a well-designed pit lined with impervious liner located on site.

BASELINE ENVIRONMENTAL STATUS

Land use and land cover: The land-use and land-cover of the Khagorijan Field has been interpreted from the satellite data, toposheet of the area, and subsequently by ground truthing during field surveys. Out of 405 sq. km of the study area, about 80.67 sq. km of land i.e. 19.91% of Block area is used for agricultural purposes. Rivers and riverbed areas including the courses of Brahmaputra River, Dinjan River and Dangori river etc. cover 106.65 sq. km i.e. 26.32% of the study area. Tea garden covers the area of 105.81 sq. km, which is 26.11% of the study area. Homestead plantations located around human settlement covers about 79.51 sq. km i.e. 19.62%. Forest areas cover only 2.28% of the total Khagorijan Field, among this Dibru Saikhowa National Park and Padumoni RF are the major forest patch.

Soil Quality: Soil samples were collected from five locations spread across different types of land cover. Soil samples were found to be clayey, sandy clay and clay loam in nature with acidic pH. The macronutrient contents *viz.* NPK values of the soil samples were found to be better to very less. Metal contamination was been observed.

Climate and Meteorology: The study area experiences a humid sub-tropical climate zone with warm seasons, except for a moderately cold winter from

December to February. Hourly micro-meteorological data collected during the winter season (October 2017-December 2017) reveal that the pre-dominant wind direction is from the north-east with an average speed of 0.16 m/s.
Air Quality: Ambient air quality was monitored at eight locations within the Block. Average PM_{10} values varied from 20.86 and 89.25 µg/m3; $PM_{2.5}$ varies from 12.28 and 47.92 µg/m3. Other gaseous parameters like SO_2, NOx, CO were observed to be well within the levels specified in the National Ambient Air Quality Standards (NAAQS) for industrial, residential and other areas. The average total hydrocarbon concentration in the study area ranged between 0.90 and 1.60 ppm. All the values for non-methane hydrocarbons were recorded to be below detection limits (<0.5 ppm). Almost all the values for VOCs were recorded to be below detection limits (<2.08 µg/m3) for all the samples.

Noise Quality: The ambient noise was monitored at 13 locations within the Block. The equivalent noise level as measured at the residential areas range between 52.9 -54.9 dB(A) at day time and between 40.0-44.6 dB(A) at night time. The equivalent night time noise values in all the locations were in compliance to the night time standard of 45 dB(A) for residential areas.

Groundwater Quality: Groundwater monitored at four locations was found to be slightly acidic (pH-6.54 to 6.84). Few samples reveal values for parameters such as Nitrate to be in exceedance to the respected acceptable limits. Otherwise the concentration of majority of the parameters analysed were within the acceptable limit of IS:10500, 2012 standard.

Surface Water Quality: Surface water samples were analyzed from Brahmaputra River, Dinjan river and Dangori river. The analyzed values reveal that all the samples were in compliance to the CPCB Class D i.e. *Propagation of Wild life and Fisheries.*

Biological Environment: Podumoni and Bherjan segments of Bherjan-Borajan-Padumoni Wild Life Sanctuary located within the Khagorijan Field. Dibru Saikhowa National Park is located at the north of the field. No wells or production facilities will be located within forest areas. Four mammal species categorized as schedule 1 species have been reported in the study area. No birds, amphibian or reptile species, categorized as schedule 1 has not found in the study area.

Socioeconomic Environment: Twenty nine villages lie within 1 km of proposed well locations and production facilities. Major population in the study area villages either are workers in nearby Tea Estates or involved in agricultural crop cultivation as a source of their livelihood. Water requirement is catered through household bore well/tube well facility in the village areas. Almost every village has a primary school; however, percentage of students pursuing higher education is comparatively less. Three primary health centers are present in the influenced area villages.

IMPACT ASSESSMENT

The potential impacts arising due to the construction and operation of the drilling activities are given below:

Air Quality: The operation of DG/GG sets, movement of vehicles and machineries during construction and drilling at drill sites and production operations will result in the generation of air pollutants *viz.* PM, NOx and SOx that may affect the ambient air quality temporarily.
Noise Quality: Operation of heavy machinery/equipment and vehicular movement during site preparatory and road strengthening/construction activities may result in the generation of increased noise levels. Operational phase noise impacts are anticipated from the running of drilling rig and ancillary equipment *viz.* shale shakers, mud pumps and diesel generators, gas generators etc.

Soil Quality: Stripping of top soil will affect the soil fertility of the well sites temporarily. Potential adverse impacts on soil quality may also result from improper storage and handling of fuel, lubricants, drilling mud and drill cuttings.

Water Quality and Hydrogeology: All wastewater discharged from the drilling and production operations will be treated in the ETP and discharges will conform to CPCB standards. As the volume of water to be discharged is small, it is anticipated to cause minor increase in pollution load for specific parameters in receiving water bodies. Uncontrolled surface runoff from the drill sites and production facilities may compose of waste fluids or storm water mixed with oil and grease and may pollute the surface water quality. However, the surface runoff will be treated with sedimentation tank and oil water separator at site.

Biological Environment: The existing vegetation at the proposed drill sites, production installations, approach roads and RoU of the pipeline will be felled for site development. Noise generated from drilling operations and vehicular movement within the drill sites, production facilities and approach roads may affect the reptiles, birds and mammals adversely and may result in their moving away from the project area for a temporary period. Surface runoff from the drill sites and production facilities contaminated with sediment, may reach surface water channels and increase the suspended solids load of the channel water. Increase of suspended solid will increase the turbidity of river water that ultimately will adversely affect the DO level in the water. The turbid water and lower DO may affect the primary productivity of the impacted areas of the streams and rivers. The process effluent will be adequately treated in the ETP to meet the industrial effluent discharge standards. The discharge of treated effluent is not expected to cause perceptible changes in the water quality of the receiving stream.

Socio-Economic Environment: Approximately 3 ha. land would be required for each well and 4-7 ha. land would be required for each production facility. Land will be purchased from local communities however; no physical displacement during land procurement is anticipated. Additionally, land will also be procured for construction of 100-200 m approach road to the drill sites and production facilities from existing roads. Anticipated number of families directly impacted would be limited to 2-5 nos. for each of the drill sites. The dependency of the landowner in case of generation of livelihood is limited as the land is classified as monocropped agricultural land.

OIL/its contractors would endeavour to provide maximum employment to the local people; however, certain percentage of semi-skilled and highly

skilled migrant labour would be used by contractors for manning technical activities. It is anticipated that occasional conflicts would arise with the local community over the recruitment of migrant workers. Discomfort due to dust and noise to adjoining communities, influx of people are likely to occur. The construction phase of the project is likely to generate both direct and indirect opportunities for employment. The estimated direct employment would be approximately 50 un-skilled workers during the peak construction phase that will primarily sourced from nearby areas. Indirect employment would be primarily in the supply chain as vendors, which are anticipated to be set up to support the construction.

Impact on Community Health & Safety: Community health and safety of inhabitants residing close to the proposed well sites and production facilities stand to get affected from frequent heavy vehicular movements along village access roads and due to noise from drilling rig operations, movement of heavy vehicles during construction etc.

ENVIRONMENT MONIROING PROGRAM

Environmental monitoring Program for each well will include the following Ambient Air Quality Monitoring – at 3 monitoring location; once during construction, twice during drilling and once during site decommissioning phase

- Stack emission monitoring at 3DG sets during drilling
- Ambient Noise Monitoring – 3 locations, once during construction, twice during drilling and once during site decommissioning phase
- Workplace noise monitoring -5 locations, twice during drilling
- Surface Water Quality Monitoring- 2 locations, once during construction, once during drilling and once during site decommissioning phase
- Treated water -2 from ETP and 1 from oil/water separator- once each during drilling phase
- Ground Water Quality Monitoring, three location, once during drilling phase
- Soil Quality Monitoring - three locations, once each during pre-construction, drilling and post drilling phase

At the production facilities ambient air, stack emission monitoring from GG sets, ambient and workplace noise monitoring, surface and groundwater quality monitoring, treated wastewater monitoring and soil quality monitoring would be conducted twice a year.

RISK ASSESSMENT AND MITIGATION

Quantitative Risk Assessment (QRA) aims to provide a systematic analysis of the major risks that may arise as a result of drilling and production activities in Khagorijan Field. The QRA process outlines rational evaluations of the identified risks based on their significance and provides the outline for appropriate preventive and risk mitigation measures.

Three major categories of hazards that can be associated with proposed Project which includes:

- Blowouts leading to uncontrolled well flow, jet fires, pool fires;

- Hydrocarbon leaks due to loss of containment while drilling;
- Non-process fires / explosions, the release of a dangerous substance or any other event resulting from a work activity which could result in death or serious injury to people within the site; and
- Any event which may result in major damage to the structure of the rig.

Risk Reduction Measures

Blow Out Risk reducing measures include:

- Kick simulation training for personnel;
- Presence of well-trained engineers;
- Appropriate well design;
- Good well control procedures;
- Appropriate mud weight formulations;
- Installation of primary and secondary blow out preventors; and
- Trained and skilled operation staff.

Accidents related to leaks from equipment can be minimised by:

- Ensuring that equipment is designed, installed and maintained as per international standards;
- Implementing a robust preventive maintenance system of all safety critical equipment; and
- Efficient test separator;

Risk from storage areas can be minimized by;

- Proper preventive maintenance and robust safety management and security systems.
- For the storage tank, secondary containment to be provided.

Other risk management can be achieved by;

- A hydrocarbon gas detection system with suitable alarm system will be provided at the drilling sites and production facilities.
- Management of Oil Spills/Leaks and Soil contamination

PROJECT BENEFITS

- Provision of more royalty to Assam Government and more cess to Govt. of India;
- Provision of more employment opportunity to local people;
- Development of infrastructure (roads, culverts, bridges, schools etc.) in the area;
- Increase in business opportunity for the local people;
- Energy security for the country;
- Programs related to livelihood generation, health improvement as per OIL's Corporate Social Responsibility (CSR) programmes.

ENVIRONMENTAL MANAGEMENT PLAN

Air Quality Management Plan

- Vehicles delivering raw materials like fine aggregates will be covered to prevent fugitive emissions.

- Sprinkling of water on earthworks, material haulage and transportation routes on a regular basis during construction and decommissioning phase of the wells.
- Flare stacks of adequate height would be provided.
- DG/GG set stacks would have adequate height, as per statutory requirements, to be able to adequately disperse exhaust gases
- Periodic monitoring of DG/GG set stack emission will be carried out in accordance with the Environmental Monitoring Plan to assess compliance with CPCB DG set exhaust standards.

Noise Management Plan

- Selection and use of low noise generating equipment with in-built engineering controls viz. mufflers, silencers, etc.
- All DG/GG sets would be provided with acoustic enclosures.
- Appropriate PPEs (e.g. ear plugs) will be used for by workers while working near high noise generating equipment.
- All vehicles utilized in transportation of raw materials and personnel will have valid Pollution under Control Certificates (PUC).
- All high noise generating equipment will be identified and subjected to periodic preventive maintenance.
- No night time operation of vehicles and construction activities will be undertaken.

Soil Quality Management Plan

- Drip trays to be used during vehicular/equipment maintenance and during re-fuelling operations.
- Spill kits will be made available at all fuel and lubricant storage areas. All spills/leaks contained, reported and cleaned up immediately.
- Dedicated paved storage area will be identified for the chemicals, fuel, lubricants and oils within the drill sites and production facilities.
- 1.5 mm HDPE lined pits will be considered for the disposal of unusable drilling mud cuttings and drilling wastewater etc.

Surface Water Quality Management Plan

- Levelling and grading operations will be undertaken with minimal disturbance to the existing site contours thereby maintaining the general slope and topographical profile of the site.
- During site preparation and construction, surface water run-off will be channelized through appropriately designed drainage system. Sediment filters and oil-water separators will be installed to intercept run-off and remove sediment before it enters water courses. ? Domestic wastewater generated from drill sites and production facilities will be treated through septic tank and soak pit system and then discharged.
- Process wastewater would be treated in Effluent Treatment Plant (ETP) at drill sites and production facilities.

Ground Water Quality Management Plan

- Water based mud would be used as a drilling fluid for the proposed project.
- Eco-friendly synthetic based mud if required for deeper sections, will be used after providing intimation to the Pollution Control Board;

- The drill cutting along with spent mud will be stored in HDPE lined pit.

Waste Management Plan

- Use of low toxicity chemicals for the preparation of drilling fluid.
- Management of drill cuttings, waste drilling mud, waste oil and domestic waste, wastewater in accordance with Standards for Emission or Discharge of Environmental Pollutants from Oil Drilling and Gas Extraction Industry of CPCB as modified in 2005.
- The hazardous waste (waste and used oil) will be managed in accordance with Hazardous Waste (Management, Handling & Transboundary Movement) Rules, 2016.
- The kitchen waste will be disposed in nearest municipal/village dumping site on a daily basis through approved waste handling contractors.
- The sewage generated will be treated through septic tank and soak pit system.
- Used batteries will be recycled through the vendors supplying lead acid batteries as required under the Batteries (Management & Handling) Rules, 2001.
- The drill cuttings pit will be bunded and kept covered using tarpaulin sheets during monsoon.

Wildlife Management Plan

- Movement of heavy vehicles will be restricted at night time as most of the mammals movement occurs during night;
- Noise levels at the drill sites and production facilities will be controlled through selection of low noise generating equipment and installation of sufficient engineering controls viz. mufflers, silencers etc.
- No temporary electric supply connection line from the grid will be laid for the proposed project activity. All electric requirements will be supplied from the internal DG sets.

Road Safety & Traffic Management Plan

- The condition of roads and bridges identified for movement of vehicles and drilling rig will be assessed and if required strengthened by OIL to ensure their safe movement.
- Precautions will be taken by the contractor to avoid damage to the public access routes including highways during vehicular movement.
- Traffic flows will be scheduled wherever practicable during period of increased commuter movement.

Occupation Health & Safety Management Plan

- All machines to be used in the construction will conform to the relevant Indian Standards (IS) codes, will be kept in good working order, will be regularly inspected and properly maintained as per IS provisions and to the satisfaction of the site Engineer.
- Hazardous and risky areas, installations, materials, safety measures, emergency exits, etc. shall be appropriately marked.

Management of Social issues and concerns

- People from adjoining areas especially given job preference through local contractors according to the skill sets possessed.

- Prior to the commencement of the proposed activity, a consultation program will be conducted by OIL with the target groups and local authorities. The primary objective of such consultation will be to share with the concerned villagers/stakeholders the objective of the proposed project associated impacts and their mitigation.
- OIL will give more emphasis and priority on periphery development, development of health facilities and provision for drinking water facility as per Corporate Social Responsibility (CSR) Plan.
- The drill sites and production facilities would be fenced and gates would be constructed so that the children are refrained from straying into the site.

Emergency Response Plan

- Drilling rig and related equipment to be used for drilling will be conformed to international standards specified for such equipment.
- Blow-out preventers and related well control equipment shall be installed, operated, maintained and tested generally in accordance with internationally recognized standards.
- Appropriate gas and leak detection system will be made available at each of the drill sites and production facility.
- Adequate fire-fighting equipment shall be provided at each site.

PROJECT COST

Total cost of the project would be approximately INR 1988.62 crore. EMP implementation cost per well will be approximately 11.22 lakhs per well. EMP implementation cost of each production facility would be approximately 6.27 lakhs per year.

PCBA Website link - http://pcbassam.org/EIA%20Reports%20new.htm

POLLUTION CONTROL BOARD : ASSAM
BAMUNIMAIDAM : GUWAHATI-21

	Name of the Project	EIA Reports & Executive Summary	Date & Venue of Public Hearing
101.	Public hearing on Proposed project for "Onshore Oil & Gas Development Drilling and production in Jorhat district of Assam under 4 (four) nos. of Blocks namely – (i) AA-ONHP-2017/4; (ii) AA-ONHP-2017/8; (iii) AA-ONHP-2017/5; & (iv) AA-ONHP-2017/11 by M/s Vedanta Limited (Division: Cairn Oil & Gas), Gurgaon	Proposed project for "Onshore Oil & Gas Development Drilling and production in Jorhat district of Assam under 4 (four) nos. of Blocks namely – (i) AA-ONHP-2017/4; (ii) AA-ONHP-2017/8; (iii) AA-ONHP-2017/5; & (iv) AA-ONHP-2017/11 by M/s Vedanta Limited (Division: Cairn Oil & Gas), Gurgaon Draft EIA Report (Block 4) , Draft EIA Report (Block 5) , Draft EIA Report (Block 8) , Draft EIA Report (Block 11) Executive Summary English(Block 4) , Executive Summary English(Block 5) , Executive Summary English(Block 8) , Executive Summary English(Block 11) Executive summary Assamese(Block 4) , Executive summary Assamese(Block 5) , Executive summary Assamese(Block 8) , Executive summary Assamese(Block 11) EIA Report is available in 1. The Deputy Commissioner's Office, Jorhat district, Assam. 2. The District Industry Centre, Jorhat district, Assam. 3. The President/Secretary to the concerned Gaon Panchayat 4. Chief Executive Officer, Zilla Parishad, Jorhat district, Assam. 5. Ministry of Environment & Forests, Govt. of India, Regional Office, Law-U-Sib, Lumbatngen, Near MTC Workshop, Shillong-793021. 6. Regional Office of the Board at Sivasagar, Assam. 7. The Head Office of the Board, Bamunimaidam, Guwahati-21.	23rd December, 2019 at 11.00 AM (District Library, Jorhat District)
100.	Public hearing on Proposed "Drilling ,production & laying of pipelines in Tinisukia district(khagorijam ,Jorajan are,Naharkotia-Deohal-Bogapani-nagajan ,North Hapjan Tinsukia Dhola Doomdooma Pengree area,ERD,Baghjan)by M/S Oil India Ltd.Duliajan."	Proposed \"Drilling ,production & laying of pipelines in Tinisukia district(khagorijam ,Jorajan are,Naharkotia-Deohal-Bogapani-nagajan ,North Hapjan Tinsukia Dhola Doomdooma Pengree area,ERD,Baghjan)by M/S Oil India Ltd.Duliajan." Draft EIA Report English, Executive Summary(English & Assamese) EIA Report is available in DC office,Tinsukia district; District Industry Centre,Tinsukia district; President/Secretary of the concerned Gaon Panchayat under whose jurisdiction the proposed site falls,Chief Executive Officer, Zilla Parishad, Tinsukia district; Ministry of Environment & Forests, Govt. of India, Regional Office, Law-u-Sib, Lumbatngen, near MTC Workshop, Shillong-793021; Regional Office of the Board at Dibrugarh,behind ASTC,CHowkidinghee,Dibrugarh-786001,Assam,The Head Office of the Board, Bamunimaidam, Guwahati-21.	24th December,2019 at 11.00 AM (Public/Community Hall,baghjan T.E,Baghjan,Tinsukia,Assam) (For Khagorijan ,North Hapjan,Tinsukia Dhola Doomdooma & ERD,Baghjan area) 27th December,2019 at 11.00 AM (Sadbhavana Khetra,Balijan,Digboi(Under Forest Deptt.)) (For Jorajan ,naharkotia & Pengree area)